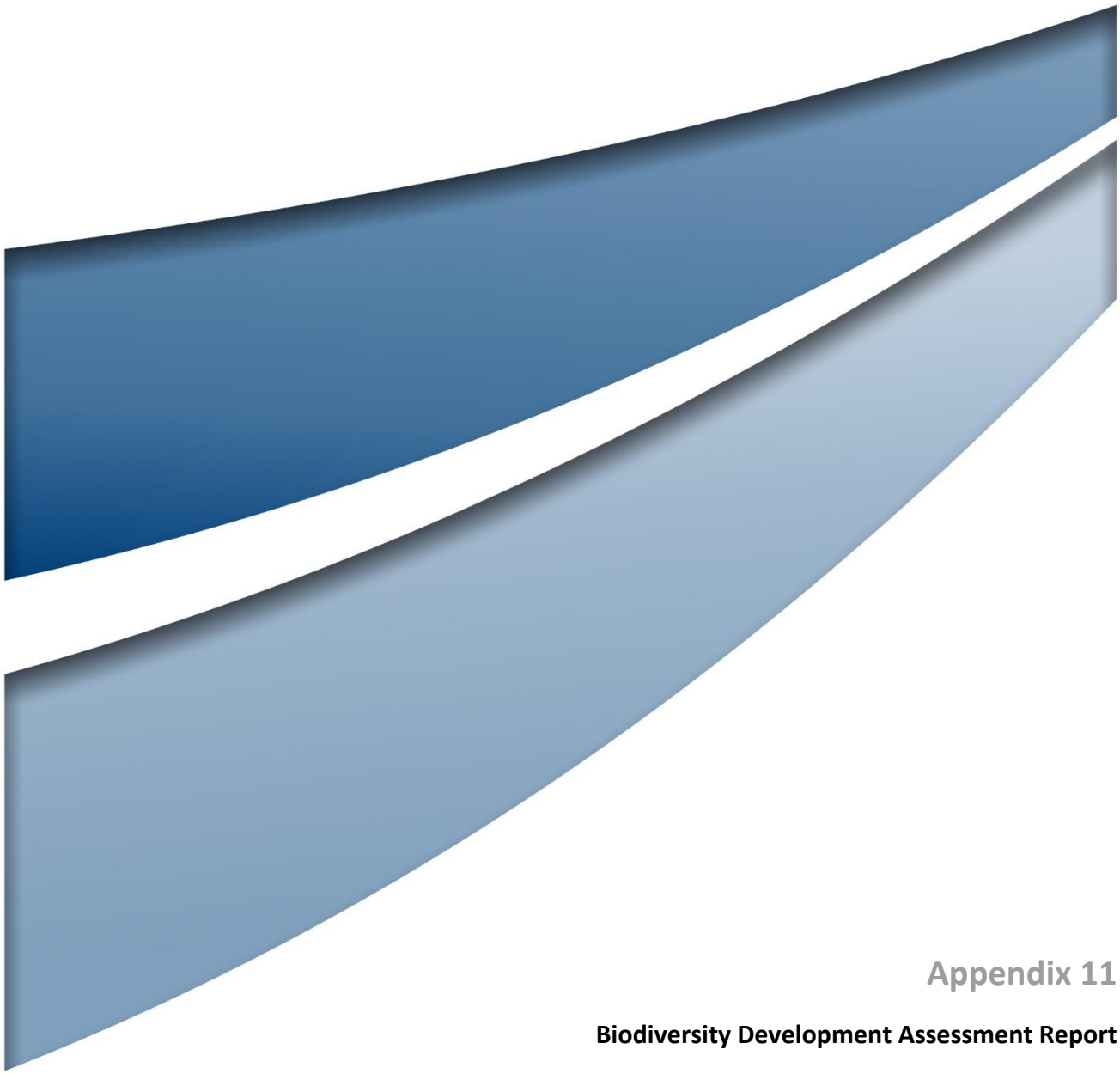


# Appendix 11

**Biodiversity Development Assessment Report**



# Junction Rivers Wind Project

## Biodiversity Development Assessment Report

FINAL REPORT

Prepared for Umwelt (Australia) Pty Ltd on behalf of Windlab Pty Ltd

15 May 2024

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# Glossary

| Term | Definition |
|---|---|
| **Assessment Area** | All land within a 1500 m buffer zone of the subject land. |
| **BAM** | NSW Biodiversity Assessment Method |
| **BAM-C** | BAM Calculator |
| **BC Act** | *Biodiversity Conservation Act 2016* |
| **BCS** | Biodiversity, Conservation and Science |
| **BDAR** | Biodiversity Development Assessment Report |
| **BMP** | Biodiversity Management Plan |
| **BSSAR** | Biodiversity Stewardship Site Assessment Report |
| **Biosecurity Act** | *Biosecurity Act 2015* |
| **BOS** | Biodiversity Offsets Scheme |
| **CEEC** | Critically Endangered Ecological Community |
| **CEMP** | Construction Environmental Management Plan |
| **CM Act** | *Coastal Management Act 2016* |
| **CoC** | Conditions of Consent |
| **DA** | Development Application |
| **Cth DCCEEW** | Australian Government Department of Climate Change, Energy, the Environment and Water |
| **DBH** | Diameter at Breast Height |
| **DCDB** | Digital cadastral database |
| **Development footprint** | The area of land that is directly impacted by the proposal |
| **Development site** | The broader area in which the subject land is located. |
| **DoIW** | Directory of Important Wetlands |
| **DP** | Deposited Plan |
| **DPE** | NSW Department Planning and Environment |
| **DPI** | NSW Department of Primary Industries |
| **DTDB** | Digital topographic databases |
| **Ecosystem credits** | A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development |
| **Ecosystem credit species** | Threatened species whose occurrence can generally be predicted by vegetation surrogates and/or landscape features, or that have a low probability of detection using targeted surveys. A targeted survey is not required to identify or confirm the presence of ecosystem credit species. |
| **EMS** | Environmental Management Strategy |
| **EEC** | Endangered Ecological Community |

| Term | Definition |
|---|---|
| **EP&A Act** | NSW E*nvironmental Planning and Assessment Act 1979* |
| **EPBC Act** | Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* |
| **GDE** | Groundwater Dependent Ecosystem |
| **GIS** | Geographic Information System |
| **IBRA** | Interim Biogeographic Regionalisation of Australia |
| **LEP** | Local Environmental Plan |
| **LGA** | Local Government Area |
| **Locality** | Area located within 10 km radius from the subject land |
| **LPI** | NSW Land and Property Information |
| **MNES** | Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act |
| **NPW Act** | *National Parks and Wildlife Act 1974* |
| **NSW DCCEEW** | NSW Government Department of Climate Change, Energy, the Environment and Water |
| **PCT** | Plant Community Type |
| **SAII** | Serious and Irreversible Impact |
| **SALIS** | NSW Soil and Land Information System |
| **SEARs** | Secretary's Environmental Assessment Requirements |
| **SEPP** | NSW State Environmental Planning Policy |
| **SIS** | Species Impact Statement |
| **Species credits** | A class of biodiversity credits required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. |
| **Species credit species** | Threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence or components of their habitat. A targeted survey or an expert report is required to confirm the presence of these species on the subject land. Alternatively, the proponent may elect to assume the species is present for development/clearing projects only. |
| **SSD** | State Significant Development |
| **subject land** | The areas within or the combined areas of the development site, and any indirect and prescribed impacts. Land subject to development to which the BAM has been applied. |
| **TEC** | Threatened Ecological Community |
| **TBDC** | Threatened Biodiversity Data Collection |
| **TPZ** | Tree Protection Zone |
| **VEC** | Vulnerable Ecological Community |
| **WM Act** | *NSW Water Management Act 2000* |
| **WHS** | Work Health and Safety |

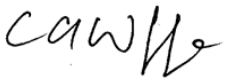
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# Certification and Declarations

I certify that this report has been prepared based on the requirements of, and information provided under the Biodiversity Assessment Method (DPIE 2020) and s6.15 of the *Biodiversity Conservation Act 2016*.

In preparing this assessment I have acted in accordance with the Accredited BAM Assessor Code of Conduct.

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest.

| | |
|---|---|
| **Signature:** |  |
| **Date:** | 15/05/2024 |
| **BAM Assessor Accreditation Number:** | Callan Wharfe BAAS18138 |

# Summary

Biosis Pty Ltd (Biosis) was commissioned by Umwelt (Australia) Pty Limited (Umwelt), on behalf of Windlab Developments Australia (Windlab) to undertake a biodiversity assessment for the proposed Junction Rivers Wind Project (formerly Burrawong Wind Farm) located around 15 kilometres south of Balranald, and 12 kilometres north of Kyalite, New South Wales (NSW).

The project is considered a State Significant Development (SSD) and therefore the NSW Biodiversity Offset Scheme (BOS) applies in accordance with Section 7.9 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A Biodiversity Development Assessment Report (BDAR) is required, prepared by an Accredited Assessor in accordance with the NSW Biodiversity Assessment Method (BAM) (DPIE 2020a).

Secretary's Environmental Assessment Requirements (SEARs) were issued for the project on 21 December 2021 (SSD-30448824). The project has also been declared a Controlled Action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), (referral number 2023/09603) with the Controlling Provisions including listed threatened species and communities and listed migratory species. The project will be assessed under the assessment bilateral agreement with NSW, and as such this BDAR also contains an assessment of the project's impacts to relevant Matters of National Environmental Significance (MNES). Supplementary SEARs following declaration of the project as a controlled action were issued on 19 December 2023.

The Junction Rivers Wind Project is proposed to produce an estimated 750 Megawatts of renewable electricity, and the project includes the construction, operation and decommissioning of a range of permanent and temporary infrastructure. It is expected that the project will be constructed in two stages and will be subject to detailed design within the confines of a pre-determined micro-siting envelope.

The project's **subject land** is defined as an area of approximately 10,800 hectares, is subject to the project, and is the area to which the BAM has been applied. The project's **development corridor** comprises an area of approximately 2100 hectares and is defined as the land within which the development footprint is located and encompasses the area subject to vegetation integrity and targeted candidate species surveys. The development corridor is also the area within which micro-siting can occur. The project's **development footprint** comprises an area of approximately 768 hectares, being the area of land directly impacted by the project. The development footprint may be subject to minor alterations at the detailed design stage as a result of micro-siting of infrastructure.

The subject land occurs within the Murray Darling Depression Interim Biogeographic Regionalisation of Australia (IBRA) bioregion and the South Olary Plain IBRA subregion. The project has been sited such that the majority of proposed infrastructure is located in dryland cropping paddocks generally lacking native vegetation, with the majority of the subject land located on land mapped as Category 1 – Exempt land under the NSW *Local Land Services Amendment Act 2016*.

Category 1 – Exempt land encompasses:

- Approximately 79% of the subject land (8,500 hectares of 10,800 hectares total area).
- Approximately 86% of the development corridor (1,800 hectares of 2,100 hectares total area).
- Approximately 90% of the development footprint (680 hectares of 768 hectares total area).

The subject land supports approximately 2248 hectares of native vegetation with varying levels of disturbance. Native vegetation is found as small to medium isolated patches surrounded by cultivated/grazed land, corridors alongside public roads and a small number of larger patches. Field investigations of native vegetation were undertaken by Biosis between August 2022 and March 2023. Earlier preliminary surveys were also undertaken by NHG Consulting in December 2020 and November 2021

The following Plant Community Types (PCT) were assessed as present within the development corridor:

- PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions in south-western NSW, Riverina Bioregion and Murray Darling Depression Bioregion.
- PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion.
- PCT 23 Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones.
- PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion.
- PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion.
- PCT 163 Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones.
- PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones.

Vegetation within the subject land was found to represent two Threatened Ecological Communities (TECs) listed under the NSW BC Act. No TECs listed under the EPBC Act were determined to occur within the subject land. TECs within the subject land include:

- Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions (Endangered).
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions (Endangered).

Vegetation within the subject land was assessed and stratified, based on PCT and broad condition state, into vegetation zones. This resulted in 15 vegetation zones identified within the development footprint and development corridor. In total, 63 BAM plots have been completed as part of the assessment of vegetation integrity.

A total of 77 scattered paddock trees have been assessed as likely to be impacted under Streamlined assessment module – Scattered trees assessment (Appendix B of the BAM), and were entered into the scattered tree assessment module of the BAM-C.

The subject land supports a mosaic of cleared cropping land with scattered paddock trees, and small to large patches of native vegetation, subject to varying levels of disturbance associated with grazing and historical clearing and thinning of trees. Broad habitats types present with the subject land include:

- Mallee woodland
- Semi-arid open woodlands
- Black Box woodlands
- Acacia shrublands and open chenopod shrublands
- Cleared and cropped land

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- Natural waterbodies are generally absent from the subject land, with larger ephemeral lakes occurring in the surrounding landscape.

Targeted threatened species surveys of the subject land were undertaken by Biosis between September 2022 and March 2023, with additional surveys undertaken by Nature Advisory between 2021 and 2023 as part of the project's Bird and Bat Utilisation Survey (BBUS) work.

BAM species credit species recorded during surveys include:

- Bitter Quandong *Santalum murrayanum* and *Austrostipa metatoris* both of which have been avoided by the project.
- Major Mitchell's Cockatoo *Lophochroa leadbeateri* commonly recorded during surveys.
- Localised areas of assumed presence have been included for Menindee Nightshade *Solanum karsense*, Mossgiel Daisy *Brachyscome papillosa*, Winged Peppercress *Lepidium monoplocoides* due to limited survey coverage in places areas due to issues such as flooding in spring 2022.
- Regent Parrot (eastern subspecies) *Polytelis anthopeplus monarchoides* was commonly recorded, however not in a species credit (breeding) capacity.
- A range of other threatened species listed under the BC Act and/or EPBC Act were also recorded over the course of the biodiversity surveys.

Nature Advisory completed the BBUS work for the project, which included 24 months of bird surveys, over eight seasons between February 2021 and October 2022, as well as two microbat surveys completed in 2021 to provide baseline data on the utilisation of the subject land by microbats. Microbat surveys were undertaken in February and November 2021. A total of 81 bird species were recorded across the 24 months of survey, and nine microbat species were positively identified within the subject land.

Further to BBUS work, Nature Advisory completed detailed assessments (both desktop-level and field-based) to better understand the use of the subject land by Regent Parrot, Australasian Bittern *Botaurus poiciloptilus* and waterbirds generally. This work was completed to provide additional background data for the turbine collision risk and barrier effect risk assessments completed as part of this BDAR.

The project has implemented design changes prior to and since preliminary biodiversity assessments were completed in spring 2021. The project design has been informed through biodiversity field surveys, including targeted flora and fauna surveys and identification of low to high constraint areas.

Following all efforts to avoid and minimise impacts to biodiversity values, the project has been assessed as likely to result in the residual unavoidable impacts outlined in the tables below.

**Summary of direct impacts to vegetation**

| Vegetation zone | TEC | Area impacted (ha) | VI Score |
|---|---|---|---|
| **PCT 16_Moderate** | - | 3.80 | 54.4 |
| **PCT 16_Low** | - | 0.36 | 29.5 |
| **PCT 16_DNG** | - | 2.78 | 14.7 |
| **PCT 16_Paddock Trees** | - | 0.21 | 10.7 |
| **PCT 21_Moderate** | Sandhill Pine Woodland | 1.17 | 64.6 |
| **PCT 23_Moderate** | *Acacia melvillei* Shrubland | 2.03 | 62.7 |
| **PCT 57_Moderate** | - | 0.19 | 61.1 |

| Vegetation zone | TEC | Area impacted (ha) | VI Score |
|---|---|---|---|
| **PCT 58_High** | - | 0.85 | 91 |
| **PCT 58_Moderate** | - | 20.90 | 74.8 |
| **PCT 58_DNG** | - | 31.01 | 17.7 |
| **PCT 58_Paddock Trees** | - | 0.07 | 46.6 |
| **PCT 163_Moderate** | - | 3.58 | 59.5 |
| **PCT 170_Moderate** | - | 4.67 | 61.5 |
| **PCT 170_Low** | - | 0.56 | 29.7 |
| **PCT 170_DNG** | - | 3.50 | 12.8 |
| **Total** | - | **75.68** | - |

**Summary of direct impacts species credit habitat or individuals**

| Species | Biodiversity Risk Weighting | Area impacts (ha) |
|---|---|---|
| **Major Mitchell's Cockatoo** | 2.0 | 37.40 |
| **Menindee Nightshade** | 1.5 | 2.34 (assumed) |
| **Mossgiel Daisy** | 2.0 | 3.91 (assumed) |
| **Winged Peppercress** | 2.0 | 3.66 (assumed) |

**Summary of direct impacts to scattered trees**

| Class | No. trees impacted |
|---|---|
| **1** | 7 |
| **2** | 11 |
| **3** | 59 |
| **Associated TEC impacts (included in the totals above)** | |
| **Trees conforming to Sandhill Pine Woodland** | 5 |
| **Trees conforming to *Acacia melvillei* Shrubland** | 14 |

All direct, indirect and prescribed impacts have been assessed in the development of this BDAR, and a range of mitigation measures are proposed to ensure the ongoing implementation of the principles of avoidance and minimisation of impacts. This includes measures to minimise impacts during the construction, operational and decommissioning phases of the project, and includes the development of a detailed Bird and Bat Adaptive Management Plan (BBAMP), to minimise impacts to aerial fauna during the operational life of the wind farm. A working draft version of the BBAMP is provided with this BDAR.

The project will not result in any Serious and Irreversible Impacts (SAIIs) to BC Act listed entities, however the project has been assessed as likely to result in a Significant Impact under the EPBC Act to Major Mitchell's Cockatoo. This Significant Impact determination has been made on the basis of the project having the potential to disrupt the breeding cycle of the local population of the species, and reduce the availability and quality of habitat critical to the survival of the species. Targeted mitigation measures have been developed to ensure ongoing minimisation of residual impacts, and a suite of biodiversity offsets (including nature positive strategies) have been proposed, and will be secured post approval.

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As a result of the project's residual impacts to biodiversity values, the project has been determined to require the following offsets in accordance with the NSW BOS:

- 1,351 ecosystem credits for impact to native vegetation and threatened species habitat.
- 47 species credits for assumed impacts to Menindee Nightshade.
- 109 species credits for assumed impacts to Mossgiel Daisy.
- 103 species credits for assumed impacts to Winged Peppercress.
- 840 species credits for impacts to Major Mitchell's Cockatoo
  - Offsets for Major Mitchell's Cockatoo must also meet the requirements of the EPBC Act Offsets Policy (CoA 2016)

The project's Biodiversity Offset Strategy currently includes investigation of two proposed offset sites proximal (within 10 kilometres) to the subject land. Following initial field investigations, these sites are expected to be able to provide approximately 37 % of ecosystem credit offsets required by the project. Investigation of these sites will continue, along with other options, post submission of the project's Environmental Impact Statement.

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# STAGE 1 – BIODIVERSITY ASSESSMENT

# 1 Introduction

Biosis Pty Ltd (Biosis) was commissioned by Umwelt (Australia) Pty Limited (Umwelt), on behalf of Windlab Developments Australia (Windlab) to undertake a biodiversity assessment for the proposed Junction Rivers Wind Project (formerly Burrawong Wind Farm) located around 15 kilometres south of Balranald, and 12 kilometres north of Kyalite, New South Wales (NSW). The project is located within the Murray Local Government Area (LGA) (Figure 1).

The project is considered a State Significant Development (SSD) and therefore the NSW Biodiversity Offset Scheme (BOS) applies in accordance with Section 7.9 of the NSW *Biodiversity Conservation Act 2016* (BC Act). A Biodiversity Development Assessment Report (BDAR) is required, prepared by an Accredited Assessor in accordance with the NSW Biodiversity Assessment Method (BAM) (DPIE 2020a).

The purpose of this assessment is to apply the BAM (DPIE 2020a) to the proposed development, and provide Umwelt and Windlab with a BDAR to support the project's Environmental Impact Statement (EIS). The BDAR and EIS are to be submitted to the NSW Department of Planning, Housing and Infrastructure (DPHI) as part of a State Significant Development Application (DA), under Part 4 of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act), for the project.

Secretary's Environmental Assessment Requirements (SEARs) were issued for the proposed Junction Rivers Wind Project on 21 December 2021 (SSD-30448824).

The project has also been declared a Controlled Action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), (referral number 2023/09603) with the Controlling Provisions including listed threatened species and communities and listed migratory species. The project will be assessed under the assessment bilateral agreement with NSW, and as such this BDAR also contains an assessment of the project's impacts to relevant Matters of National Environmental Significance (MNES). Supplementary SEARs following declaration of the project as a controlled action were issued on 19 December 2023.

## 1.1. Project description

The Junction Rivers Wind Project is proposed to produce an estimated 750 Megawatts of electricity, and the project includes the construction, operation and decommissioning of a range of permanent and temporary infrastructure. It is expected that the project will be constructed in two stages and will be subject to detailed design within the confines of a pre-determined micro-siting envelope.

### 1.1.1. Infrastructure components

The infrastructure components that comprise the project are outlined in Table 1 below.

**Table 1 Junction Rivers Wind Project components**

| Component | Approximate Dimensions | Quantity |
|---|---|---|
| **Wind Turbine Generator (WTG)*** | | **Up to 96** |
| **Blade length** | Maximum of 100 m | - |
| **Hub height** | Maximum of 200 m | - |
| **Uppermost blade tip** | Maximum of 300 m | - |
| **Lowermost blade tip** | Minimum of 49 m | - |
| **Hardstand** | Maximum of 100 x 115 m | - |
| **Crane laydown** | Maximum of 30 x 240 m | - |
| **Ancillary Infrastructure – Electrical** | | |
| **Grid Support (Battery Energy Storage System (BESS) (up to 200MW / StatCom))** | Maximum of 3.2 ha | Up to 4** |
| **Main substation (33/220kV and/or 33/330kV)** | Maximum of 5.0 ha | Up to 4** |
| **Underground and/or overhead cables (33kV)** | 5 m width trench | Approx.78 kms (total length of trenches)<br>Approx.148 kms (total length of cable) |
| **Overhead transmission line (220kV and/or 330kV)** | 80 m easement | Approx.17.2 km |
| **Ancillary Infrastructure – Other** | | |
| **Internal access tracks and drainage** | Width ranging from 5.5 -10 m | Approx. 91 km |
| **O&M facility including carpark** | Maximum 2.5 ha | Up to 2** |
| **Meteorological masts (power performance masts)** | Maximum height of 200 m | Up to 7 |
| **Temporary Facilities** | | |
| **Construction compound** | Maximum of 2.25 ha | 1 main and up to 4 satellite |
| **Concrete batching plants** | Maximum of 3.0 ha | Up to 4 |
| **Laydown areas** | Maximum of 2.28 ha | Up to 5 |
| **Temporary calibration meteorological masts** | Maximum height of 200 m | Up to 7 |

*** Turbine parameters are based on a combination of two models under consideration. Further information in relation to this BDAR is presented in Section 6.3.**

**** 1 per stage, if constructed in stages.**

### 1.1.2. Potential staging

As is typical of projects of this scale, the construction of the wind farm may be staged. The decision to construct the wind farm in stages will depend on a number of factors, including but not limited to:

- Access arrangements for the South-West Renewable Energy Zone (SW REZ).
- Availability of offtake and other energy market considerations.
- Financing arrangements and other commercial considerations.

### Stage 1

If the project is constructed in stages, the first stage would connect into the existing TransGrid 220 kV line. Ancillary infrastructure located in the northern part of the site closest to the transmission line and WTGs would therefore be used for Stage 1.

The final configuration for Stage 1 will depend on the WTG model selected and the outcome of detailed grid studies and technical design, amongst others. However, initial studies indicate that Stage 1 would comprise up to 30 WTGs and a BESS of up to 75MW. Infrastructure proposed to be included within Stage 1 is detailed below within Table 2.

**Table 2 Stage 1 potential infrastructure components**

| Component | Quantity |
|---|---|
| **Wind turbine generator (WTG)** | Up to 30 |
| **Battery Energy Storage (BESS) / StatCom** | Up to 1 |
| **Substation** | 1 |
| **Switching station** | 1 |
| **O&M facility including carpark** | 1 |
| **Meteorological masts** | Up to 2 |
| **Temporary Facilities** | 1 |
| **Concrete batching plants** | 1 |
| **Laydown areas** | 1 |
| **Construction compound** | 1 |
| **Temporary meteorological masts** | Up to 2 |
| **Site access points** | 2 |

### Stage 2

The second stage would connect into Project Energy Connect with exact details dependent on the access scheme defined in the Renewable *Energy Zone (South West) Access Scheme Order*. The balance of the WTGs and ancillary infrastructure outlined in Table 1 would be constructed for Stage 2.

### Micro-siting

The proposed layout included in this assessment has undergone numerous design iterations with input from a range of specialists, however it remains indicative and subject to detailed design, which will incorporate detailed geotechnical investigations and selection of the final WTG model.

In order to facilitate refinement of the layout during the detailed design process, an allowance for micro-siting of WTGs by up to a 100 metre radius from the locations identified in the EIS (and this BDAR) is being sought. Other project infrastructure components, including substations, switchyard, grid support, maintenance building, temporary facilities, cabling and access tracks, may also be micro-sited within the assessed development corridor subject to ensuring that micro-siting does not result in greater impacts to biodiversity values, and resultant offsets, than assessed in this BDAR and the EIS. The micro-siting will also need to comply with all conditions imposed on any development consent granted for the project.

Any micro-siting would ensure that there is no increase in impact to biodiversity values detailed in Table 61, Table 62 or Table 63 of this BDAR. If micro-siting results in an increase in impacts of biodiversity values outlined in in Table 61, Table 62 or Table 63 of this BDAR, an amendment report or update to this BDAR would be required to consider additional impacts and their implications in relation to the proposed wind farm prior to the commencement of construction activities.

## 1.2. Purpose of this assessment

This BDAR will:

- Address the BAM (DPIE 2020a) and the BOS.
- Adress SEARs issues under section 4.12(8) of the *Environment Planning and Assessment Act 1979* (EP&A Act) and Part 8 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation).
- Identify how the proponent has avoided and minimised impacts to biodiversity.
- Identify any potential impact that could be characterised as serious and irreversible.
- Describe the offset obligations required to compensate for any unavoidable biodiversity impacts resulting from the proposed development.
- Consider and assess the proposal in accordance with other relevant legislation such as the Commonwealth EPBC Act.

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared and certified by BAM Accredited Assessor Callan Wharfe (BAAS18138) and reviewed by BAM Accredited Assessor Mitch Palmer (BAAS17051).

This BDAR describes the outcome of the BAM Credit Calculator (BAM-C) development assessment cases 00034462/BAAS18138/22/00034463 and 00044469/BAAS18138/23/00044470 conducted consistent with the BAM. A separate child case has been prepared to assess the potential for biodiversity values associated with the adjacent Interim Biogeographic Regionalisation for Australia (IBRA) subregion (00034462/BAAS18138/22/00034466), however this case will not be finalised and does not form part of the BAM assessment.

## 1.3. Project terminology

The terms subject land, development corridor, development footprint, development site and assessment area are used throughout this BDAR and are defined below.

- The **subject land** is defined as an area of approximately 10,838.27 hectares, is subject to the project, and to which the BAM has been applied. The subject land has been derived based on a 500 metre buffer on the development corridor (see below), includes higher confidence vegetation mapping (i.e. subject to rapid ground validation at a minimum), and is sufficiently broad to capture habitats potentially indirectly impacted or fragmented as a result of the project (Figure 1).

  The subject land also encompasses a number of public roadsides subject to impact along the infrastructure transport route from Port Adelaide to the development site.

  The subject land is located off Yanga Way and Balranald-Moulamein Road approximately 15 kilometres south of Balranald, 150 kilometres south-east of Mildura, approximately 350 kilometres north of the Melbourne Central Business District (CBD) and 700 kilometres south-west of the Sydney CBD. The land is located in the Murray Shire Council Local Government Area (LGA) and the Murray

Local Land Services (LLS) Region and is zoned as RU1 – Primary Production under the Wakool Local Environmental Plan 2013 (LEP).

- The **development corridor** comprises an area of 2096 hectares and is defined as the land within which the development footprint is located and encompasses the area subject to vegetation integrity and targeted candidate species surveys.

  This development corridor generally comprises a 100 metre to 200 metre wide area, although up to 500 metres width occurs in some areas. The development corridor has been defined and assessed to allow for more detailed assessment of potential indirect impacts and to provide flexibility and micro-siting during the detailed design phase.
- The **development footprint** comprises an area of 768 hectares being the area of land directly impacted by the project, including all infrastructure for construction and operation of the wind farm. The development footprint may be subject to slight alterations at the detailed design stage as a result of micro-siting of infrastructure.
- The **assessment area** includes the subject land and the area of land within the 1500 metre buffer zone surrounding the subject land as defined by the BAM.
- The **development site** comprises the landholdings upon which the project is located (it is synonymous with the project area defined in the EIS).

## 1.4. Sources of information

Sources of information used in the assessment include relevant databases, spatial data, literature and previous site reports.

In order to provide a context for the assessment area, records of flora and fauna from within 10 kilometres of the edge of the development site (the locality) were collated and reviewed from the following databases or spatial datasets:

- Commonwealth Department of Climate Change, Energy, the Environment and Water (Cth DCCEEW) Protected Matters Search Tool for matters protected by the EPBC Act.
- NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) BioNet Atlas of NSW Wildlife for species, populations and ecological communities listed under the BC Act.
- NSW BAM Calculator.
- Biodiversity values map (DPE 2023).
- Native vegetation regulatory map.
- BAM Important Areas maps (DPE 2022b).
- PlantNET (The Royal Botanic Gardens and Domain Trust).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015.

Other sources of biodiversity information relevant to the assessment area were sourced from:

- The NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Classification database (NSW DCCEEW 2024a).
- Relevant vegetation mapping, such as (Riverina Region Version v1.2 – VIS_ID 4469 (DPIE 2016)).

The following reports were also reviewed and relied on to provide additional information, particularly in relation to bird and bat utilisation of the subject land and potential risks to those species recorded / predicted to occur:

- NGH (Windlab) (2021). 20-468 Scoping Report Burrawong Wind Farm.
- NGH (Windlab) (2022). 20-468 Burrawong Wind Farm Spring 2021 Survey Report.
- Nature Advisory (NGH). (2022). Burrawong Wind Farm, Bat Utilisation Survey. Report No.20195.3(1.0)
- Nature Advisory (NGH). (2022). Burrawong Wind Farm, Bird Utilisation Survey – Year One. Report. No.20195.04 (1.0).
- Nature Advisory (Windlab). Burrawong Wind Farm, Bird Utilisation Survey – Autumn. Project No. 20195.3
- Nature Advisory (Windlab). Burrawong Wind Farm, Bird Utilisation Survey – Summer. Project No. 20195.3
- Nature Advisory (Windlab). (2023). Burrawong Wind Farm, Preliminary Literature Review on Habitat Use of the Australasian Bittern in the Riverina. Report No.20195.07(10).
- Nature Advisory (Windlab). (2023). Burrawong Wind Farm, Bird and Bat Baseline Report. Year 2. Report No.20195.05(1.1).
- Nature Advisory (Windlab). (2023). Burrawong Wind Farm, Initial Bird and Bat Risk Assessment. Report No.20195.04 (2.1)
- Nature Advisory (NGH). (2023). Burrawong Wind Farm, Regent Parrot Targeted Assessment Report. Report No. 20195.06 (1.1).
- Nature Advisory (NGH). (2023). Burrawong Wind Farm, Regional Review of Waterbirds in the Riverina. Report No.20195.07 (1.0).

Basemap data was obtained from NSW Land and property information (LPI) 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB).

The following additional spatial datasets were utilised during the development of this report:

- Catchment Boundaries of New South Wales dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DoIW).
- Spatial data associated with NSW State Vegetation Type Map (DPE 2023a), Riverina Regional Native Vegetation Map v1.2 VIS_ID 4469 (DPIE 2016) and Western Regional Native Vegetation Map v1.0 VIS_ID 4492 (DPE 2019).
- NSW Soil and Land Information System (SALIS).
- Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been provided:
  - Digital mapping with aerial photography showing 1:1000 or finer.
  - Site map as described in subsection 3.1.1 of the BAM (DPIE 2020a).
  - Location map as described in subsection 3.1.2 of the BAM (DPIE 2020a).

- Landscape map with features including 1,500 metre buffer, as described in section 3.1.3 of the BAM (DPIE 2020a).

## 1.5. Legislative requirements

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

- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Environmental Planning and Assessment Act 1979.*
- *Biodiversity Conservation Act 2016.*
- *Fisheries Management Act 1994.*
- *Local Land Services Amendment Act 2016.*

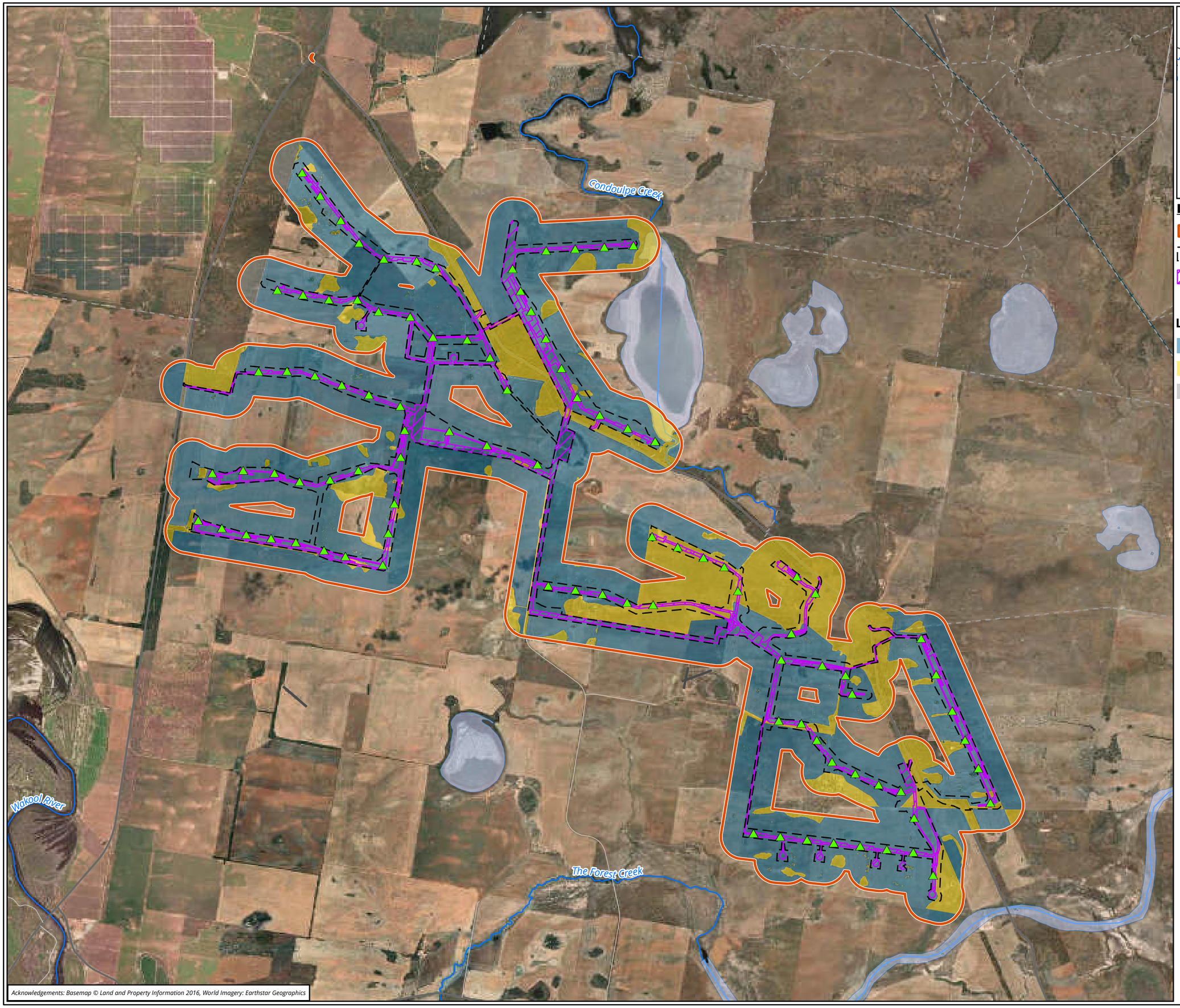
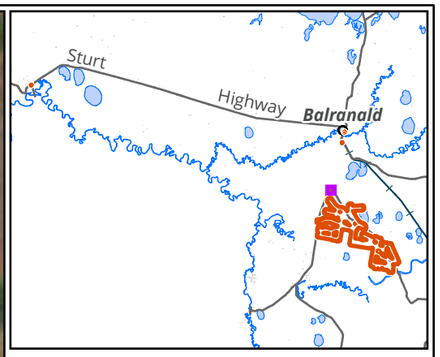



**Figure 1.1 Subject land**

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Layout: 37502_F1_SubjectLand




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 1.2 Subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

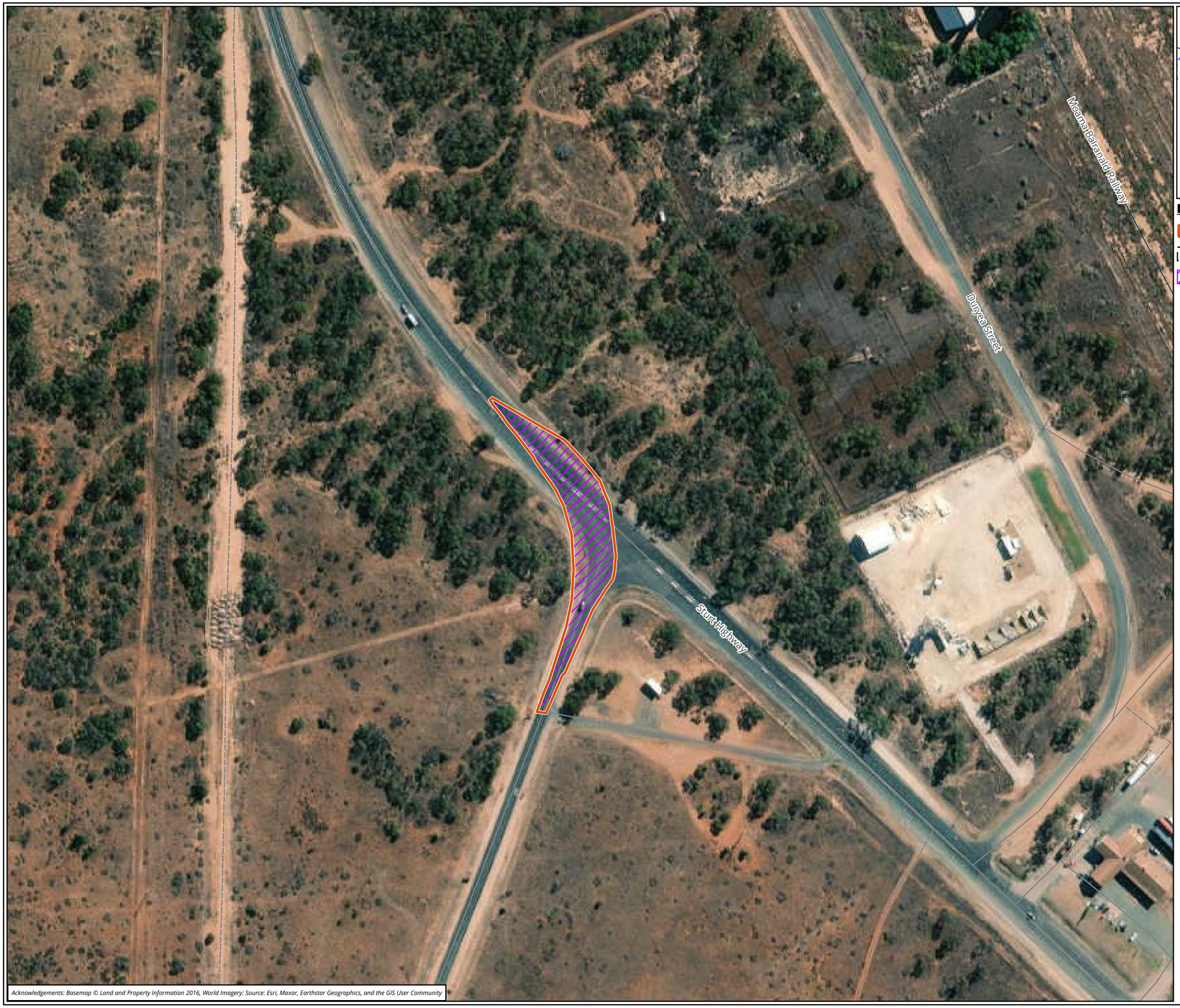
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*GDA 1994 MGA Zone 54*

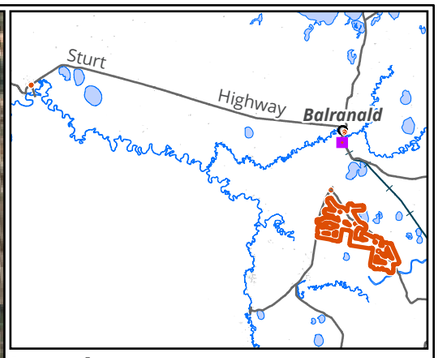
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Layout: 37502_F1_SubjectLand

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community*




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 1.3 Subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

*Coordinate System:*
*GDA 1994 MGA Zone 54*

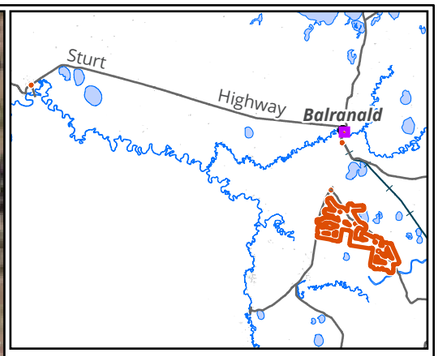
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Layout: 37502_F1_SubjectLand

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community*




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 1.4 Subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

*Coordinate System:*
*GDA 1994 MGA Zone 54*

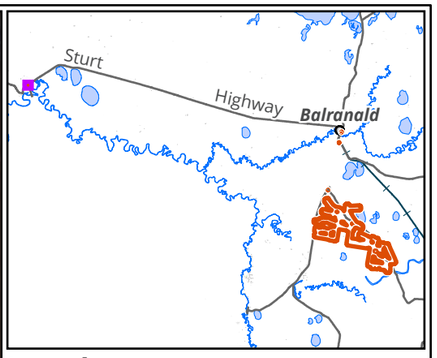
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Layout: 37502_F1_SubjectLand

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community*




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 1.5 Subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

*Coordinate System:*
*GDA 1994 MGA Zone 54*

N

biosis

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Drawn by: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F1_SubjectLand

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community*

# 2. Landscape Context

This chapter describes the landscape and site context of the subject land, describing the landscape features present within the subject land and within a 1500 metre buffer assessment area, as required by the BAM (DPIE 2020a). Figure 1 shows the location of the subject land and landscape features within the 1500 metre assessment area.

## 2.1. Subject land description

The wind farm subject land is located within several properties either side of Balranald-Moulamein Road, east of Yanga Way between Balranald and Kyalite. The subject land is currently used primarily for dryland cropping and some sheep and cattle grazing practices.

The subject land includes five public road areas that will be subject to impacts to allow blade transportation along the haulage route. These are located at:

- Yanga Way/Balranald-Moulamein Road junction.
- Yanga Way (Mallee Highway)/Sturt Highway junction.
- Sturt Highway/Market Street junction.
- Sturt Highway/Murray Valley Highway junction.
- Balranald-Moulamein/Arundel junction.

The subject land covers 10,838.27 hectares consisting primarily of cultivated agricultural paddocks within the proposed windfarm area, and vegetated/non vegetated public road reserves within the haulage route.

### Junction Rivers Wind Project

The landscape within this area consists of slightly undulating semi-arid sandplains and peneplains. One ephemeral lake (Condoulpe Lake) is present in the northern extent of the subject land and small agricultural dams are scattered throughout the subject land. Vegetation within the subject land has been subject to clearing for cultivation or contains only a grass and shrub layer for grazing. Remnant non-cleared vegetation exists within the subject land as small blocks of woodland or mallee, roadside vegetation corridors, along seasonal watercourses and within depressions subject to periodic inundation. The largest patch of non-cultivated vegetation is a large area of grazed woodland in the centre of the subject land. Seasonal watercourses include Condoulpe Creek (flowing from Condoulpe Lake) and Forest Creek.

Soils vary from aeolian sandy soils on stabilised dunes of slightly higher elevations to clay loam soils on lower elevation areas and depressions subject to inundation. Agricultural related infrastructure is present within the subject land and includes sheds, houses and water troughs.

The north-western, central and parts of the southern sections of the subject land (most of the subject land) are identified as consisting of poorly consolidated red-brown sand dunes within the NSW 1500k Simplified Surface Geology (Department of Regional New South Wales 2023). These dunes have developed predominantly from wind transport of quartz and other sand-sized particles (Department of Regional New South Wales 2023). Creek bed sections of the southern and some sections of the eastern extent of the subject land are of poorly consolidated clay within the NSW 1500k Simplified Surface Geology (Department of

Regional New South Wales 2023). The ephemeral lakebed in the northern extent of the subject land contains lacustrine deposits from when lakes are filled with sediment during wet periods. Post-evaporation, mud, silt and sand are left in the now dry lakebed (Department of Regional New South Wales 2023).

### Public road areas

Within the five areas above, the subject land consists primarily of developed road reserve subject to historical disturbance through road construction and adjacent residential or agricultural development. Soils are disturbed with the introduction of imported road base and gravels for the formation of as well as ongoing maintenance of roads and highways.

The following detail is mapped within the NSW 150k Simplified Surface Geology (Department of Regional New South Wales 2023):

- Yanga Way/Balranald-Moulamein Road junction.
  - Poorly consolidated red-brown sand dunes.
- Yanga Way (Mallee Highway)/Sturt Highway junction.
  - Poorly consolidated red-brown sand dunes.
  - Poorly consolidated clay, silt, sand and gravel.
- Sturt Highway/Market Street junction.
  - Current and recent mud, silt, sand and gravel deposited by river (alluvial) systems.
- Sturt Highway/Murray Valley Highway junction.
  - Poorly consolidated clay, silt, sand and gravel.
- Balranald-Moulamein/Arundel Road junction.
  - Poorly consolidated red-brown sand dunes.

### 2.1.1. Native vegetation cover

Vegetation within the assessment area (1500 metre buffer of the subject land) was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping. Vegetation communities mapped within the assessment area are detailed within Table 3. Table 4 provides the list of PCTs identified from existing vegetation mapping, and the current assessment, as occurring within the assessment area. Conservation status, in relation to the geographic location of the subject land, of the communities is also provided. Further assessment of the presence of these listed communities within the subject land is provided in Section 3.

The total area of the 1500 metre buffer around the subject land is 26,923.97 hectares, with the area of native vegetation mapped within the buffer being 7,922.96 hectares, which is illustrated on Figure 5. This is a native vegetation cover of 29.43% (10–30% class as defined in Section 3.2.3 of the BAM (DPIE 2020a)) and this value was entered into the BAM calculator.

Cleared/all remaining areas within the assessment area include approximately 19,000 hectares.

**Table 3 PCTs mapped within the assessment area (DPE 2023a)**

| PCT | Associated Threatened Ecological Communities (TECs) | BC Act Status | EPBC Act Status |
|---|---|---|---|
| **PCT 13 Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion).** | No associated TECs. | Not listed | Not listed |
| **PCT 15 Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion).** | No associated TECs. | Not listed | Not listed |
| **PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion).** | No associated TECs. | Not listed | Not listed |
| **PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion).** | No associated TECs. | Not listed | Not listed |
| **PCT 19 Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains.** | Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions. | Endangered | Not listed |
| **PCT 21 Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion.** | *Acacia loderi* shrublands. | Endangered | Not listed |
| | Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions. | Endangered | Not listed |
| **PCT 23 Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones.** | *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions. | Endangered | Not listed |
| **PCT 28 White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone.** | *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions. | Endangered | Not listed |
| | Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions. | Endangered | Not listed |

| PCT | Associated Threatened Ecological Communities (TECs) | BC Act Status | EPBC Act Status |
|---|---|---|---|
| **PCT 46 Curly Windmill Grass – speargrass – wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion.** | No associated TECs. | Not listed | Not listed |
| **PCT 57 Belah/Black Oak – Western Rosewood – Wilga woodland of central NSW including the Cobar Peneplain Bioregion.** | *Acacia loderi* shrublands. | Endangered | Not listed |
| **PCT 58 Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion.** | *Acacia loderi* shrublands. | Endangered | Not listed |
| | *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions. | Endangered | Not listed |
| **PCT 159 Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW).** | Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions. | Endangered | Not listed |
| **PCT 163 Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones.** | Artesian Springs Ecological Community in the Great Artesian Basin. | Critically Endangered | Not listed |
| **PCT 164 Cotton Bush open shrubland of the semi-arid (warm) zone.** | No associated TECs. | N/A | N/A |
| **PCT 165 Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone.** | No associated TECs. | N/A | N/A |
| **PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones.** | *Acacia loderi* shrublands. | Endangered | Not listed |
| | *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions. | Endangered | Not listed |
| | Plains mallee box woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions. | Not listed | Critically Endangered |
| **PCT 173 Sandplain mallee of central NSW.** | *Acacia loderi* shrublands. | Endangered | Not listed |
| | *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions. | Endangered | Not listed |
| | Plains mallee box woodlands of the Murray Darling Depression, | Not listed | Critically Endangered |

| PCT | Associated Threatened Ecological Communities (TECs) | BC Act Status | EPBC Act Status |
|---|---|---|---|
| | Riverina and Naracoorte Coastal Plain Bioregions. | | |
| **PCT 216 Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion.** | No associated TECs. | Not listed | Not listed |
| **PCT 238 Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains.** | No associated TECs. | Not listed | Not listed |

### 2.1.2. IBRA Bioregions and subregions

The subject land primarily occurs within the Murray Darling Depression IBRA subregion and the South Olary Plain IBRA subregion, with minor portions of the assessment areas also occurring in the Riverina IBRA bioregion and the Murrumbidgee and Robinvale Plains IBRA subregions (the latter only in relation to minor transport route impacts).

The Murray Darling Depression Bioregion lies in south-west NSW and extends into Victoria and South Australia and covers approximately 19,717,651 hectares. The region occupies 10.03% of NSW and is bounded in the north by the Broken Hill Complex Bioregion, with the Cobar Peneplain to the north-east and the Riverina Bioregion to the east. The Murray Darling Depression Bioregion also borders the Darling Riverine Plains to the north-west and contains outlying remnants of the Darling River and tributaries as they meet the Murray River at the Victorian border (*Bioregions of NSW*, 2003).

The Riverina IBRA region lies in south-west NSW, extending into central-north Victoria and covers approximately 9,576,964 hectares. The region occupies 8.86% of NSW and extends from Ivanhoe in the Murray Darling Depression Bioregion south to Bendigo, and from Narrandera in the east to Balranald in the west. The bioregion also includes outlying remnants of the Murray Darling Depression Bioregion in its western boundary, and the Victorian Midlands Bioregion in the south. The Murray and Murrumbidgee Rivers and their major tributaries, the Lachlan and Goulburn Rivers, flow from the highlands in the east, westward across the Riverina plain (*Bioregions of NSW*, 2003).

For the purpose of this assessment, the IBRA bioregion and subregion selected in the BAM Calculator is the Murray Darling Depression (South Olary Plain). As outlined in the *Biodiversity Assessment Method 2020 Operation Manual – Stage 1* (DPIE 2020b), for site-based development, if the subject land is located within more than one IBRA subregion, the IBRA subregion selected should be the one within where the largest proportion of the area of BDAR will occur. The subject land occurs more in the Murray Darling Depression (South Olary Plain) bioregion, with areas occurring within each subregion as follows (Figure 2):

- Murray Darling Depression (South Olary Plain) – 10,863.82 hectares (99.98% of the subject land)
- Riverina (Murrumbidgee) – 0.84 hectares (0.01% of the subject land)
- Riverina (Robinvale Plains) – 0.61 hectares (0.01 %).

For the purpose of threatened species assessments, a child case within the BAM Calculator was created to assess if additional candidate and predicted species occurred for the Riverina (Murrumbidgee) IBRA. This is

not a requirement under the BAM 2020; however this action was undertaken to ensure a thorough assessment of potential threatened species was completed due to the size, location and nature of the proposed development. No native vegetation occurs within the portion of the footprint that occurs in the Robinvale Plains IBRA subregion.

### 2.1.3. Rivers and streams

#### Junction Rivers Wind Project

The subject land is located within the Murray LLS Region and the Murrumbidgee and Murray catchments. The subject land is located around 10 kilometres north of the Wakool River (Strahler order 4) and Edward River (Strahler order 4). The Murrumbidgee River (Strahler order 5) is located around 30 kilometres to the North.

The seasonal watercourse Condoulpe Creek and dryland lake, Condoulpe Lake, occur within the subject land. Water enters these systems from the Murrumbidgee River via Yanga Lake and Yanga Creek (Figure 1). The seasonal watercourse The Forest Creek flows from Nyangay Creek, into the subject land, and into the Edward River (Figure 1).

Condoulpe Lake occurs within the subject land. This lake is mapped as a natural waterbody that is 'mainly dry'. An assessment of historical and recent aerial imagery indicates that seasonal cropping of the lakebed has occurred since at least 1961 (NSW Spatial Services 2024). To ensure impacts to Condoulpe Lake were accurately assessed, the lake area was mapped as native vegetation and its role as occasional waterbird habitat was considered.

There is Key Fish Habitat as mapped by the NSW Department of Primary Industries (DPI) within the subject land and within the adjacent area (DPI 2013). The Key Fish Habitat runs from Lake Talbetts (west of the subject land), through an unnamed ephemeral watercourse within the subject land and into The Forest Creek where it exits the subject land.

#### Public road areas

No mapped watercourses or streams occur within the subject land of the assessed haulage route development areas. The Sturt Highway/Market Street junction occurs around 200 metres north east of the Murrumbidgee River that runs through Balranald, NSW. The Sturt Highway/Murray Valley Highway junction occurs directly adjacent to a floodplain area of the Murray River. The Murray River watercourse is located around 1.3 kilometres south-east of the development footprint at the Sturt Highway/Murray Valley highway junction.

### 2.1.4. Wetlands

#### Junction Rivers Wind Project

No parts of the subject land are mapped as part of a wetland included in the Directory of Important Wetlands (DoIW) of Australia (Cth DCCEEW 2005). However, Yanga Lake, approximately 3.6 kilometres north of the subject land is 1200 hectares in area and was listed as part of the Lowbidgee Floodplain on the DoIW for the following reasons:

- It is a good example of a wetland type occurring within a biogeographic region in Australia.
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex.

- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail.
- The wetland supports 1% or more of the national populations of any native plant or animal taxa.
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level (Cth DCCEEW 2023a).

The development site does not lie within, or in close proximity to any Ramsar Wetland nature reserves. However, the development site is connected to, and lays 50 – 100 kilometres downstream of Hattah-Kulkyne Lakes, 200 – 300 kilometres downstream of Riverland and Banrock Station Wetland Complex, and 300 – 400 kilometres downstream of The Coorong, and Lakes Alexandrina and Albert Wetland, which are all listed Ramsar Wetlands. The development site and proposed development do not pose any effect to these wetlands as they are all upstream of the development site by at least 50 kilometres.

Harvey's Lake, located around 300 metres north of the subject land is mapped under the DPE Wetlands (DPE 2023b). Within a 5-kilometre radius of the subject land, Lake Merwin, an unnamed floodplain water body and large areas of the Edward River are also identified as wetlands under the NSW DPE Wetlands layer.

#### Public road areas

Areas of mapped wetland by DPE (DPE 2023b) occur within proximity to the Sturt Highway/Market Street junction and Sturt Highway/Murray Valley Highway junction. These areas are associated with the Murrumbidgee and Murray Rivers and include extensive floodplain wetlands. No mapped Ramsar wetlands or DoI Wetlands occur within proximity to any of the haulage route development areas.

### 2.1.5. Connectivity

The key connectivity features relevant to the wind farm subject land are:

- The uncleared riparian corridor following Condoulpe Creek into the Yanga National Park, Yanga Nature Reserve and Yanga State Conservation Area, Yanga Lake and Murrumbidgee River to the north of the subject land.
- The vegetated road reserves of Balranald-Moulamein Road and Yanga Way leading north through a series of Travelling Stock Reserves to Yanga National Park, Yanga Nature Reserve, Yanga State Conservation Area and Murrumbidgee River and south to the Murray Valley Regional Park, Edwards River and Wakool River.

Yanga National Park, Yanga Nature Reserve, Yanga State Conservation Area, Murray Valley Regional Park contain extensive woodland, mallee, riparian and wetland habitats connected to a network of floodplain, channel, creek, wetland and lake systems throughout the landscape. These habitats together form an important network of corridors and refugia for fauna species in a fragmented landscape.

These key areas of connectivity form a mosaic with a large number of smaller features subject to disturbance and fragmentation. Although disturbed, these areas aid in maintaining contiguous connectivity throughout the landscape between larger core areas of habitat. Smaller features include The Forest Creek, a series of named and unnamed floodplain lakes and Arundel Road (Figure 5).

The Yanga Way/Balranald-Moulamein Road junction, Yanga Way (Mallee Highway)/Sturt Highway junction and Sturt Highway/Market Street junction occur between the windfarm subject land and Balranald. These areas

occur along the connectivity features noted above occurring primarily along the road reserve connecting Wakool and Edward Rivers to the Murrumbidgee River via Yanga Way.

The Sturt Highway/Murray Valley Highway junction occurs directly adjacent to floodplain and mapped DPE wetlands of the Murray River, this is the key connectivity feature of this section of the subject land, where the Murray River and its associated floodplains, wetlands and riparian vegetation form a major connectivity pathway within the landscape.

### 2.1.6. Geological features of significance

The assessment area is characterised by relatively flat terrain with sections subject to periodic inundation. There are no recorded karst, caves, crevices cliffs or other areas of geological significance within the development site or within the assessment area of the wind farm or public road areas.

The subject land is located within 50 kilometres of a number of areas considered to be of geological significance for the region. These include:

- Yanga Lake, Murrumbidgee River, Murray River, Wakool River.
- Lowbidgee Floodplain.
- Yanga National Park, Yanga Nature Reserve, Yanga State Conservation Area, Murray Valley Regional Park.

### 2.1.7. Areas of outstanding biodiversity value

Under the BC Act, the Minister for the Environment has the power to declare Areas of Outstanding Biodiversity Value (AOBVs). To date no AOBVs have been declared within the subject land or broader assessment area.

### 2.1.8. NSW (Mitchell) Landscape

The subject land occurs within the Mallee Cliff Sand Plains, Murrumbidgee Depression Plains, Murrumbidgee Lakes, Swamps and Lunettes, Murrumbidgee Channels and Floodplains and Murrumbidgee Scaled Plains Mitchell Landscapes (Department of Environment & Climate Change NSW 2002).

The majority of the subject land occurs within the Murrumbidgee Depression Plains Mitchell Landscape, as such, this was the landscape feature selected within the BAM Calculator. The following percentages of each Mitchell Landscape occurred within the subject land (Figure 3):

- Murrumbidgee Depression Plains – 8,967.33 hectares (82.74% of the subject land).
- Murrumbidgee Scalded Plains – 3.04 hectares (0.03% of the subject land).
- Mallee Cliffs Sandplains – 1,698.80 hectares (15.67% of the subject land).
- Murrumbidgee Lakes, Swamps and Lunettes – 167.65 hectares (1.55% of the subject land).
- Murrumbidgee Channels and Floodplains – 1.45 hectares (0.01% of the subject land).

#### Mallee Cliff Sand Plains

The Mallee Cliffs Sandplains landscape encompasses various parts of twelve distinct land systems, namely Ashmont, Bulgamurra, Frenchmans, Gulthul, Hatfield, Menilta, Mulurulu, Overnewton, Quambi, Roo Roo,

Trelega, and Wilkura. This landscape features extensive, slightly undulating sandplains composed of aeolian sands from the Quaternary period, with east-west oriented dunes that may have blowouts, as well as scalded broad swales and small depressions. The terrain has a relief of 6 to 10 metres. The plain comprises solonized brown soils, calcareous loamy sand, and texture-contrast soils, while the dunes have red and brown sands, and the depressions have non-cracking grey or brown clays (Department of Environment & Climate Change NSW 2002).

### Murrumbidgee Depression Plains

The Murrumbidgee Depression Plains landscape consists of Quaternary alluvial plains that contain several circular depressions, interpreted as high floodplains or low terraces situated beyond the reach of typical floodwaters. This landscape has a relief of up to 10 metres and consists of grey to brown clays and clay loams with linear patterns of sandy prior streams (Department of Environment & Climate Change NSW 2002).

### Murrumbidgee Lakes, Swamps and Lunettes

The Murrumbidgee Lakes, Swamps, and Lunettes landscape includes parts of the Cargelligo land system. This terrain features large active freshwater lakes and swamps that are frequently flooded by the Murrumbidgee River and are typically round or kidney shaped. They are often nested within larger relic Quaternary Lake features and may include areas of saline plains. The eastern margins of this landscape are characterised by beaches, sand, and clay pellet lunettes, as well as sand hills. The lake beds and associated channels consist of grey cracking clay, while the beaches are composed of brown to white sands. The lunettes, on the other hand, are made up of deep cemented yellow to white sands, sometimes with interbedded strata of pelleted clay. The relief of the lakes and channels can be up to 8 metres, while the lunettes have a relief of up to 15 metres (Department of Environment & Climate Change NSW 2002).

### Murrumbidgee Scalded Plains

The Murrumbidgee Scalded Plains landscape is characterised by quaternary alluvial plains with extensive scalding interpreted as relic floodplains or terraces. Soils are comprised of grey, brown and red cracking clays, red brown texture-contrast soils with scalds. Levees traces are evident, and relief is generally <1 metre, up to 5 metres on associated pans, swamps and lunettes. Vegetation associated with this landscape consists of low shrublands and grasslands of bladder saltbush *Atriplex vesicaria*, other annual saltbushes *Atriplex* spp., numerous burrs *Sclerolaena* spp., cottonbush *Maireana aphylla*, Bush Minuria *Minuria cunninghamii*, White-top Grass *Austrodanthonia caespitosa*, Windmill Grass *Chloris truncata*, and Hill Wallaby Grass *Austrodanthonia eriantha* (Department of Environment & Climate Change NSW 2002).

### Murray Channels and Floodplains

The Murray Channels and Floodplains landscape encompasses various parts of four land systems, which are Canally, Murrumbidgee, Riverland, and Wentworth. The terrain is characterized by active channels and seasonally inundated floodplains of the Murray streams, which are composed of Quaternary alluvium. Additionally, there are associated billabongs, swamps, channels, levees, and source bordering dunes, with a relief of up to 10 meters. This landscape also includes scalded alluvial flats, broad elevated floodplains, and associated relict channels, as well as isolated sandy rises with a relief of up to 5 meters (Department of Environment & Climate Change NSW 2002).

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### 2.1.9. Additional landscape features

There are no additional landscape features within the subject land identified or covered in the development's SEARS.

## 2.2. Land categorisation assessment

Assessment of non-native vegetation or areas exempt from further assessment was undertaken in accordance with BC Act s6.8(3), which states that any assessment relating to biodiversity is to exclude the clearing of native vegetation and loss of habitat on category 1 – exempt land (within the meaning of Part 5A of the *Local Land Services Act 2013* (LLS Act). This excludes any impacts prescribed by the regulations under section 6.3 of the BC Act. Additionally, in accordance with section 1.5 of the BAM, biodiversity values that do not need to be assessed include: (d) biodiversity values associated with the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the LLS Act), other than the additional biodiversity impacts in accordance with clause 6.1 of the BC regulation.

In the absence of a published Native Vegetation Regulatory Map (NVR), an accredited assessor can identify lands as Category 1-exempt land or Category 2-regulated land by applying the definitions in the LLS Act, or advice from Local Land Services. This is completed by approximating the method used to make the NVR map under the provisions of the BC Act and the LLS Act. This is undertaken by using the same methodology including:

- Historical aerial imagery at or closet available to 1990.
- 2017 land use mapping.
- Woody vegetation extent layer 2017.
- Sensitive regulated land and vulnerable regulated land layer.

Category 1-exempt land is classified broadly as:

- Land cleared of native vegetation as at 1 January 1990 or lawfully cleared after 1 January 1990 and before 25 August 2017.
- Land containing low conservation value grasslands or groundcover.
- Native vegetation identified as regrowth in a Property Vegetation Plan (PVP) under the repealed *Native Vegetation Act 2003* only where the PVP specifies a regrowth date.
- Land bio-certified under the BC Act.

Category 2-regulated land is classified broadly as:

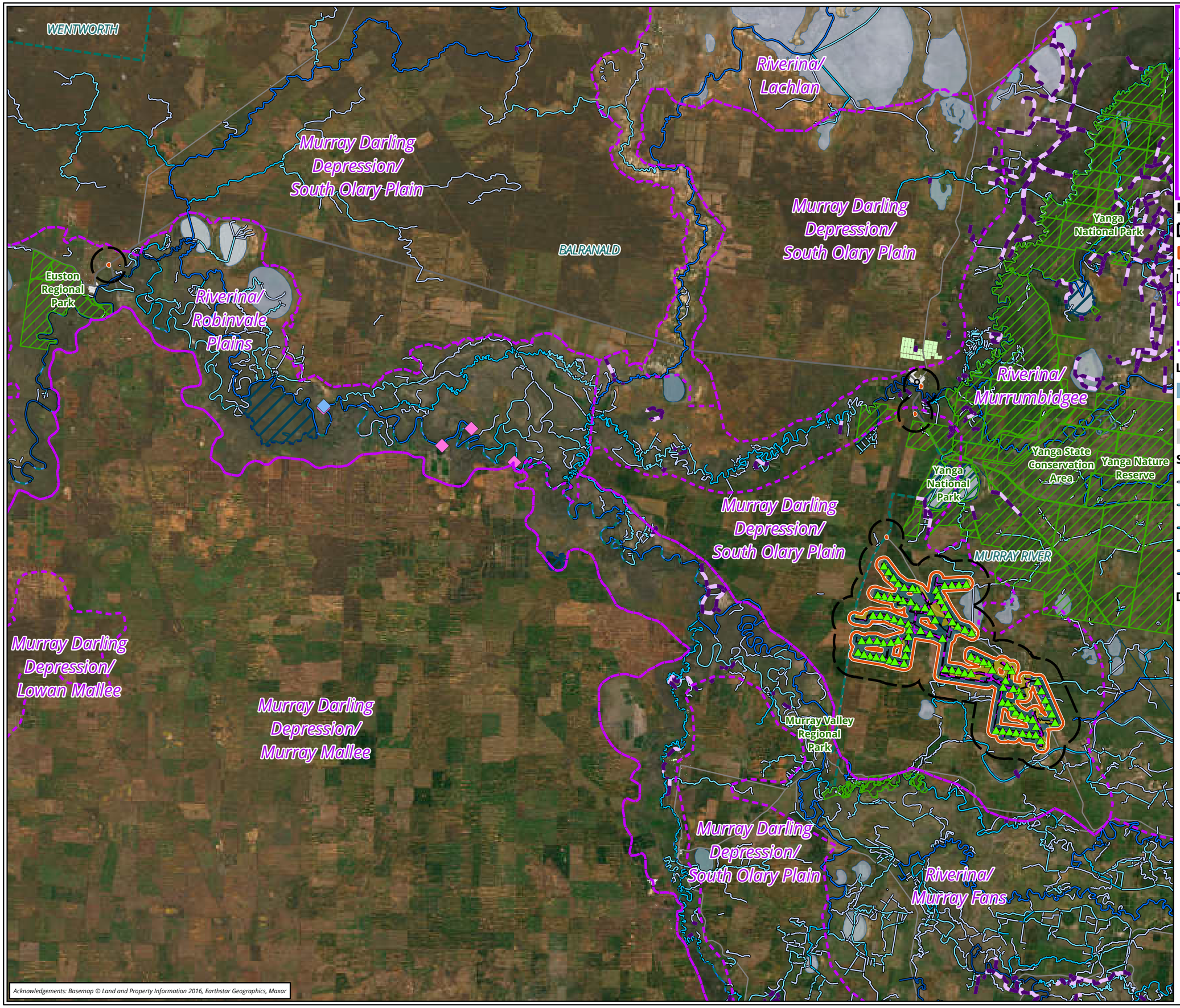
- Vulnerable and sensitive regulated land.
- Land not cleared of native vegetation before 1 January 1990 or unlawfully cleared of native vegetation after 1 January 1990.
- Land containing native vegetation grown or preserved using public funds.
- Land subject to an expired remedial action to restore or protect the biodiversity values.
- Land in the proximity area of a coastal wetland or littoral rainforest areas of the coastal zone under the *Coastal Management Act 2016*.
- Land subject to (or previously subject to) a private native forestry plan under either the *Forestry Act 2012* or the *Native Vegetation Act 2003*.

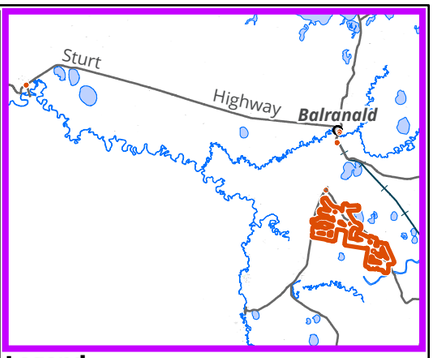
- Land containing medium conservation value grasslands.
- Land containing low conservation grasslands beneath the canopy or drip line of woody vegetation.
- Land is a travelling stock reserve (unless the land is located in the Western Division).
- The land is otherwise prescribed by the Local Land Services Regulation as category 2–regulated land.

There are no areas of Critically Endangered Ecological Communities (CEEC) or habitat for Critically Endangered species on Category 1-exempt land that are required to be re-categorised as Category 2-regulated land within the subject land.

Consultation was undertaken with NSW DCCEEW to obtain a copy of the draft NVR mapping for the subject land on 20 September 2022. This data was analysed and used as the primary determinant, alongside the features listed above in order to complete the Land Category Assessment for the Junction Rivers Wind Project.

Areas identified as non-native vegetation or Category 1-exempt land are shown on Figure 4.




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region

**Land category**

- Category 1 - Exempt Land
- Category 2 - Regulated Land
- Excluded Land

**Strahler stream order**

- 1
- 2
- 3
- 4
- 5

**Distinctive Land Surface - point**

- Reef
- Rock-Awash

**Figure 2.1 Site map**

0 4,000 8,000 12,000

Meters

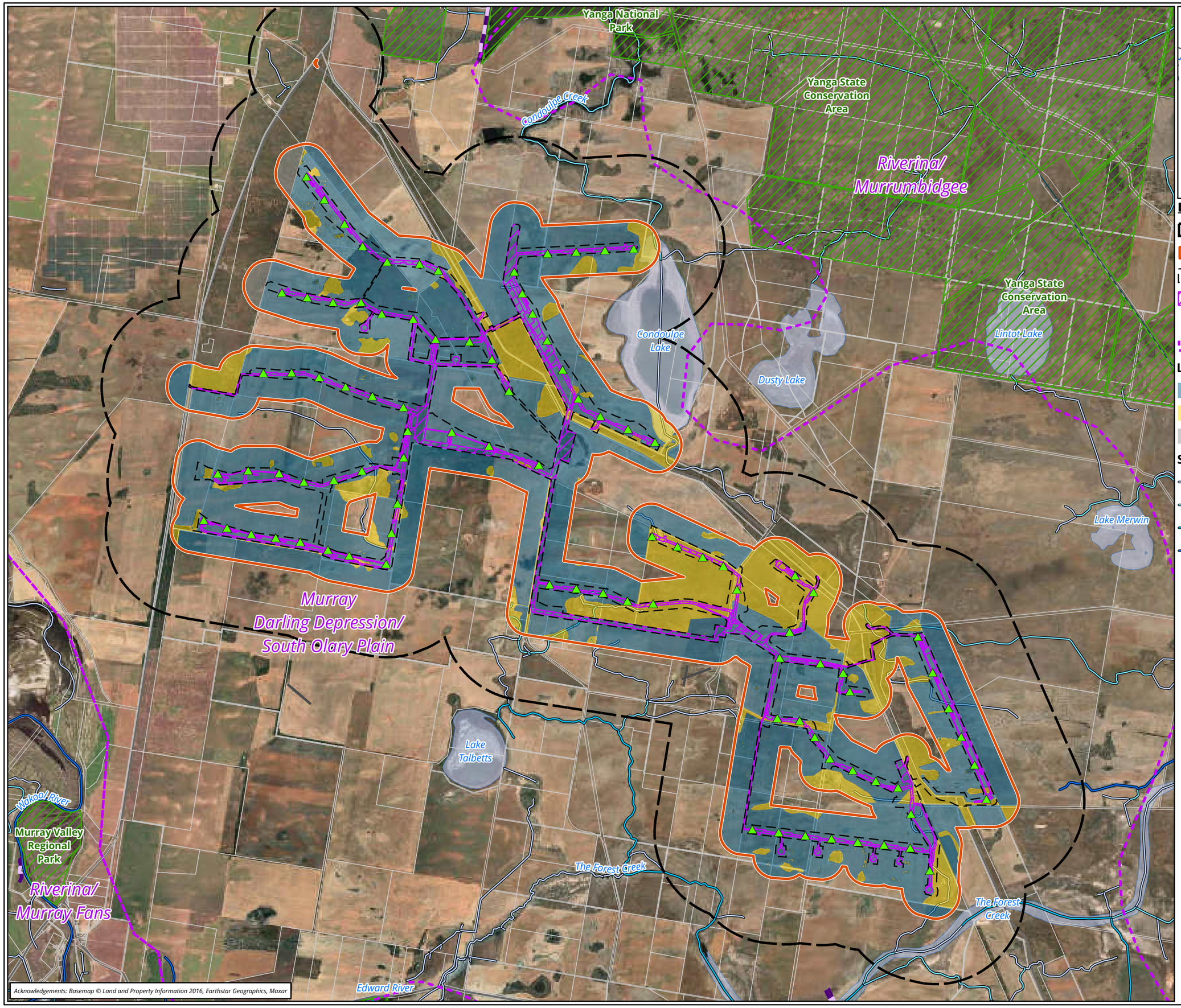
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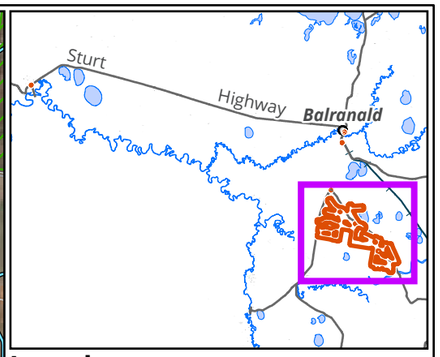
*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F2_Sitemap




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region

**Land category**

- Category 1 - Exempt Land
- Category 2 - Regulated Land
- Excluded Land

**Strahler stream order**

- 1
- 2
- 3
- 4

**Figure 2.2 Site map**

0 1,000 2,000 3,000

Meters

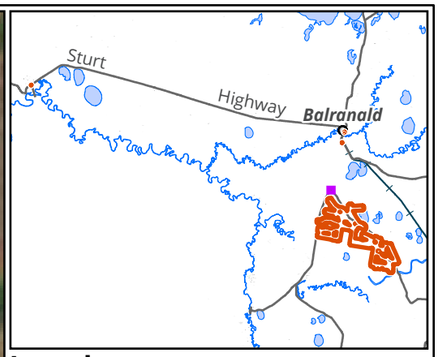
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*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
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Layout: 37502_F2_Sitemap




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region

*Acknowledgements: Basemap © Land and Property Information 2016, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar*

**Figure 2.3 Site map**

0 25 50 75

Meters

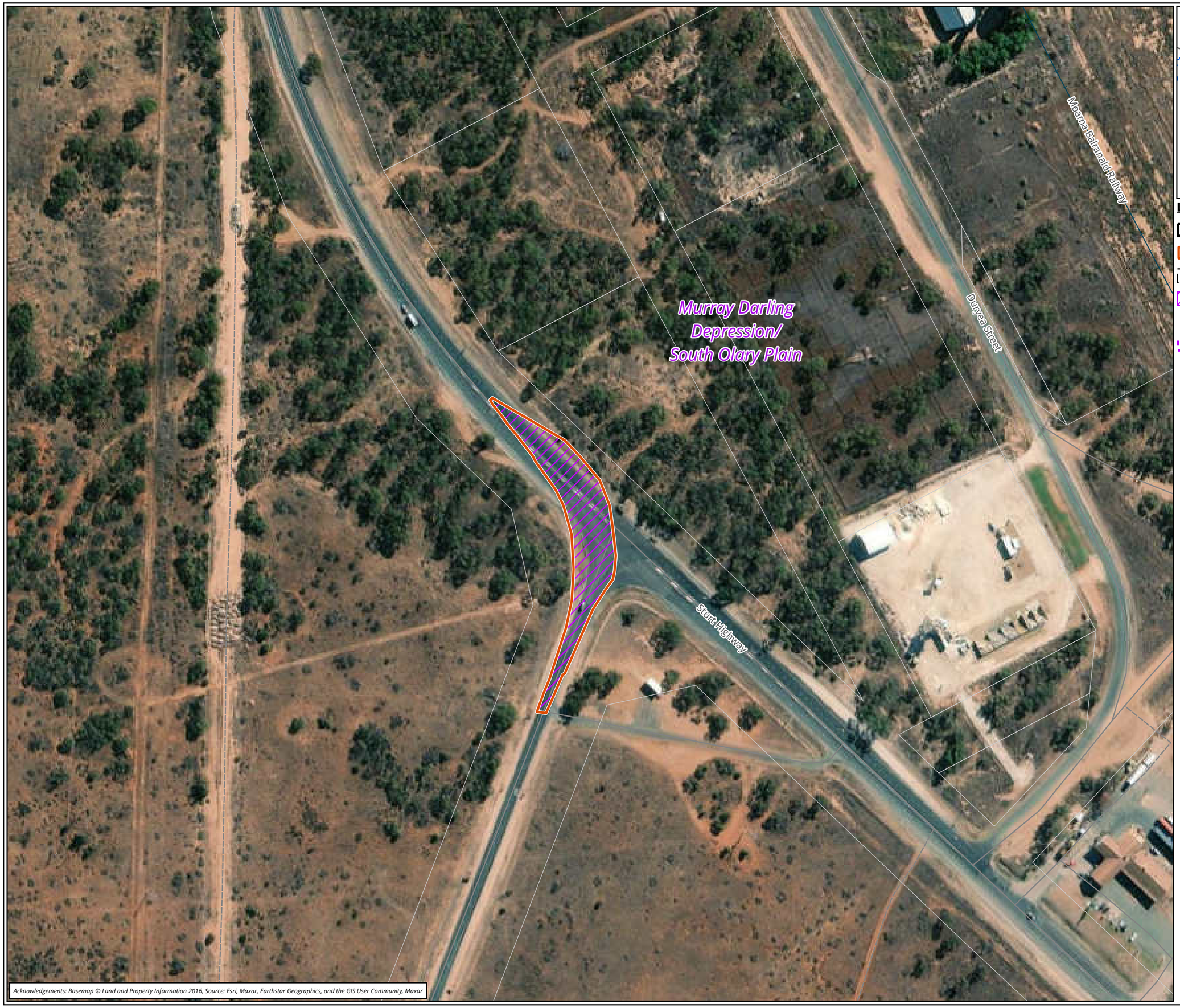
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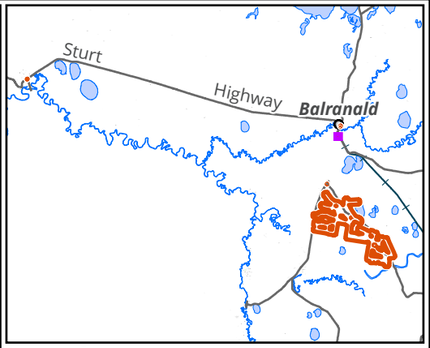
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N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F2_Sitemap




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region

*Acknowledgements: Basemap © Land and Property Information 2016, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar*

**Figure 2.4 Site map**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

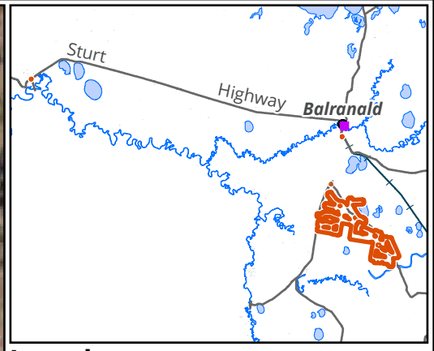
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F2_Sitemap




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region

**Strahler stream order**

- 5

**Figure 2.5 Site map**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

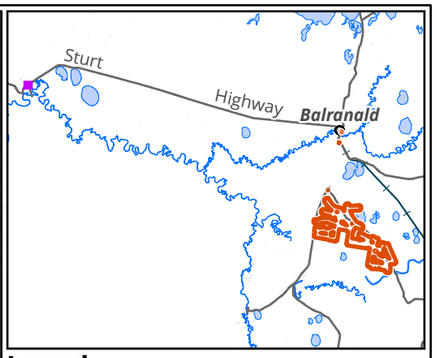
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F2_Sitemap




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region

**Figure 2.6 Site map**

0 25 50 75

Meters

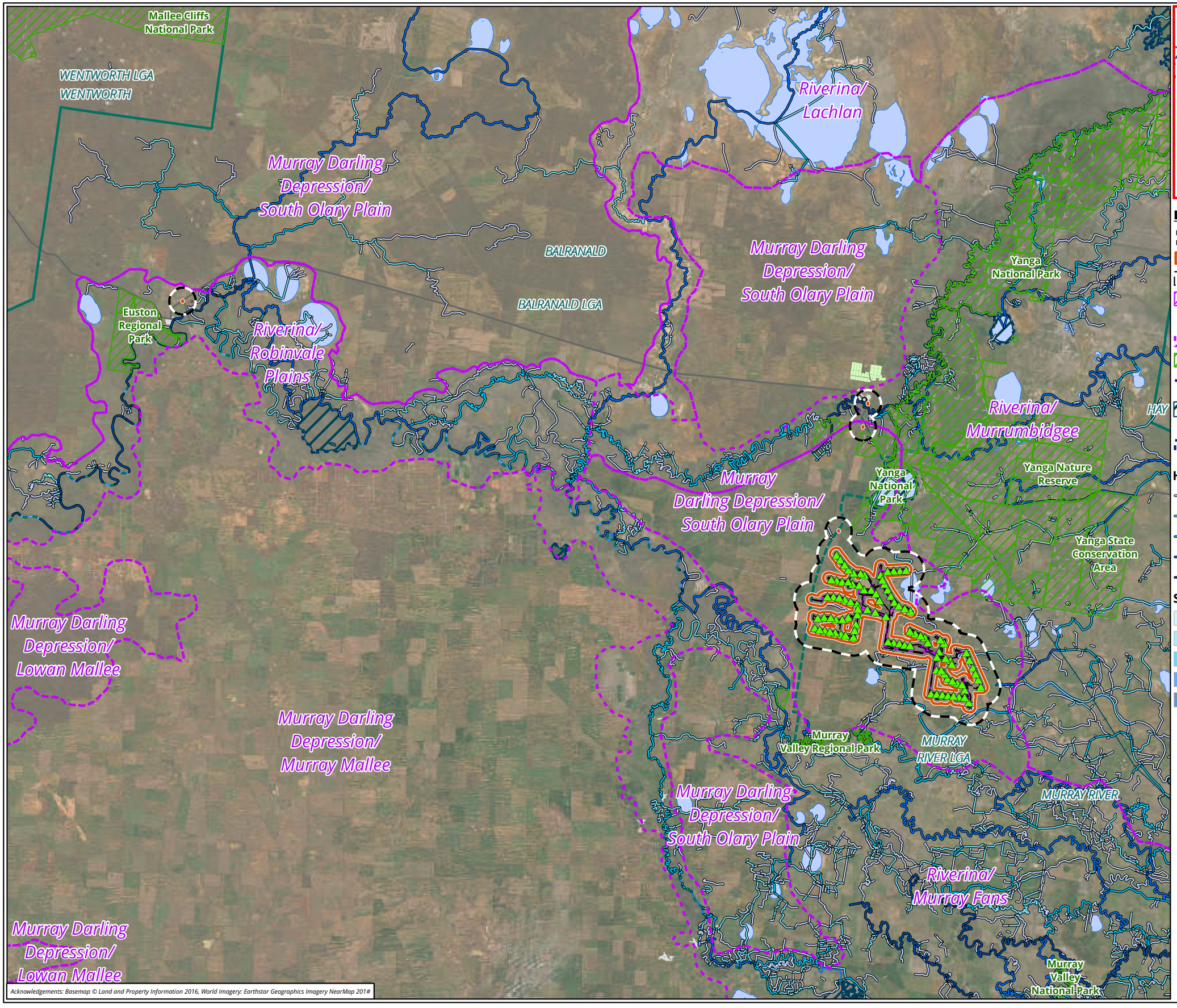
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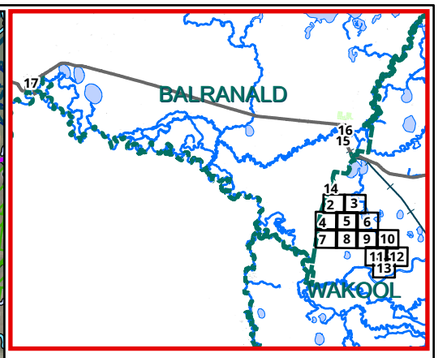
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Layout: 37502_F2_Sitemap

*Acknowledgements: Basemap © Land and Property Information 2016, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Maxar*




**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region
- National Park/Reserve
- Levee
- Directory of Important Wetlands of Australia (DIWA)
- Riparian buffers - Important wetlands

**HydroLine stream order**

- 1
- 2
- 3
- 4
- 5

**Strahler stream order buffers**

- 1
- 2
- 3
- 4
- 5

**Figure 3.1 Location map**

0 4 8 12 16

Kilometers

Scale: 1:376,000 @ A3

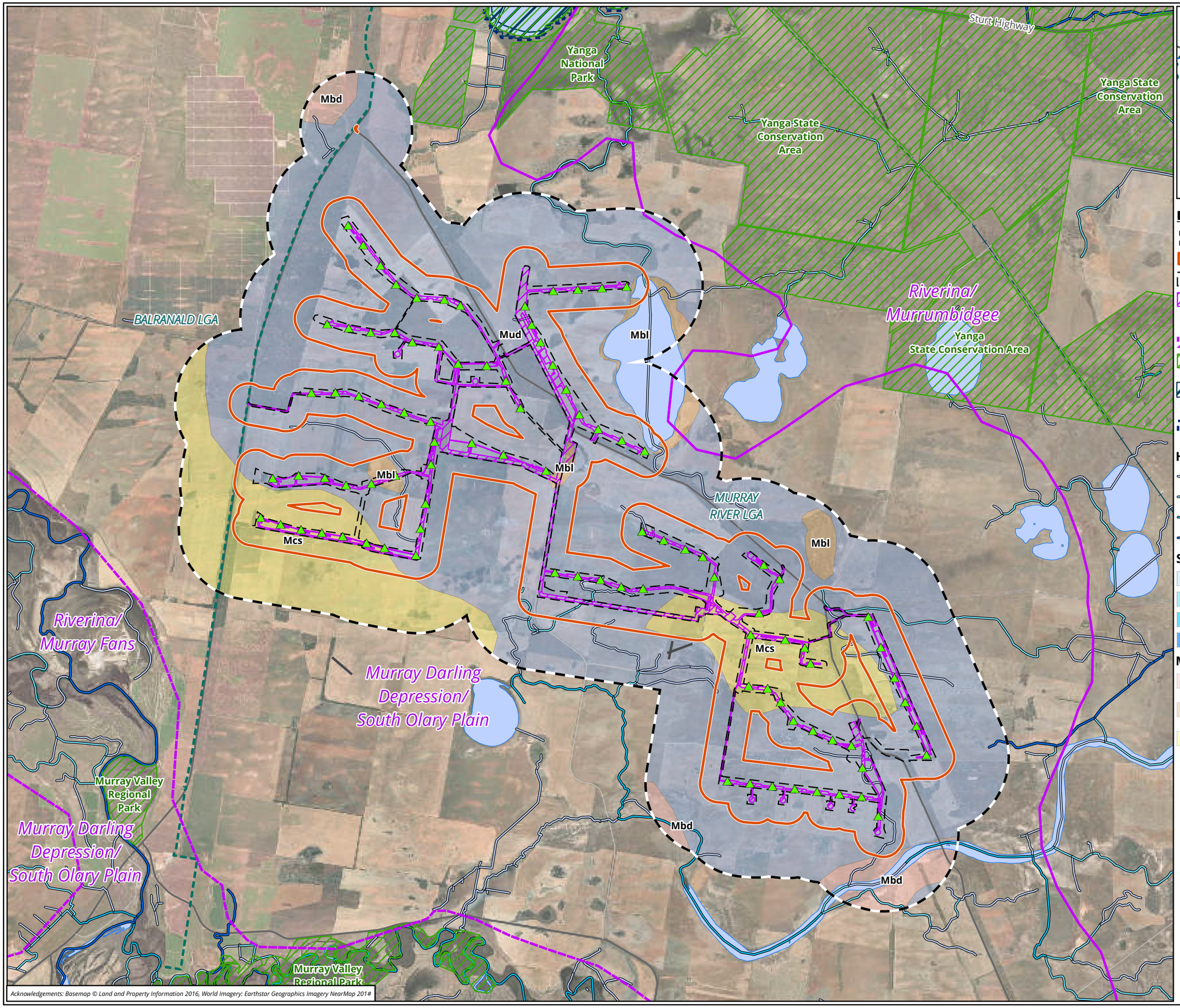
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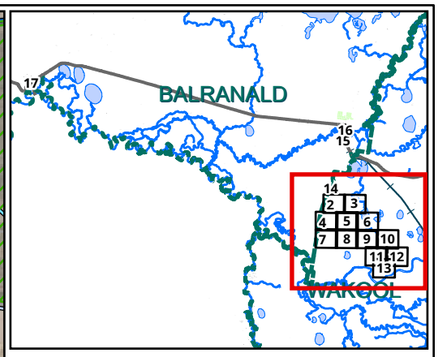
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F3_Location

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**Legend**

- Assessment area
- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- IBRA Region/Sub-region
- National Park/Reserve
- Directory of Important Wetlands of Australia (DIWA)
- Riparian buffers - Important wetlands

**HydroLine stream order**

- 1
- 2
- 3
- 4

**Strahler stream order buffers**

- 1
- 2
- 3
- 4

**Mitchell landscapes**

- Mbd,Murrumbidgee Scalded Plains
- Mbl,Murrumbidgee Lakes, Swamps and Lunettes
- Mcs,Mallee Cliffs Sandplains
- Mud,Murrumbidgee Depression

**Figure 3.2 Location map**

0 1 2 3 4

Kilometers

Scale: 1:94,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F3_Location

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**Legend**

- Assessment area
- Subject land
- Development footprint
- IBRA Region/Sub-region

**Mitchell landscapes**

- Mud,Murrumbidgee Depression Plains

**Figure 3.3 Location map**

0 0.02 0.04 0.06 0.08

Kilometers

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

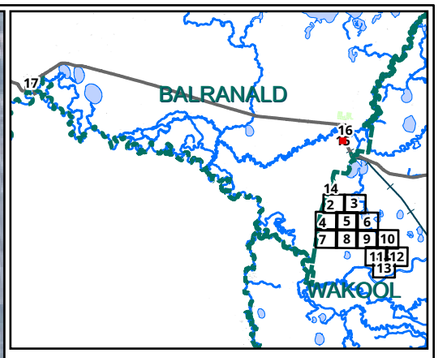
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F3_Location

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**Legend**

- Assessment area
- Subject land
- Development footprint
- IBRA Region/Sub-region

**Mitchell landscapes**

- Mud,Murrumbidgee Depression Plains

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community Imagery NearMap 201#*

**Figure 3.4 Location map**

0 0.02 0.04 0.06 0.08

Kilometers

Scale: 1:2,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

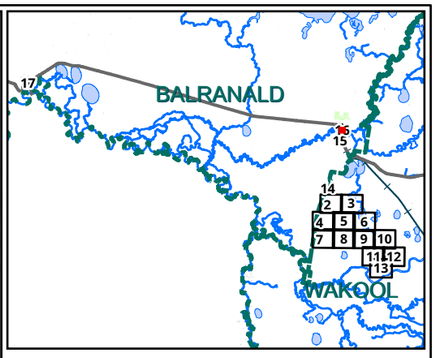
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Layout: 37502_F3_Location

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**Legend**

- Assessment area
- Subject land
- Development footprint
- IBRA Region/Sub-region

**HydroLine stream order**

- 5

**Strahler stream order buffers**

- 5

**Mitchell landscapes**

- Mbc,Murrumbidgee Channels and Floodplains

**Figure 3.5 Location map**

0 0.02 0.04 0.06 0.08

Kilometers

Scale: 1:2,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

N

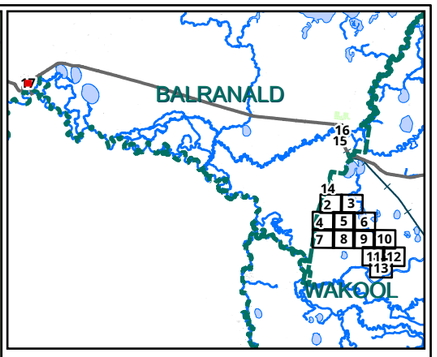
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Layout: 37502_F3_Location

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*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community Imagery NearMap 201#*




**Legend**

- Assessment area
- Subject land
- Development footprint
- IBRA Region/Sub-region

**Mitchell landscapes**

- Muc,Murray Channels and Floodplains

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community Imagery NearMap 201#*

**Figure 3.6 Location map**

0 0.02 0.04 0.06 0.08

Kilometers

Scale: 1:2,000 @ A3

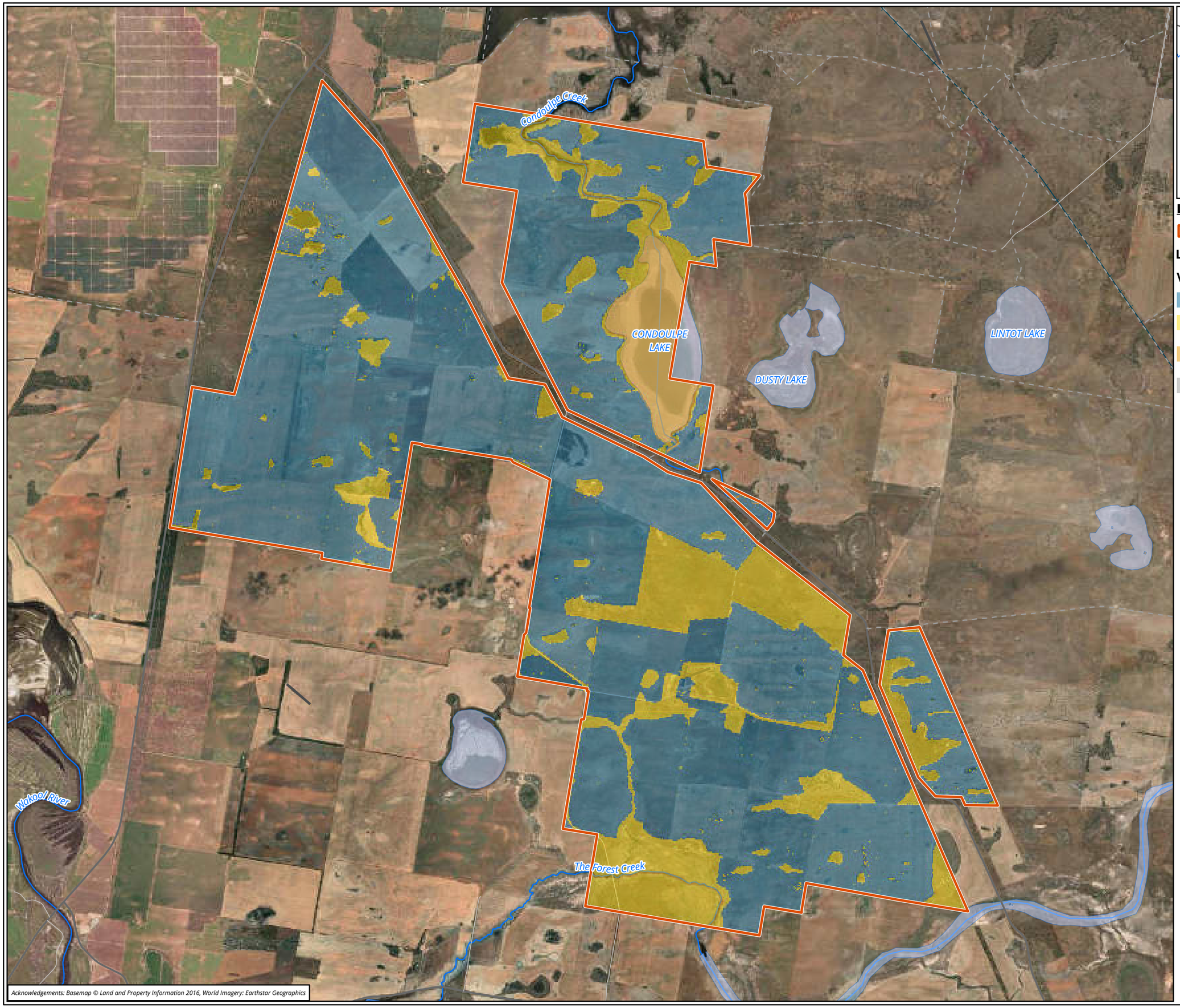
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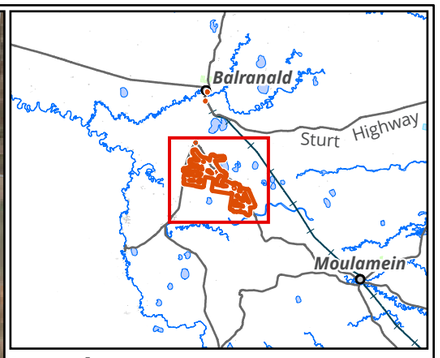
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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F3_Location

00




**Legend**

Project site

**Land category**

**Value**

- Category 1 - Exempt land
- Category 2 - Regulated land
- Category 2 - Regulated land - Vulnerable
- Excluded land

**Figure 4 Land category**

0 1 2 3

Kilometers

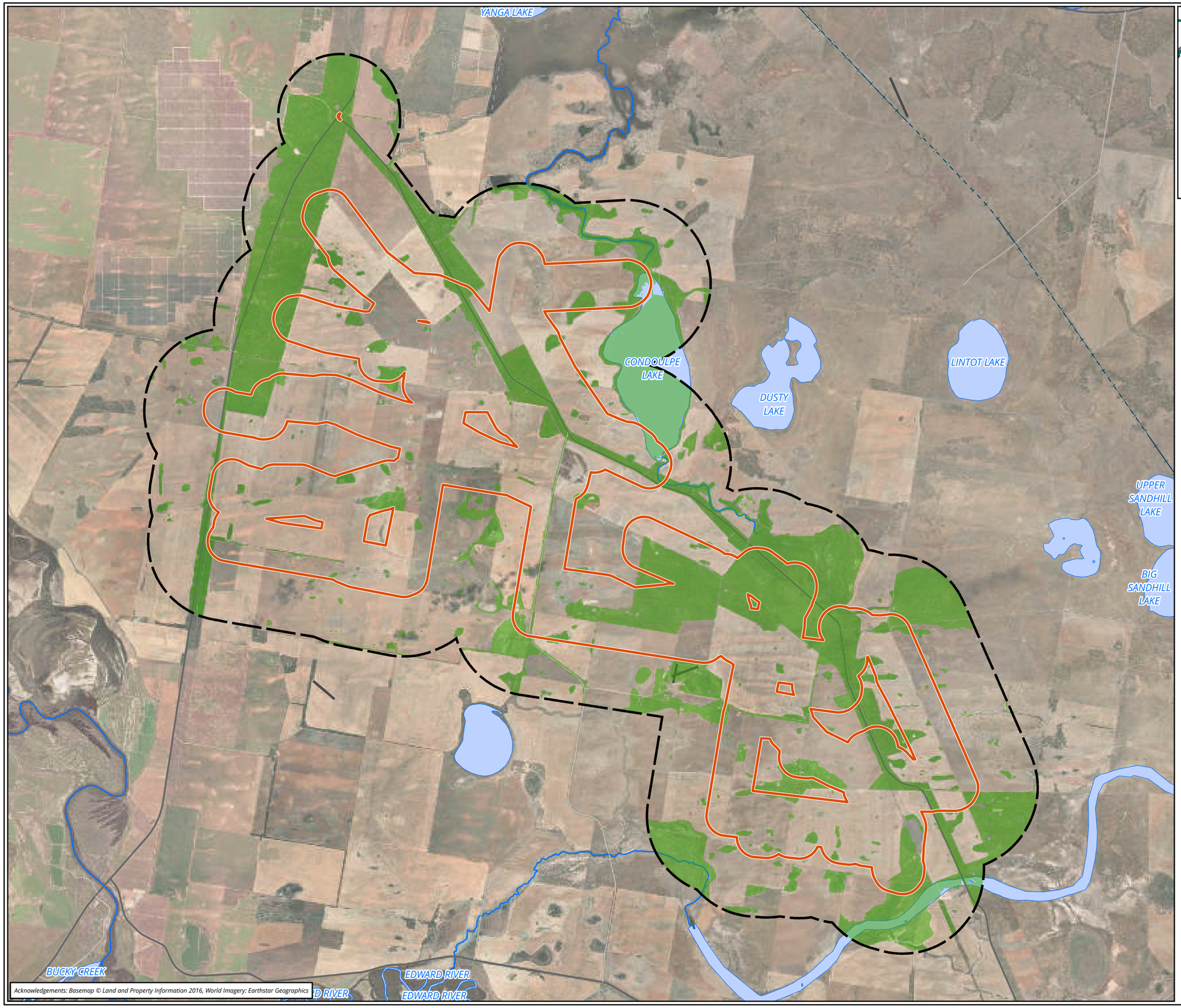
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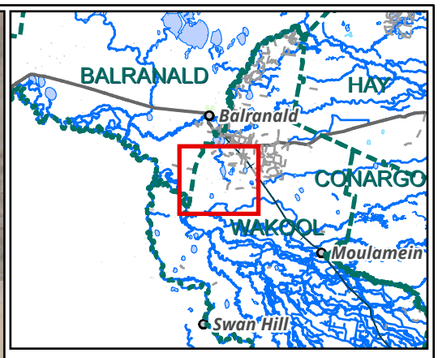
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Layout: 37502_F4_LandCat




**Legend**

- Assessment area
- Subject land
- Native vegetation

**Figure 5.1 Native vegetation extent**

0 1,000 2,000 3,000 4,000

Meters

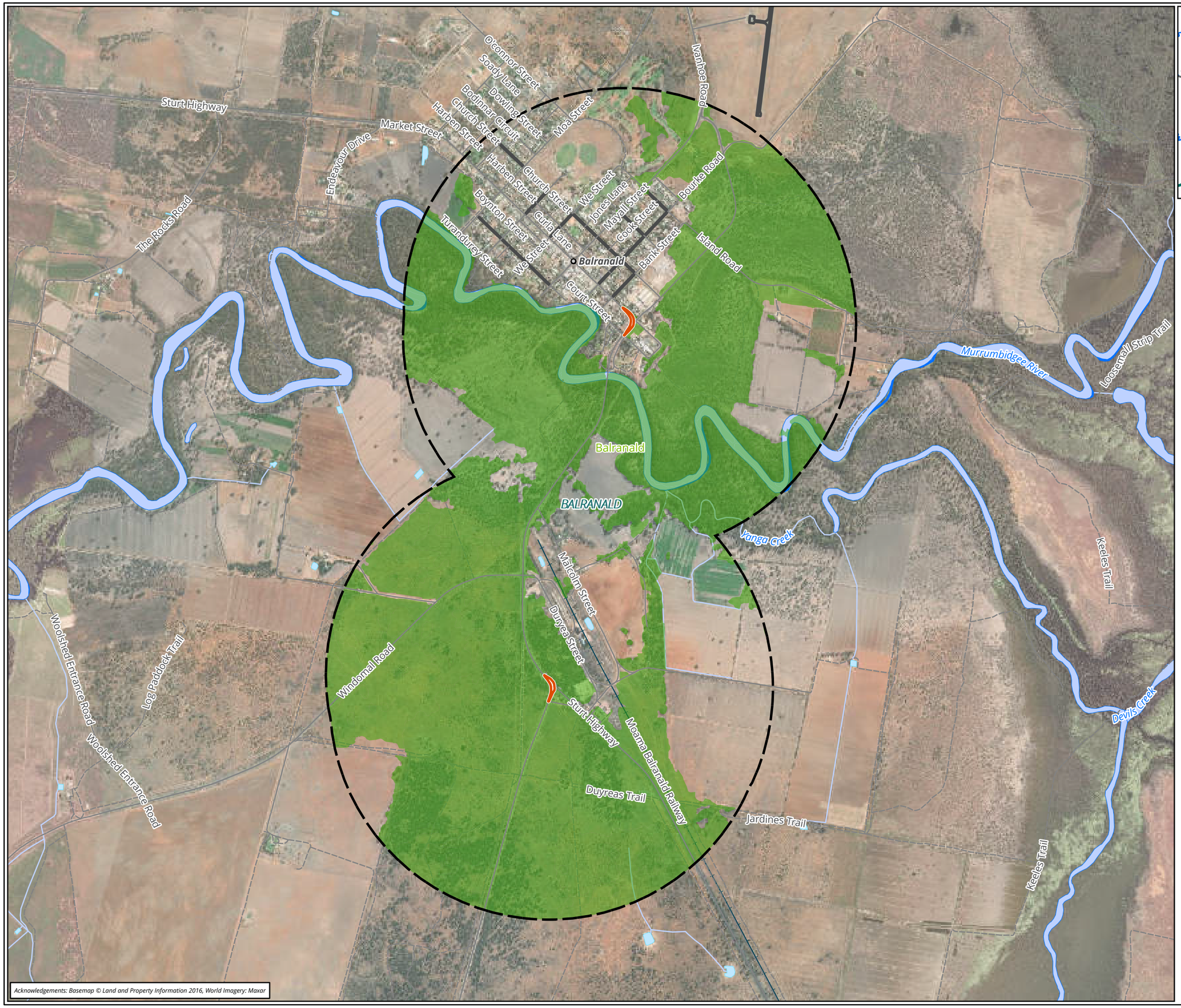
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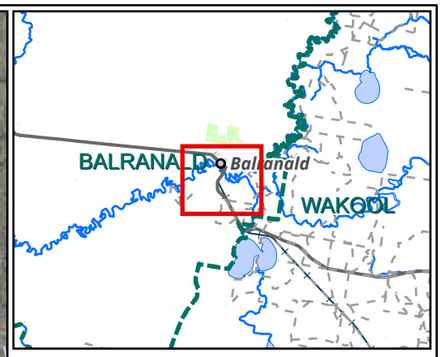
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 15 March 2024GIS: JET, Checked by: CW, Last edited by: jtownsendLocation: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F5_NativeVeg




**Legend**

- Assessment area
- Subject land
- Native vegetation

**Figure 5.2 Native vegetation extent**

0 300 600 900 1,200

Meters

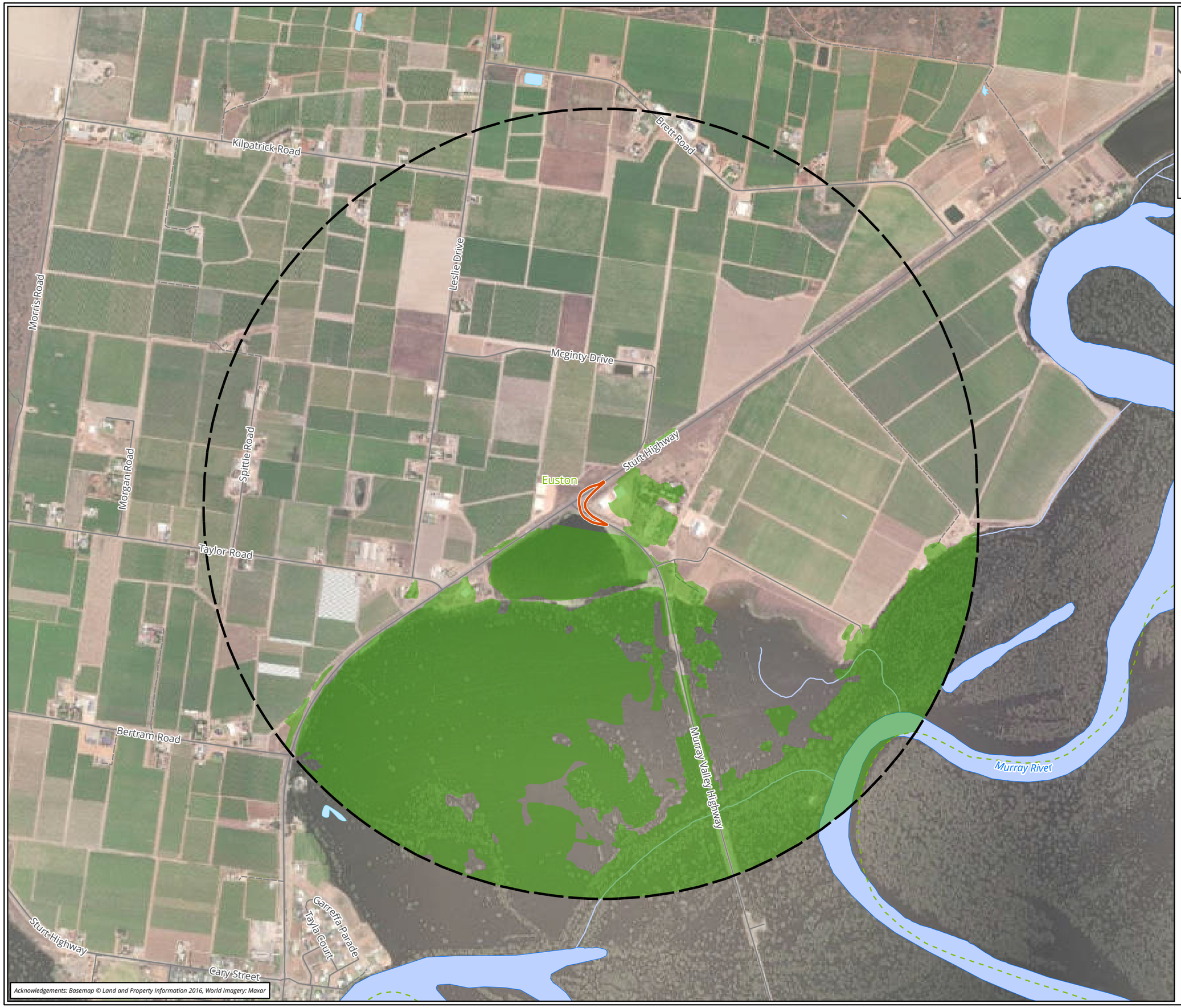
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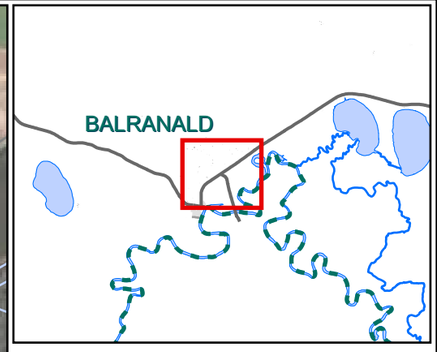
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Layout: 37502_F5_NativeVeg




**Legend**

- Assessment area
- Subject land
- Native vegetation

**Figure 5.3 Native vegetation extent**

0 175 350 525 700

Meters

Scale: 1:14,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 15 March 2024GIS: JET, Checked by: CW, Last edited by: jtownsendLocation: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F5_NativeVeg

# 3. Native vegetation

The subject land supports 2248.21 hectares of native vegetation with varying levels of disturbance. Native vegetation is found as small to medium isolated patches surrounded by cultivated/grazed land, corridors alongside public roads and a small number of large patches, the largest being near the centre of the subject land. Vegetation in small patches generally occur in a more degraded condition subject to historical under-scrubbing, ongoing grazing and weed invasion from surrounding agricultural land. Vegetation in larger patches and alongside road corridors generally occur in a less disturbed, higher intact condition state often supporting native ground, shrub and canopy vegetation.

## 3.1. Native vegetation methods

### 3.1.1. Native vegetation extent

The extent of native vegetation, threatened ecological communities, and vegetation integrity within the subject land was determined using the results of site investigations, previous studies undertaken at the site (NGH 2022) and Section 4 of the BAM (DPIE 2020a).

Figure 5 provides a map of the native vegetation extent recorded within the subject land, as assessed during field investigations undertaken between August 2022 and March 2023. The figure includes all areas of native vegetation (native ground cover and areas with canopy) within the subject land. Areas not shown as native vegetation cover within Figure 5, are considered cleared / non-native vegetation, and are addressed further below.

### 3.1.2. Review of existing information

Existing information regarding native vegetation was reviewed to inform field investigations including:

- Spatial data associated with NSW State Vegetation Type Map (DPE 2023a), Riverina Regional Native Vegetation Map v1.2 VIS_ID 4469 (DPIE 2016) and Western Regional Native Vegetation Map v1.0 VIS_ID 4492 (DPE 2019).
- NGH (Windlab) (2021). 20-468 Scoping Report Burrawong Wind Farm.
- NGH (Windlab) (2022). 20-468 Burrawong Wind Farm Spring 2021 Survey Report.
- Database searches, as outlined Section 1.4.

Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the subject land and development footprint.

### 3.1.3. Field investigation of biodiversity values

A systematic biodiversity assessment was conducted by Biosis between August 2022 and March 2023 under the terms of Biosis' Scientific Licence issued by the EES under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2024). Fauna survey was conducted under approval CSB 17/892 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2024). Field investigation dates are as below and further threatened species survey details are provided in Section 4:

- 29 August 2022 – 1 September 2022 PCT mapping, flora and fauna habitat assessments.
- 26 August 2022 – 30 September 2022 Threatened species surveys and BAM plots.
- 24 October 2022 – 27 October 2022 Threatened species surveys.
- 5 December 2022 – 9 December 2022 PCT mapping updates and BAM plots.
- 20 February 2023 – 23 February 2023 Fauna surveys and hollow mapping.
- 27 March 2023 – 31 March 2023 Scattered tree surveys, BAM plots and threatened species surveys.

The subject land was surveyed in accordance with the BAM (DPIE 2020a), which involved:

- The identification and mapping of PCTs according to the structural definitions held in the BioNet Vegetation Classification database, with reference to information provided in State Vegetation Type Map: Riverina Region Version v1.2 (OEH 2016a).
- Undertaking floristic plots within each vegetation zone in accordance with Section 4 of the BAM (DPIE 2020a), considering varying condition states and avoidance of ecotones, areas of disturbance, and edges.
- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, 1993, 2000, 2002) with reference to recent taxonomic changes.
- Targeted searches for plant species of conservation significance according to *Surveying Threatened Plants and Their Habitats* (DPIE 2020b).
- Incidental observations using the "random meander" method (Cropper 1993).
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the development site.
- An assessment of the natural resilience of the vegetation of the site.
- Identifying and mapping fauna habitats (e.g. hollow-bearing trees, rock outcropping etc.), assessing their condition and value to threatened fauna species, and considering threatened species' habitat constraints.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- Targeted surveys for threatened fauna species.
- Identification and classification of scattered trees in accordance with the BAM.

The conservation significance of plant species and plant communities was determined according to:

- BC Act for significance within NSW
- EPBC Act for significance within Australia.

Detailed field mapping and collection of GPS point locations were conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab X) running the ArcGIS Field Maps application, using the inbuilt GPS, and aerial photo interpretation. Spatial locations are therefore considered to have an accuracy of generally ±5 metres.

Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined and assigned. Identification of PCTs within the subject land was confirmed with reference to the community profile descriptors (and diagnostic species tests) held within the

NSW BioNet Vegetation Classification database (DPE 2023). Locations of floristic plots surveyed are shown on Figure 9

#### Vegetation surveys not completed by Biosis

Biodiversity surveys of the subject land were undertaken by NGH Consulting for the early scoping stages of the project. These surveys included initial PCT and condition mapping, targeted searches for candidate threatened flora species, and incidental surveys for fauna habitat and fauna species. Surveys were conducted by NGH during the following dates:

- 8 December 2020 – 9 December 2020.
- 15 November 2021 – 19 November 2021.

The results of these surveys were compiled into a memo report by NHG Consulting, and relevant GIS data was also provided to Windlab (NGH Consulting 2022). This report and GIS data has been relied on in various parts of the current assessment.

### 3.1.4. Local data

No local data has been used for this native vegetation assessment.

## 3.2. Native vegetation results

### 3.2.1. Non-native vegetation

A large proportion of the subject land is mapped as non-native vegetation, comprising predominately cultivated paddocks dominated by exotic/crop species which have been subject to a long history of agricultural disturbance (Figure 6).

Areas not shown as native vegetation cover within Figure 6, and which do not provide habitat for threatened species, are not included for further assessment in accordance with Section 5.1.1.5 of the BAM (DPIE 2020a). Non-native vegetation which does provide habitat for threatened species is required to be assessed as a prescribed impact. A total of 8588.72 hectares of non-native vegetation occurs within the subject land.

### 3.2.2. Planted native vegetation

Vegetation within the central portion of the subject land and on the Sturt Highway within the town of Balranald (haulage route) is considered to be 'planted native vegetation' in accordance with Appendix D of the BAM (Figure 6). Planted vegetation within the subject land is considered to be impacted by the project as it is within the project development footprint. Planted vegetation in Balranald is considered to potentially be subject to impacts to provide roadside space for the transport of wind turbine components during the construction phase of the project, if impacts were to occur it would be to one or two planted non-indigenous Eucalypts. Following implementation of D.1 – Decision-making key in Appendix D of the BAM, an assessment of the habitat values this vegetation provides to threatened species was undertaken in accordance with D.2 – Assessment of planted native vegetation for threatened species habitat. This assessment is provided as Appendix 6 of this BDAR.

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### 3.2.3. Plant community types

The following Plant Community Types (PCT) were assessed as present within the development corridor:

- PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW, Riverina Bioregion and Murray Darling Depression Bioregion (Table 4).
- PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion (Table 5).
- PCT 23 Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones (Table 6).
- PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion (Table 7).
- PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion (Table 8).
- PCT 163 Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones (Table 9).
- PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Table 10).

Table 4 to Table 10 provide detailed descriptions of the seven PCTs recorded within the development corridor. PCTs recorded within the development corridor are shown in Figure 6. A number of additional PCTs were recorded outside the development corridor but within the broader subject land and descriptions are provided in Appendix 3.3.

PCTs and associated ecological condition states within the subject land have been assigned based on ground-validation (minimum of rapid assessment) and as such there is a high level of confidence in the type of vegetation and habitats present. This is important to allow for accurate assessment of indirect impacts to surrounding vegetation and habitats and to ensure any threatened species associated with PCTs and/or habitats not present within the development corridor are appropriately considered.

Areas outside the subject land, but within the assessment area (including a broader area subject to initial desktop assessment) have been subject to assessment and refinement of mapping and habitat values at the desktop level and are based on the PCTs and habitat types provided in the State Vegetation Type Mapping. Where PCTs could not be reliably allocated, outside the study area, some vegetation types have been characterised by the border habitat type (or class). Such areas include those mapped in the SVTM as PCT 46 Curly Windmill Grass – Speargrass – wallaby grass grassland on alluvial clay loam on the Hay Plain and Riverina Bioregion, which is not considered to occur in the locality, and as such has been designated as ‘Undefined grasslands’. For the most part, these grasslands are considered derived communities from previous woodland, mallee or chenopod shrubland vegetation cover. Further discussion on the presence of PCT 46 is provided below.

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**Table 4 PCT 16 Black Box grassy open woodland wetland**

| PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW, Riverina Bioregion and Murray Darling Depression Bioregion | |
|---|---|
| **Common name** | Black Box grassy open woodland wetland |
| **Vegetation formation** | Semi-arid Woodlands (Grassy sub-formation) |
| **Vegetation class** | Inland Floodplain woodlands |
| **Extent within development corridor** | Moderate – 9.36 ha<br>Low – 10.72 ha<br>DNG – 14.76 ha<br>Paddock Trees – 0.36 ha (this relates to a mapped vegetation zone, not the BAM scattered tress assessment model, see Appendix 7) |
| **Condition** | This community occurs as derived native grassland (DNG) (due to past clearing), and in low and moderate condition states. Areas of low condition are generally smaller patches surrounded by cultivated land therefore being more susceptible to weed invasion compared to larger areas of moderate condition. Higher general weed coverage compared to other PCTs is due to higher water availability from more regular inundation of Black Box areas being favourable to exotic species, and as a result of livestock sheltering in these woodlands. |
| **Description** | PCT 16 within the development corridor occurs as predominately open woodland dominated by Black Box *Eucalyptus largiflorens* generally with an open understorey dominated by forbs, grasses and low growing chenopods. With the exception of Thorny Saltbush *Rhagodia spinescens* and Dillon Bush *Nitraria billardierei*, this community lacks shrubs including tall saltbushes or bluebushes. Weeds are common and include Wiry Noon-flower *Psilocaulon tenue*, Smooth Mustard *Sisymbrium erysimoides*, Winged Sea Lavender *Limonium lobatum*, Common Sowthistle *Sonchus oleraceus* and Medics *Medicago* spp. The understorey contains low shrubs including *Enchylaena tomentosa*, *Sclerolaena diacantha*, *Sclerolaena brachyptera*, *Sclerolaena muricata* var. *semiglabra* and *Atriplex leptocarpa;* forb species such as *Calotis hispidula*, *Crassula colorata* and *Tetragonia tetragonioides*; grass species such as *Austrostipa* spp. and exotic grasses such as *Schismus barbatus* and *Hordeum* spp. Occurs on heavy clay soils in ephemeral discharge areas including claypans and depressions distant from the major river floodplains. This community contains a sparser understorey than Black Box communities on the floodplains near major rivers (such as PCT 13 and 15). The original understorey may have contained perennial saltbushes that have been grazed out and displaced by weeds. |
| **Survey effort** | Fourteen BAM plots (four DNG, five low, four moderate, one paddock tree condition) were collected over the course of the field assessment (Figure 9). |
| **Justification of PCT** | Black Box grassy open woodland wetland within the subject land meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil - occurs on clays and alluvial loams and clays.<br>• Landform – occurs on alluvial plains.<br>• Dominant species – overstorey of Black Box, and understorey of Thorny Saltbush, *Enchylaena tomentosa*, *Sclerolaena diacantha* and a mix of grasses and forbs including *Calotis hispidula*, *Crassula colorata*, *Austrostipa* spp. and *Enteropogon acicularis*.<br>The PCT differs from similar PCT 13 Black Box – Lignum woodland wetland by being generally drier and rarely flooded, absence or very low cover of Lignum *Duma florulenta* and comprising a different floristic assemblage. The PCT differs from similar PCT 15 Black Box open woodland wetland with chenopod understorey by comprising a grassier understorey relative to chenopod cover. PCT 15 is recorded within the subject land but |

| PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW, Riverina Bioregion and Murray Darling Depression Bioregion | |
|---|---|
| | did not fall within the development survey corridor; species assemblage, inundation regime and landscape context were used to distinguish between areas of PCT 15 and PCT 16 *In situ*. |
| **TEC Status** | **NSW BC Act:** This community is not associated with a TEC listed under the BC Act.<br>**Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act. |
| **Estimate of percent cleared value of PCT (BioNet)** | 50% (NSW DCCEEW 2024a). |
| **PCT 16 – DNG condition** |  |
| **PCT 16 – Low condition** |  |

| PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW, Riverina Bioregion and Murray Darling Depression Bioregion | |
|---|---|
| **PCT 16 – Moderate condition** |  |

**Table 5 PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland**

| PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion | |
|---|---|
| **Common name** | Slender Cypress Pine - Sugarwood - Western Rosewood open woodland |
| **Vegetation formation** | Semi-arid Woodlands (Shrubby sub-formation) |
| **Vegetation class** | Riverine Sandhill Woodlands |
| **Extent within development corridor** | Moderate: 5.02 ha |
| **Condition** | This community is recorded in a moderate condition state. |
| **Description** | PCT 21 within the development corridor occurs as predominately open woodland composed of Slender Cypress Pine *Callitris gracilis* subsp. *murrayensis* and Western Rosewood *Alectryon oleifolius* subsp. *canescens.* A sparse shrub layer includes *Maireana decalvans*, *Enchylaena tomentosa*, *Sclerolaena muricata*, *Rhagodia spinescens* and *Salsola australis*. The ground cover is sparse and includes *Sclerolaena diacantha*, *Austrostipa nitida*, *Enteropogon acicularis* and *Convolvulus clementii*. Weed species include *Medicago* spp., *Sisymbrium officinale*, *Psilocaulon tenue* and grasses *Hordeum* spp. and *Schismus barbatus*. Occurs on calcareous sandy loam soils on low dunefields or lunettes sometimes on floodplains above flood levels. Distributed in the arid parts of far south-western NSW and north-western Victoria with annual rainfall from 250-300 mm. Examples within the development corridor were often disturbed by the impacts of grazing by rabbits and sheep, timber harvesting and some clearing. |
| **Survey effort** | Four BAM plots were collected over the course of the field assessment (Figure 9). |
| **Justification of PCT** | Slender Cypress Pine - Sugarwood - Western Rosewood open woodland within the development corridor meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil – occurs on calcareous sandy loam soils.<br>• Landform – occurs on low dunefields. |

| PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion | |
|---|---|
| | • Dominant species – overstorey of Slender Cypress Pine and Western Rosewood, understorey of *Rhagodia spinescens* and *Enchylaena tomentosa*.<br>The PCT differs from similar PCT 22 Semi-arid shrubby Buloke - Slender Cypress Pine woodland for the following reasons:<br>• Buloke *Allocasuarina luehmannii* is generally absent from this part of NSW<br>• It does not comprise a shrubby understorey partly dominated by *Dodonaea viscosa* subsp. *angustissima*<br>• It does not occur on highly calcareous soils.<br>The PCT differs from similar PCT 631 White Cypress Pine - Western Rosewood - spinifex grass open woodland by the lack of spinifex grass and the absence of White Cypress Pine *Callitris glaucophylla*. |
| **TEC Status** | **NSW BC Act:** This community is associated with and meets the condition thresholds for listing of *Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western* Slopes bioregions.<br>**Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act.<br>**Justification:** *Acacia loderi* and characteristic species of this community were not identified within this PCT.<br>No associated TECs are within the subject land due to key TEC species (*Acacia loderi* and *Callitris glaucophylla*) is not present, other characteristic species and landscape characters of the Sandhill Pine Woodlands were determined to occur. |
| **Estimate of percent cleared value of PCT (BioNet)** | 80% (NSW DCCEEW 2024a). |
| **PCT 21 – Moderate condition** |  |

### Table 6 PCT 23 Yarran tall open shrubland

| PCT 23 Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones | |
|---|---|
| **Common name** | Yarran tall open shrubland |
| **Vegetation formation** | Semi-arid Woodlands (Shrubby sub-formation) |
| **Vegetation class** | Riverine Sandhill Woodlands |
| **Extent within development corridor** | Moderate: 7.73 ha |
| **Condition** | This community is recorded in a moderate condition state. |
| **Description** | PCT 23 within the development corridor occurs as tall open shrubland dominated by Yarran *Acacia melvillei*. Other shrub species include *Rhagodia spinescens, Enchylaena tomentosa, Sclerolaena obliquicuspis, Maireana decalvans, Nitraria billardierei* and *Senna artemisioides* subsp. *filifolia*. Grass species include *Austrostipa nodosa, Austrostipa nitida* and *Enteropogon acicularis*. Forb species include *Calotis hispidula, Einadia nutans, Minuria leptophylla, Crassula colorata, Goodenia fascicularis, Senecio glossanthus, Plantago turrifera, Minuria leptophylla* and *Rhodanthe corymbiflora*. Lichen crust is present in untrampled locations. Occurs as localised stands on red-brown, sandy-loam soils on undulating sandplains in far western NSW from Bourke in the north to Mildura in the south. This semi-arid region receives between 250 and 400 mm of rainfall and is subject to frequent drought. Largely cleared on alluvial plains or very severely degraded. Grades into the Yarran community of central NSW (ID77) that receives a higher average rainfall and contains a number of different associate species and where *Acacia homalophylla* is more common. |
| **Survey effort** | Five BAM plots were collected over the course of the field assessment (Figure 9). |
| **Justification of PCT** | Yarran tall open shrubland within the development corridor meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil – occurs on red-brown, sandy-loam soils.<br>• Dominant species – dominant shrubs layer of Yarran and herb-rich understorey including *Calotis hispidula, Einadia nutans, Minuria leptophylla, Crassula colorata* and *Goodenia fascicularis.*<br>The PCT differs from similar PCT 77 Yarran shrubland of the NSW central to northern slopes and plains by a lack of Weeping Myall *Acacia pendula*, Belah *Casuarina cristata* and several *Eucalyptus* spp. PCT 77 also does not occur in the region surrounding or nearby the subject land. |
| **TEC Status** | **NSW BC Act:** This community is associated with and meets the requirements for the BC Act listed *Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions*.<br>**Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act.<br>**Justification:** The vegetation supports flora species characteristic of the BC Act TEC and occurs in the correct geographic location. |
| **Estimate of percent cleared value of PCT (BioNet)** | 71% (NSW DCCEEW 2024a). |

| PCT 23 Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones | |
|---|---|
| **PCT 23 – Moderate condition** |  |

**Table 7 PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland**

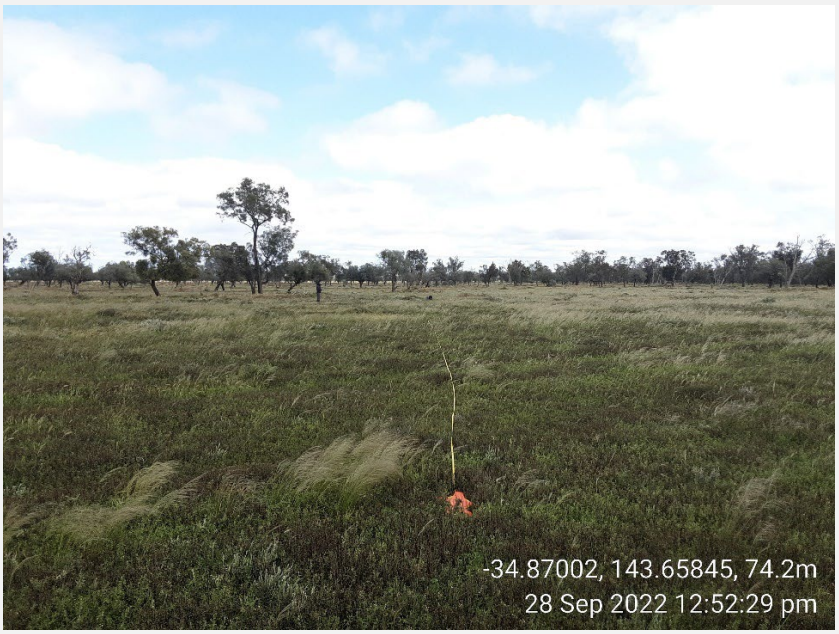
| PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion | |
|---|---|
| **Common name** | Belah/Black Oak - Western Rosewood - Wilga woodland |
| **Vegetation formation** | Semi-arid Woodlands (Shrubby sub-formation) |
| **Vegetation class** | Semi-arid Sand Plain Woodlands |
| **Extent within development corridor** | Moderate: 0.40 ha |
| **Condition** | This community is recorded in a moderate condition state. |
| **Description** | PCT 57 within the development corridor occurs as low to mid-high woodland or open woodland dominated by Western Rosewood *Alectryon oleifolius* subsp. *canescens* (this PCT can also include Belah *Casuarina cristata,* Black Oak *Casuarina pauper* and Wilga *Geijera parviflora,* Leafless Cherry *Exocarpos aphyllus* and Warrior Bush *Apophyllum anomalum*). Low shrub cover dominated by Bluebushes *Maireana* spp., Burrs *Sclerolaena* spp. and other chenopods. Occurring on texture contrast soils of brown to red-brown sandy loams sometimes overlying red to red-brown clays or on claypans of silty clay on the eastern and northern edges of the Hay Plain from near Lake Cowal in the east to Gunbar to Ivanhoe to Round Hill/Hillston mainly in the Riverina Bioregion on the south west plains of NSW with outliers on the lower slopes of the NSW South-western Slopes Bioregion. |
| **Survey effort** | One BAM plot was collected over the course of the field assessment (Figure 9). |
| **Justification of PCT** | Belah/Black Oak - Western Rosewood - Wilga woodland within the subject land meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil - occurs on texture contrast soils of brown to red-brown sandy loams sometimes overlying red to red-brown clays or on claypans of silty clay.<br>• Dominant species – dominant cover of Western Rosewood, Bluebushes and Burrs. |

| PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion | |
|---|---|
| | The PCT differs from similar PCT 58 Black Oak – Western rosewood open woodland by a greater dominance of Western Rosewood and Wilga with less Black Oak, being denser shrub cover and a less open and grassy ground stratum. Additional to this, characteristic species of PCT 57, such as Wilga and Leafless Cherry occurred. |
| **TEC Status** | **NSW BC Act:** This community is associated with BC Act listed *Acacia loderi shrublands*. It does not meet the requirements for this TEC due to a lack of *Acacia loderi* as a dominant species; *A. loderi* was absent from PCT 57 within the BAM plot.<br>**Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act. |
| **Estimate of percent cleared value of PCT (BioNet)** | 43% (NSW DCCEEW 2024a). |
| **PCT 57 – Moderate condition** |  |

**Table 8 PCT 58 Black Oak – Western Rosewood open woodland**

| PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion | |
|---|---|
| **Common name** | Black Oak – Western Rosewood open woodland |
| **Vegetation formation** | Semi-arid Woodlands (shrubby sub-formation) |
| **Vegetation class** | Semi-arid Sand Plain Woodlands |
| **Extent within development corridor** | High – 3.34 ha<br>Moderate – 73.28 ha<br>DNG – 97.72 ha<br>Paddock Trees – 0.32 ha (as previous, see Appendix 7) |
| **Condition** | This community occurs as derived native grassland (DNG) (due to past clearing), in low, moderate and high condition states. Areas of lower condition were more dominated by weed species compared to areas of higher condition. DNG examples were mostly cleared of their tree cover. |

| PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion | |
|---|---|
| **Description** | PCT 58 within the development corridor occurs as low open woodland or isolated stands of trees dominated by Black Oak *Casuarina pauper* and Western Rosewood *Alectryon oleifolius* subsp. *canescens* with either a shrubby or grassy understorey. These two tree species often form pure or mixed stands. Other low trees include *Pittosporum angustifolium*. The shrub layer is sparse or very sparse. It includes species such as *Senna artemisioides* subsp. *filifolia*, *Enchylaena tomentosa*, *Maireana decalvans*, *Exocarpos aphyllus, Rhagodia spinescens* and *Nitraria billardierei*. The ground cover is generally very sparse and includes low shrubs such as *Sclerolaena diacantha, Dissocarpus paradoxus, Sclerolaena obliquicuspis, Salsola tragus* subsp. *tragus and Atriplex eardleyae.* Spear grass (*Austrostipa nitida, Austrostipa scabra, Austrostipa eremophila* and *Austrostipa nodosa)* are common along with a range of forbs such as *Zygophyllum apiculatum, Tetragonia moorei, Rhodanthe corymbiflora, Brachyscome lineariloba* and *Atriplex lindleyi.* A grassy ground cover exists in some areas that have been partially cleared and are of heavier soils. Occurring on level to undulating sandplains, sandy rises and interdune swales composed of calcareous earths (pH >7) of red to red-brown loam, sand and texture contrast soils. Widely distributed in far south-western NSW mainly in the Murray Darling Depression Bioregion, generally subject to less than 400 mm of annual rainfall. Although there appears to be consistent presence of associate species across large distances, significant variation occurs in the community. It grades into Black Oak/Belah communities in the east (ID57) and Black Oak – Western Rosewood communities in the north (ID59 and 60) where Leopardwood, Mulga and other wattles become more common. The main threats to this community are clearing for opportunistic cropping and overgrazing that prevents the regeneration of key woody species. |
| **Survey effort** | Twenty-one BAM plots (nine DNG, two paddock trees, eight moderate and two high condition) were collected over the course of the field assessment (Figure 9). |
| **Justification of PCT** | Black Oak – Western Rosewood open woodland within the subject land meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil - occurs on red to red-brown loam, sand and texture contrast soils.<br>• Landform – occurs on level to undulating sandplains, sandy rises and interdune swales.<br>• Dominant species – low open cover of Western Rosewood, Black Oak with either a shrubby or grassy understorey.<br>The PCT differs from similar PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland by being sparser in shrub cover and subsequently higher in grass cover, and more open. |
| **TEC Status** | **NSW BC Act:** This community is associated with BC Act listed *Acacia loderi shrublands* and *Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions*. It does not meet the requirements for these TEC's due to not containing *Acacia loderi* as a dominant species (*A. loderi* was absent from all PCT 58 plots) and *Acacia melvillei* was not a dominant tree/shrub within this PCT, although being present in other areas (see PCT 23).<br>**Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act. |
| **Estimate of percent cleared value of PCT (BioNet)** | 50% (NSW DCCEEW 2024a). |

| PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion | |
|---|---|
| **PCT 58 – DNG condition** |  |
| **PCT 58 – Low condition** |  |
| **PCT 58 – Moderate condition** |  |

| PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion | |
|---|---|
| **PCT 58 – High condition** |  |

**Table 9 PCT 163 Dillon Bush (Nitre Bush) shrubland**

| PCT 163 Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones | |
|---|---|
| **Common name** | Dillon Bush (Nitre Bush) shrubland |
| **Vegetation formation** | Semi-arid Woodlands (Grassy sub-formation) |
| **Vegetation class** | Riverine Chenopod Shrublands |
| **Extent within development corridor** | Moderate: 24.85 ha |
| **Condition** | This community occurs in a moderate condition state. |
| **Description** | PCT 163 within the development corridor occurs as low to mid-high open to sparse shrubland dominated by Dillon Bush *Nitraria billardierei*. The ground cover may be sparse or dense depending on the season. It includes low shrubs such as *Sclerolaena diacantha, Sclerolaena muricata, Enchylaena tomentosa, Dissocarpus paradoxus, Atriplex leptocarpa* and *Rhagodia spinescens.* Grasses may dominate a site and they include *Austrostipa nitida, Rytidosperma setaceum and Enteropogon acicularis*. A high proportion of the ground cover may be composed of weed species including *Hordeum* spp., *Medicago minima, Carrichtera annua* and *Bromus* spp. Occurs light grey to brown clay and loam soils that may be saline on alluvial plains and dry lake beds mainly in the Riverina Bioregion in the semi-arid (warm) zone. Dillon Bush shrubland occurs in heavily disturbed sites and is probably a derived community possibly from previous Bladder Saltbush (ID157) and Old Man Saltbush shrubland communities that were heavily modified by heavy grazing by domestic stock and rabbits. Dillon Bush shrubland also occurs on lands that have been cropped in the past. This community is commonly found adjacent to River Red Gum and Black Box woodlands or dry lake beds such as the Willandra Lakes but also in gypsum dune fields where flooding occurs. Scalding and soil erosion is commonplace as are rabbit warrens. This community has increased since European settlement. Unless an area contains a significant species requiring protection, the community is not a priority for conservation. |
| **Survey effort** | Six BAM plots were collected over the course of the field assessment. (Figure 9) |

| PCT 163 Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones | |
|---|---|
| **Justification of PCT** | Dillon Bush (Nitre Bush) shrubland within the subject land meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil - occurs light grey to brown clay and loam soils.<br>• Dominant species – dominant cover of Dillon Bush and native grasses.<br>The PCT differs from similar PCT 160 Nitre Goosefoot shrubland wetland due to less frequent inundation, occurrence on lighter soils and not being dominated by Nitre Goosefoot *Chenopodium nitrariaceum*. The PCT differs from similar PCT 164 Cotton Bush open shrubland by being dominated by Dillon Bush and not Cotton Bush *Maireana aphylla* and containing a different floristic assemblage. |
| **TEC Status** | **NSW BC Act:** This community is associated with BC Act listed *Artesian Springs Ecological Community in the Great Artesian Basin.* It does not meet the requirements for this TEC due to being geographically distant from the known TEC location, having no association with natural springs/discharge areas and observed dominant species (i.e., Dillon Bush, *Austrostipa nitida, Rytidosperma setaceum* and *Enteropogon acicularis*).<br>**Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act. |
| **Estimate of percent cleared value of PCT (BioNet)** | 26% (NSW DCCEEW 2024a). |
| **PCT 16 – Moderate condition** |  |

**Table 10 PCT 170 Chenopod sandplain mallee woodland/shrubland**

| PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones | |
|---|---|
| **Common name** | Chenopod sandplain mallee |
| **Vegetation formation** | Semi-arid Woodlands (Shrubby sub-formation) |
| **Vegetation class** | Sand Plain Mallee Woodlands |
| **Extent within development corridor** | Moderate – 13.87 ha<br>Low - 4.08 ha |

| PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones | |
|---|---|
| | DNG – 22.58 ha<br>Paddock Trees – 0.03 ha |
| **Condition** | This community occurs as derived native grassland (DNG) (due to past clearing) in low and moderate condition states. Areas of low condition were generally smaller patches surrounded by cultivated land therefore being more susceptible to weed invasion and the impacts of regular stubble burning compared to larger areas of moderate condition. |
| **Description** | Mallee woodland or open mallee shrubland usually about 8 m tall dominated by several mallee species including White Mallee *Eucalyptus dumosa*, Red Mallee *Eucalyptus socialis* and Snap and Rattle *Eucalyptus gracilis*. The mallee species occur in different proportions across the distributional range. The structure can either be bull mallee woodland or whipstick mallee shrubland depending on time since the last fire, other disturbance, or the clay content of the soil. Chenopods shrubs form a major component of the understorey compared to mallee on sandy dunes (IDs 171, 172) or the mallee communities of the slightly wetter areas in the east (IDs 173-175). Common shrubs include *Chenopodium curvispicatum, Enchylaena tomentosa, Atriplex eardleyae, Dissocarpus paradoxus, Chenopodium desertorum* subsp. *desertorum, Maireana decalvans, Sclerolaena obliquicuspis*, and *Rhagodia spinescens*. Forbs include *Zygophyllum crenatum, Zygophyllum iodocarpum, Ptilotus nobilis, Tetragonia moorei* and *Vittadinia cuneata.* Grasses include *Austrostipa* spp., *Enteropogon* spp. and *Rytidosperma* spp. A cryptogam soil crust composed of algae and lichens is commonly present in areas that are protected from being trampled by livestock. The floristic composition of the ground flora varies markedly from season to season, with changes in grazing regimes and after fire. Pearl Bluebush *Maireana sedifolia* understorey is more common in the Scotia region where more limey soils occur. Heavily grazed areas contain fewer species and a simpler structure. In areas unburnt for decades large bull mallee trees may feature with large amounts of leaf litter on the ground. This community occurs on calcareous red-brown, sandy-loam or loamy clay soils, sometimes containing limestone nodules, on eolian sandplains or in inter-dune plains or swales. The largest occurrences of this community are north-west of Balranald forming a transition between the dune mallee and the Riverine Plain, south and east of Mungo National Park, north of Mildura on the Darling River plain and in the Scotia Mallee, and south-east of Menindee. It is mainly restricted to the Murray-Darling Depression Bioregion of NSW with small outliers to the north. Extends into Victoria and South Australia. Tends to occur in regions receiving less than 300 mm of annual rainfall. Significant areas have been cleared for grazing or cropping but large areas remain uncleared. Most areas outside reserves are grazed by stock and trampling of soils leads to soil erosion. Fire and is a key disturbance factor in mallee and it may be subject to wildfire every 2-3 decades but it is burnt by landholders more often in some locations. |
| **Survey effort** | Twelve BAM plots (five DNG, two low, and five moderate condition) were collected over the course of the field assessment. (Figure 9). |
| **Justification of PCT** | Chenopod sandplain mallee woodland/shrubland within the subject land meets the PCT description (DPE 2023c) via the following:<br>• IBRA region and subregion – Riverina region and Murrumbidgee subregion.<br>• Soil - occurs on calcareous red-brown, sandy-loam or loamy clay soils.<br>• Landform – occurs on eolian sandplains or in inter-dune plains or swales.<br>• Dominant species – mallee formation with an overstorey of Red Mallee, Glossy-leaved Red Mallee and Snap and Rattle, shrub layer of chenopods and grasses including shrub layer of chenopods and grasses.<br>The PCT differs from similar PCT 172 Deep Sand mallee by being more woodland and less shrubland in structure, and lacking key species such as Ridge-fruited Mallee *Eucalyptus costata* and Mallee Pine *Callitris verrucosa*. |

| PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones | |
|---|---|
| **TEC Status** | **NSW BC Act:** This community is associated with BC Act listed *Acacia loderi* shrublands and *Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions. It does not meet the requirements for these TEC's due to not containing *Acacia loderi* or *Acacia melvillei* as a species or dominant species.<br>**Commonwealth EPBC Act:** This community does not form part of the EPBC Act listed *Plains mallee box woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions* within the subject land. |
| **Estimate of percent cleared value of PCT (BioNet)** | 41% (NSW DCCEEW 2024a). |
| **PCT 170 – DNG condition** |  |
| **PCT 170 – Low condition** |  |

| PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones | |
|---|---|
| **PCT 170 – Moderate condition** |  |

## Justification of derived grassland condition states

The state vegetation mapping for the subject land identified large areas as natural or historically-derived grassland communities, namely, *PCT 46 Curly Windmill Grass – Speargrass – wallaby grass grassland on alluvial clay loam on the Hay Plain and Riverina Bioregion*. A thorough assessment against the PCT 46 profile, the BAM plot floristic data, historical aerial imagery, landscape, geology and soil features was undertaken to determine the likely presence of natural grasslands in the local area and subject land. It was determined these grassland areas would be more appropriately classified as derived condition states of woodland, mallee or chenopod shrubland PCTs rather than natural grasslands.

A key finding of this assessment determined extensive natural grasslands were unlikely to be present in this region and the subject land. The grasslands modelled to occur here by the SVTM and observed in the field are likely to be an artefact of land clearing for pasture development and agriculture. This conclusion considers the following factors.

### Geography

In south-east Australia, natural grasslands occur in transitional zones between forests of higher rainfall in closer proximity to the Great Dividing Range and the shrublands and hummock grasslands of the drier, western interior (Williams, Marshall, & Morgan 2015).

Within southern NSW and parts of western NSW, natural grasslands occur within temperate and semi-arid climatic zones. In places, these grasslands form part of the EPBC Act listed *Natural Grasslands of the Murray Valley Plains* (TSSC 2012). These natural grasslands occur along the southern extent of the Riverina, with the northern boundary, mapped as occurring just north of Swan Hill, Conargo and Morundah, NSW (DoSEWPC 2012). Beyond this boundary, grassland areas are noted as occurring as derived communities from woodland and chenopod shrublands (TSSC 2012).

Biogeographic predictive occurrence mapping of native grasslands predict natural (and current) extents to the north-east of Deniliquin (100 kilometres east of the subject land) and to the south of Kerang (100

kilometres south of the subject land), but not within or closely surrounding the subject land (Williams, Marshall, & Morgan 2015, Benson 1992). The PCT 46 geographic distribution also describes occurrence on the western Riverine Plain near Hay and north-east of Deniliquin, but not within or closely surrounding the subject land near Balranald.

**Soils**

PCT 46 occurs on medium brown to grey clays and loams on level alluvial plains on the Western Riverine Plain (Hay Plain) near Hay and north-east of Deniliquin (DPE 2023c). Soil types near Hay, north-east of Deniliquin and within the area indicated for grasslands of western NSW are mapped predominantly as 'poorly consolidated clay, silt, sand and gravel', 'recent mud, silt, sand and gravel deposited by river (alluvial) systems' (Department of Regional New South Wales 2023). Soil types present within the subject land are not consistent with the soil types associated with PCT 46 or natural grasslands of western NSW. Within the subject land soils tend to vary from aeolian sandy soils with grey clay loam dominated soils between areas of undulating sandhill and sandplain woodlands. The majority of the subject land is identified as containing 'poorly consolidated red-brown sands dunes' (Department of Regional New South Wales 2023).

**Surrounding vegetation and community composition**

Vegetation surrounding grassland areas within the subject land consists of woodland dominated by trees such as Black Box, mallee eucalypts, Slender Cypress Pine, Black Oak and Western Rosewood. Much of the grassland condition zones within the subject land contain the same soil and topographic structure to the adjacent woodland communities. This adds weighting towards the conclusion that grassland areas within the subject land are a product of historical clearing/grazing and are not a naturally occurring grassland community. Scattered paddock trees throughout the subject land, including in historical imagery pre-1990 (NSW Spatial Services 2024) also add weight for the past natural woodland state of the area and current derived state.

Current floristic composition of derived grasslands within the subject land are not consistent with PCT 46. PCT 46 comprises high cover of Curly Windmill Grass *Enteropogon ramosus*, and Wallaby Grasses *Rytidosperma caespitosum* and *Rytidosperma setaceum,* with the floristic structure and composition of the areas mapped as DNG being more consistent with the adjacent woodland communities. Field surveys undertaken within grassland areas of the subject land found generally a low (occasionally higher) cover of similar *Enteropogon acicularis,* and high occurrence and diversity of shrub species not characteristic to PCT 46, such as *Enchylaena tomentosa, Rhagodia spinescens, Sclerolaena diacantha* and *Salsola tragus*. All of which are characteristic of the associated wooded PCTs. Areas mapped as PCT 58 DNG also recorded a low cover of trees species characteristic to that PCT. Wallaby Grasses characteristic to PCT 46 were recorded in the majority of DNG condition plots, however the species are common across the entire subject land and were recorded in 30 of the 68 total plots completed. Spear grasses *Austrostipa* spp. recorded were more commonly those characteristic of the wooded PCTs than of PCT 46. Two plots mapped as PCT 170 in DNG condition (B_52 and B_56) recorded more species characteristic to PCT 46 than to PCT 170, however those plots occur in areas that are surrounded by areas of PCT 170, generally in a degraded state, and do not represent a different grassland PCT. Both plots also recorded a high cover, abundance and diversity of shrub species that are not characteristic of PCT 46, and are more representative of historical (and potentially ongoing) disturbance.

As PCT 46 is not considered to occur within the subject land or the broader locality, areas mapped by the SVTM as PCT 46 have been considered 'Unconfirmed grassland' PCTs where they occur within the assessment area but outside the subject land. This is considered more suitable that applying a nominal PCT for areas which have not been ground-truthed, and still allows for consideration of threatened species that may utilise derived grassland habitats with regards to assessment of indirect impacts.

### 3.2.4. Threatened ecological communities

Vegetation within the subject land was found to represent two TECs listed under the NSW BC Act. No TECs listed under the EPBC Act were determined to occur within the subject land. TECs are as outlined below, in Table 11 and illustrated on Figure 7.

**Table 11 Summary of BC Act TECs within the subject land**

| BC Act TEC | Listing status | Development footprint (Ha) |
|---|---|---|
| ***Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions** | Endangered | • 2.03 ha<br>• Plus an additional 5 scattered paddock trees (not part of vegetation zone) |
| **Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions** | Endangered | • 1.17 ha<br>• Plus an additional 14 scattered paddock trees (not part of vegetation zone) |

#### Acacia melvillei Shrubland

*Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions* (*Acacia melvillei* Shrubland) is an Endangered Ecological Community (EEC) listed under the BC Act. This community typically occurs on red-brown, sandy loam soils as scattered patches dominated by *Acacia melvillei* (DPE 2021a).

Within the subject land, PCT 23 – Yarran tall open shrubland of the sandplains is associated with *Acacia melvillei* Shrublands.

Characteristics of the *Acacia melvillei* Shrublands TEC include (DPE 2021a):

- Occurs in the Riverina and Murray-Darling Depression bioregions.
- Dominance of or historical (pre-clearing) dominance of *Acacia melvillei,* often forming pure stands of *Acacia melvillei*.
- Typically occurs as an open canopy of large shrubs to small trees (subject to disturbance history), however, disturbed remnants of this community may occur is isolated individual trees or shrubs.
- Community structure variable based on disturbance history and regime, with most remaining stands heavily degraded by overgrazing, resulting in simplification of community structure.

PCT 23 within the development corridor occurs as tall open shrubland dominated by Yarran *Acacia melvillei*. PCT 23 was determined to meet the above requirements in all areas where it occurred within the subject land. As noted in the Final Determination (DPE 2021a), isolated trees and shrubs attributed to PCT 23 form part of this TEC.

#### Sandhill Pine Woodland

*Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South-Western Slopes bioregion* (Sandhill Pine Woodland) is an EEC listed under the BC Act. The community profile for this TEC indicates the subject land is in an area where this TEC is predicted to occur (OEH 2018a).

In the Riverina bioregion and the far south-western portion of the NSW South Western Slopes bioregion, this community is typically associated with prior streams and aeolian source-bordering dunes, which are

scattered within an extensive alluvial clay plain dominated by chenopod shrublands. These soil and landscape types occur within the subject land (DPE 2021b).

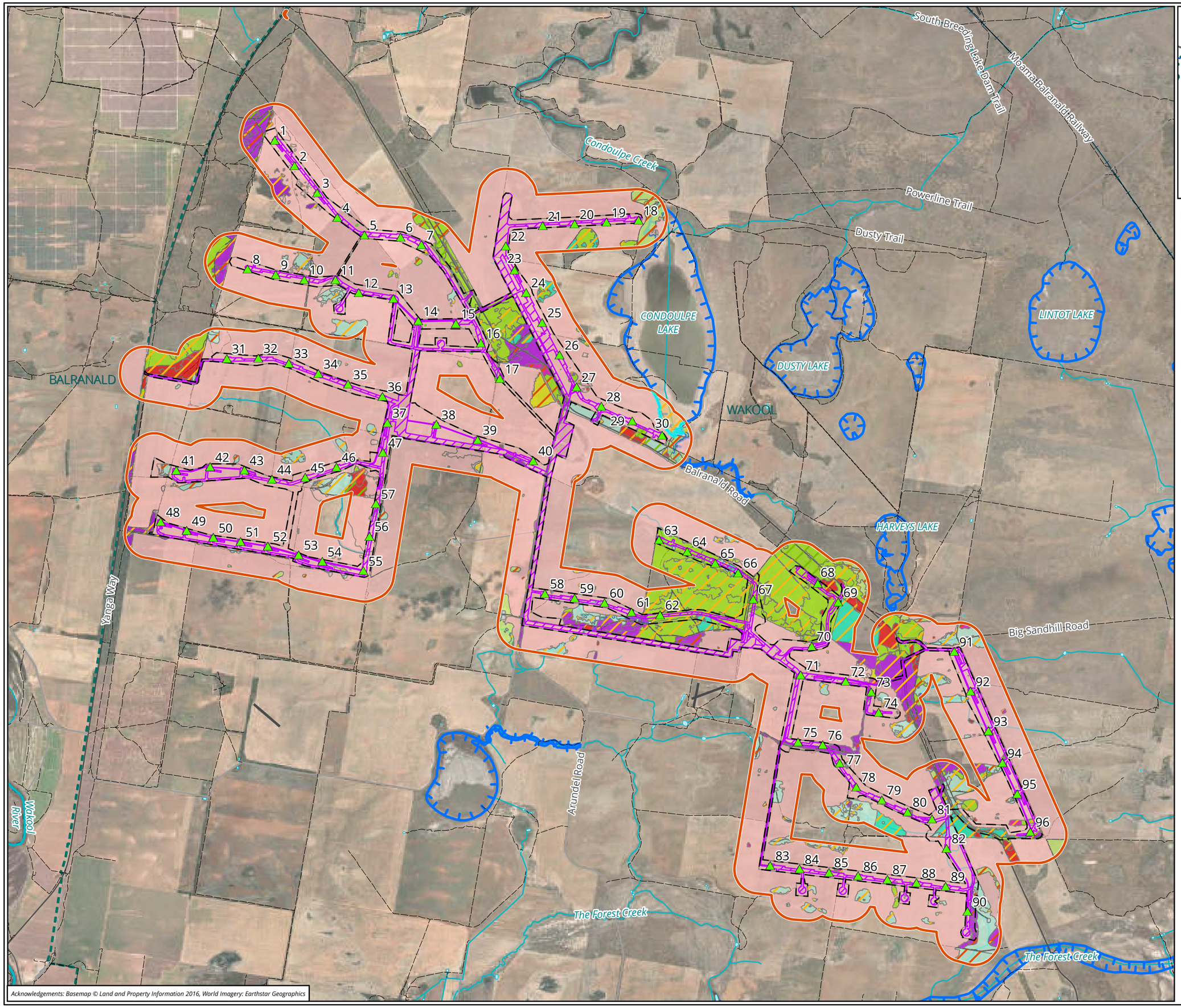
Within the subject land PCT 21 – Slender Cypress Pine - Sugarwood - Western Rosewood open is associated with Sandhill Pine Woodlands.

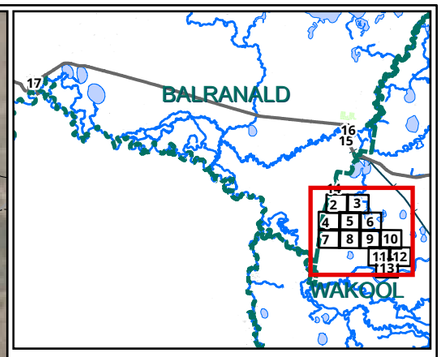
Characteristics of the Sandhill Pine TEC include (DPE 2021b):

- Occurs in the Riverina, Murray-Darling Depression and NSW South Western Slopes Bioregions.
- Dominance of or historical (pre-clearing) dominance of *Callitris glaucophylla,* including stands of *Acacia melvillei*, *Callitris gracilis* subsp. *murrayensis* and *Alectryon oleifolius.*
- Occurs as an open tree stratum (subject to variation from clearing and disturbance history).
- Can occur as remnant stands or small fragmented patches forming a disturbed mosaic.
- Community structure variable with grazed remnants typically occurring with a simplified community structure.

Although *Callitris glaucophylla* was not identified as a component of this PCT, PCT 21 occurs in a landscape where occurrences of this species have been removed for agricultural purposes, or in locations where *Callitris gracilis* subsp. *murrayensis* is the dominant native pine. Alongside this, this TEC can be formed with the characteristic species present within PCT 21.

As such, all areas of PCT 21 were determined to meet these characteristics. As a precautionary approach, isolated scattered trees identified as forming part of PCT 21 within the subject land were considered to form part of this community, where the Final Determination (DPE 2021b) notes the high level of disturbance this TEC has been subject to thorough agricultural clearing, leading to remnants forming a mosaic of small, fragmented patches.




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Cleared
- Canal-Drain
- Hydro area

**Condition**

- DNG
- High
- Low
- Moderate
- Paddock trees
- Planted natives

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 57
- 58
- 163
- 165
- 170
- 238
- Planted vegetation

**Figure 6.1 Vegetation within the subject land**

0 740 1,480 2,220 2,960

Meters

Scale: 1:72,000 @ A3

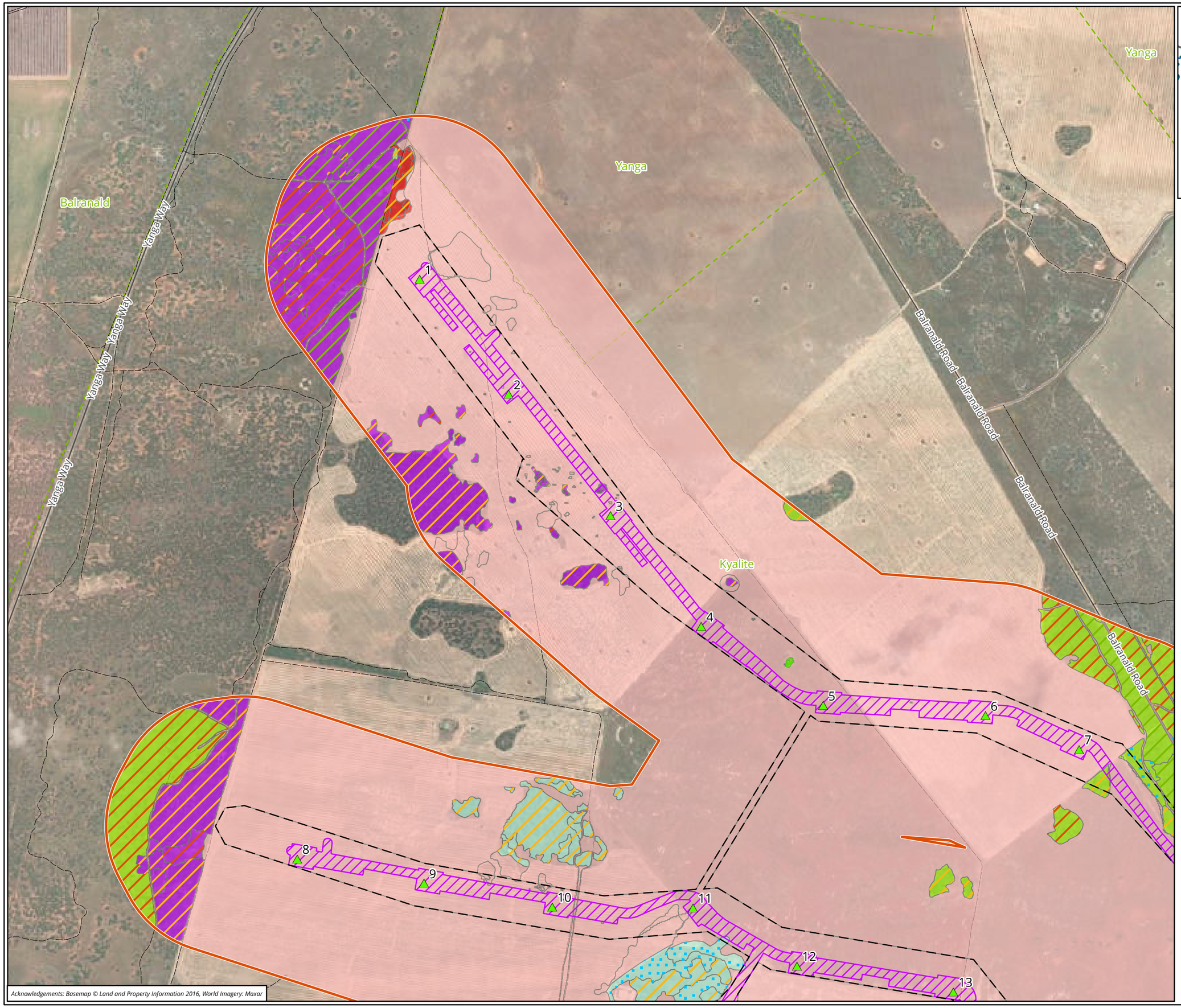
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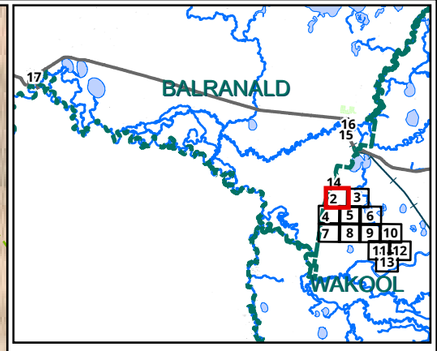
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## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Condition**

- DNG
- High
- Low
- Moderate
- Paddock trees

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 23
- 58
- 170

**Figure 6.2 Vegetation within the subject land**

0 170 340 510 680

Meters

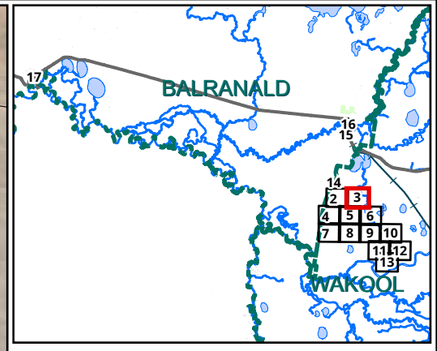
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## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain
- Hydro area

**Condition**

- DNG
- High
- Low
- Moderate

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 58
- 163
- 165



**Figure 6.3 Vegetation within the subject land**

0 170 340 510 680

Meters

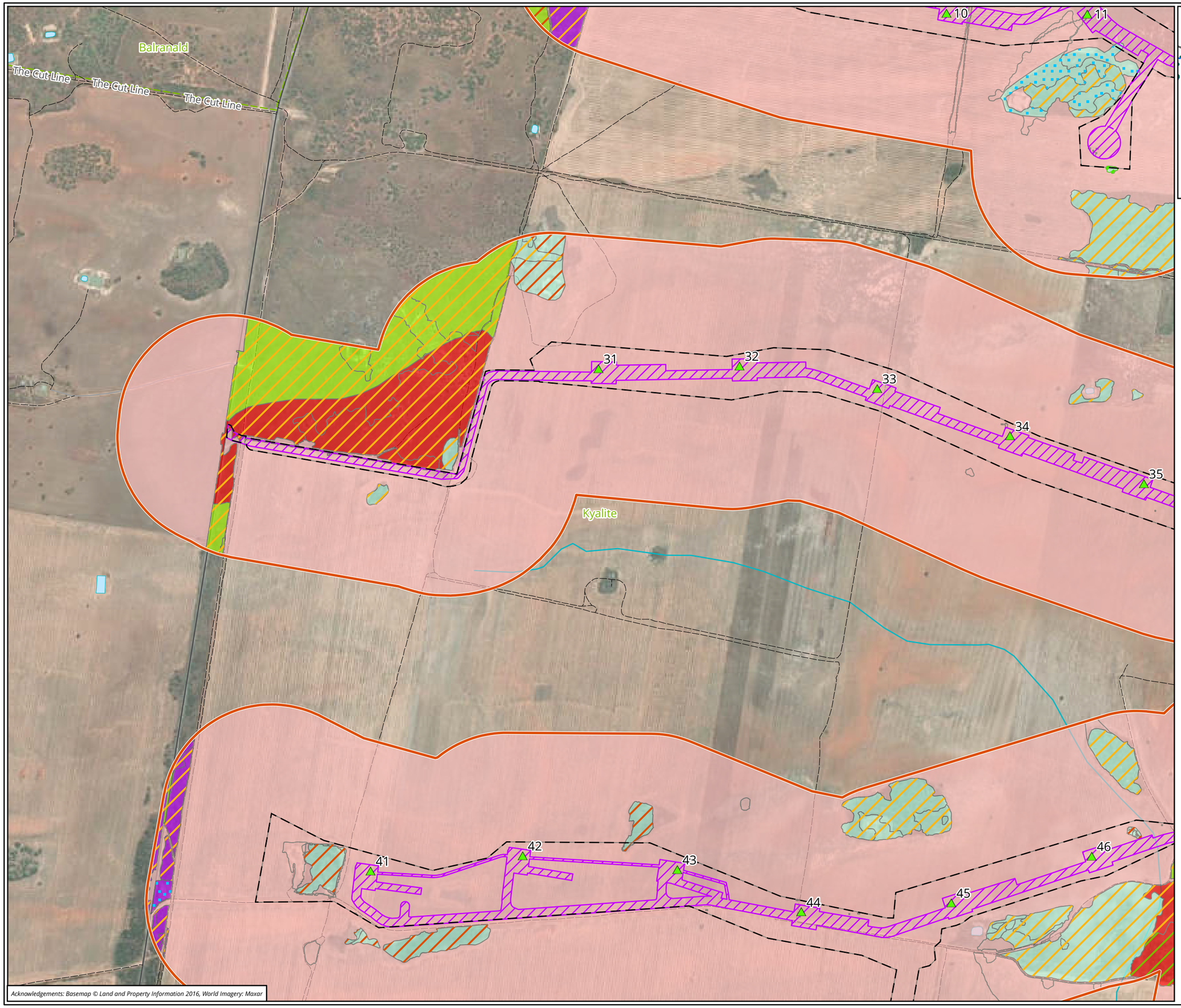
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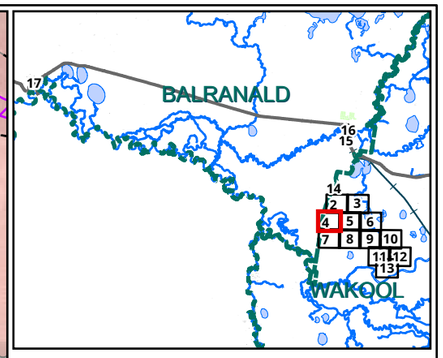
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain

**Condition**

- DNG
- High
- Low
- Moderate
- Paddock trees

**Plant community type**

- Exotic / Cropping / Disturbed
- 16
- 23
- 58
- 170

**Figure 6.4 Vegetation within the subject land**

0 170 340 510 680

Meters

Scale: 1:16,000 @ A3

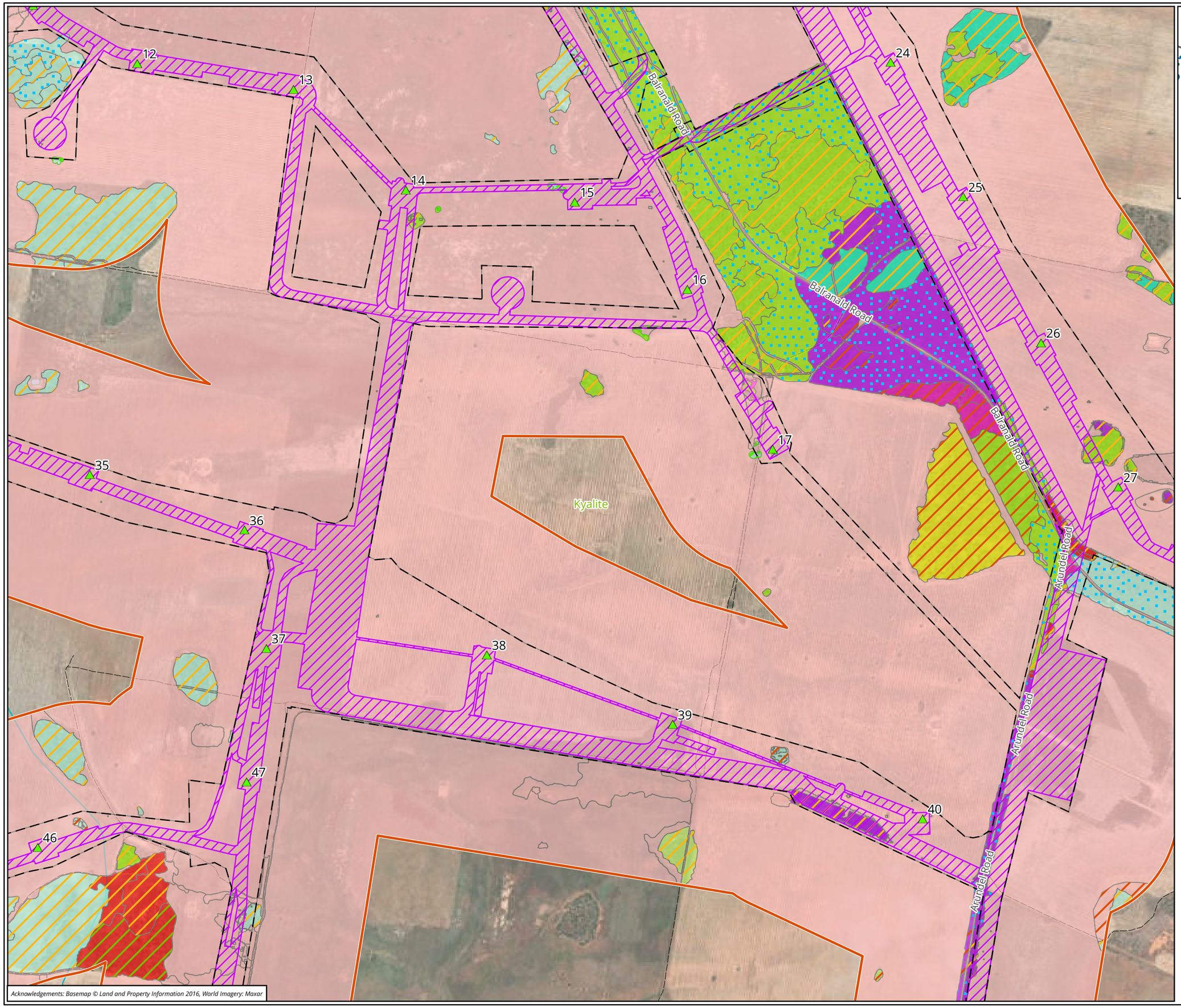
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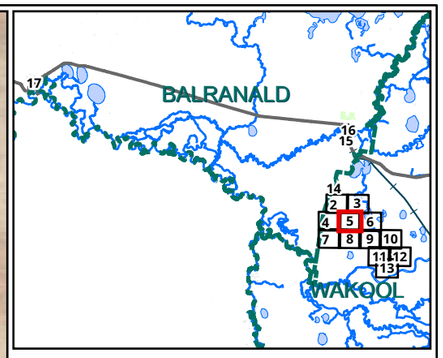
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain

**Condition**

- DNG
- High
- Low
- Moderate
- Paddock trees
- Planted natives

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 57
- 58
- 163
- 170
- Planted vegetation

**Figure 6.5 Vegetation within the subject land**

0 170 340 510 680

Meters

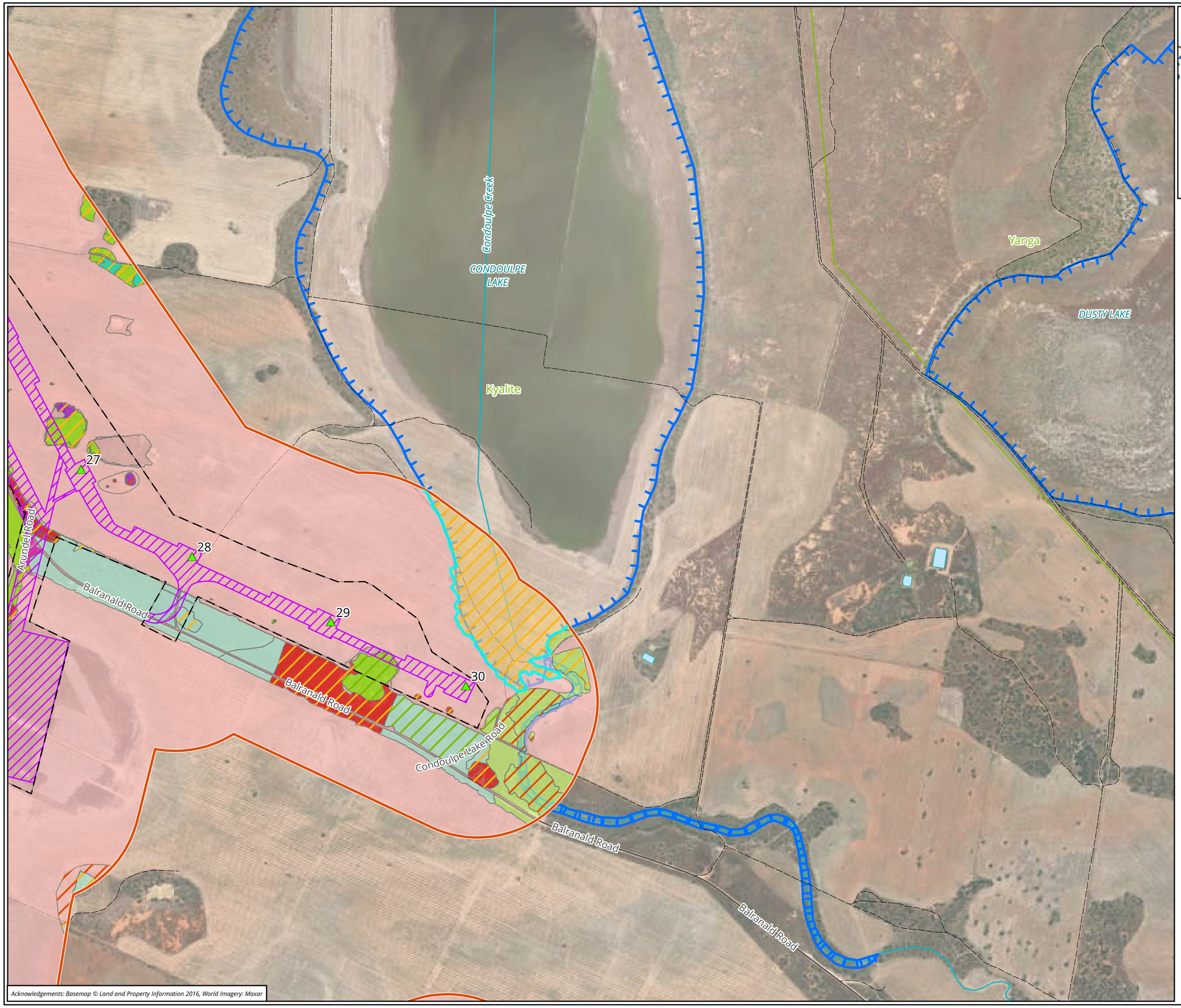
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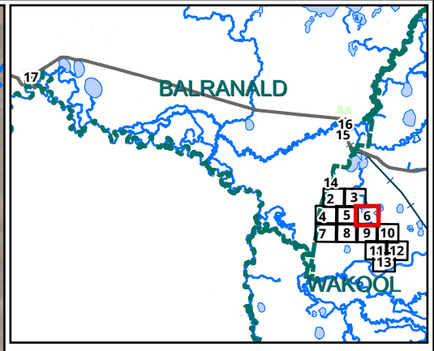
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain
- Hydro area

**Condition**

- DNG
- High
- Low
- Moderate
- Paddock trees

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 58
- 163
- 170
- 238

**Figure 6.6 Vegetation within the subject land**

0 170 340 510 680

Meters

Scale: 1:16,000 @ A3

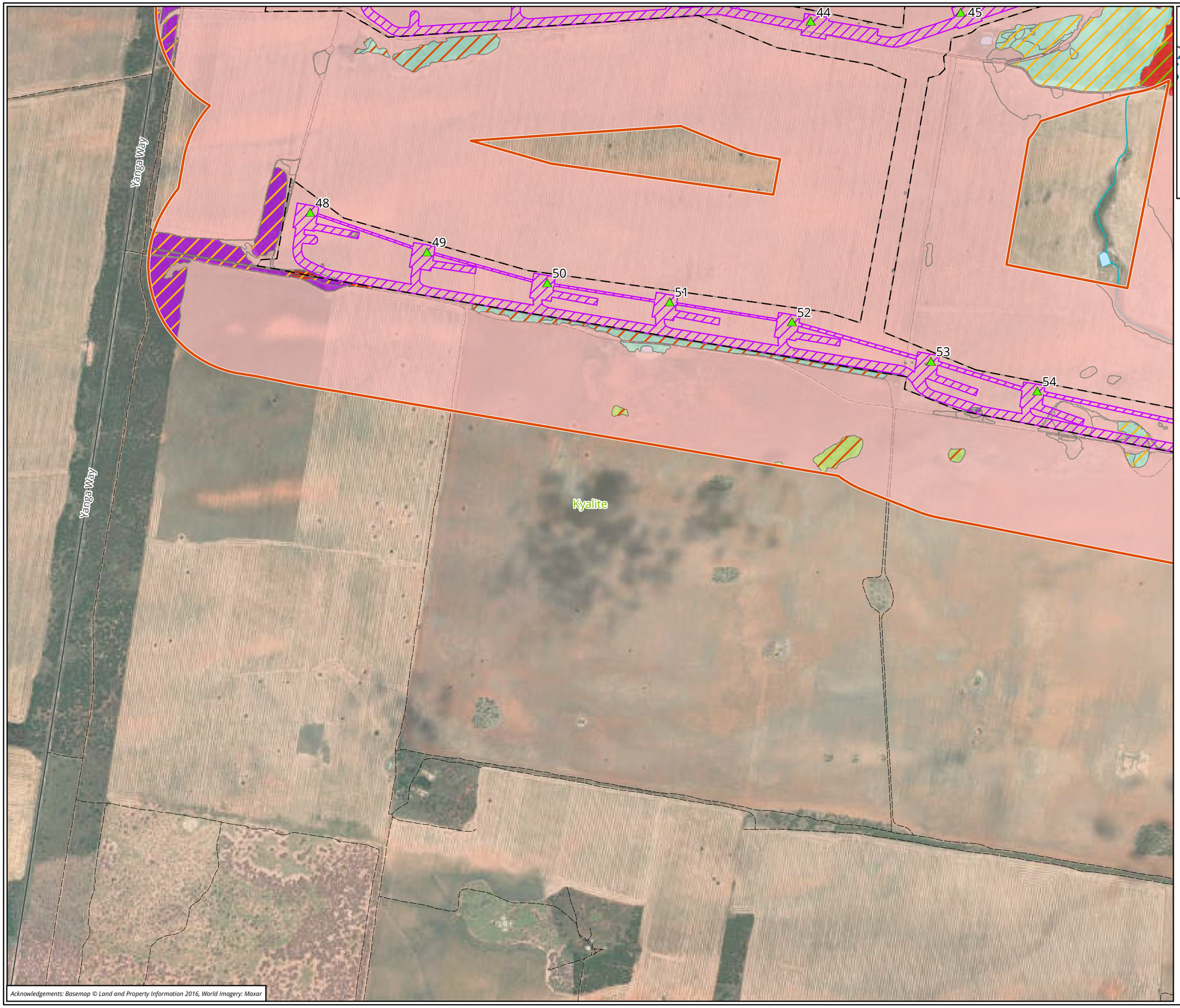
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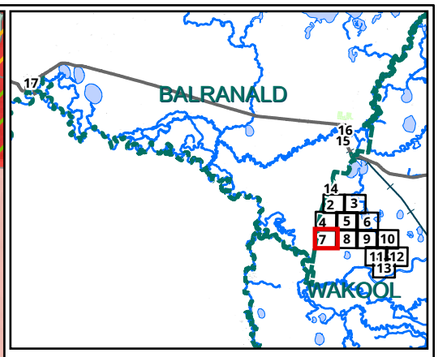
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain

**Condition**

- DNG
- High
- Low
- Moderate

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 23
- 170

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**Figure 6.7 Vegetation within the subject land**

0 170 340 510 680

Meters

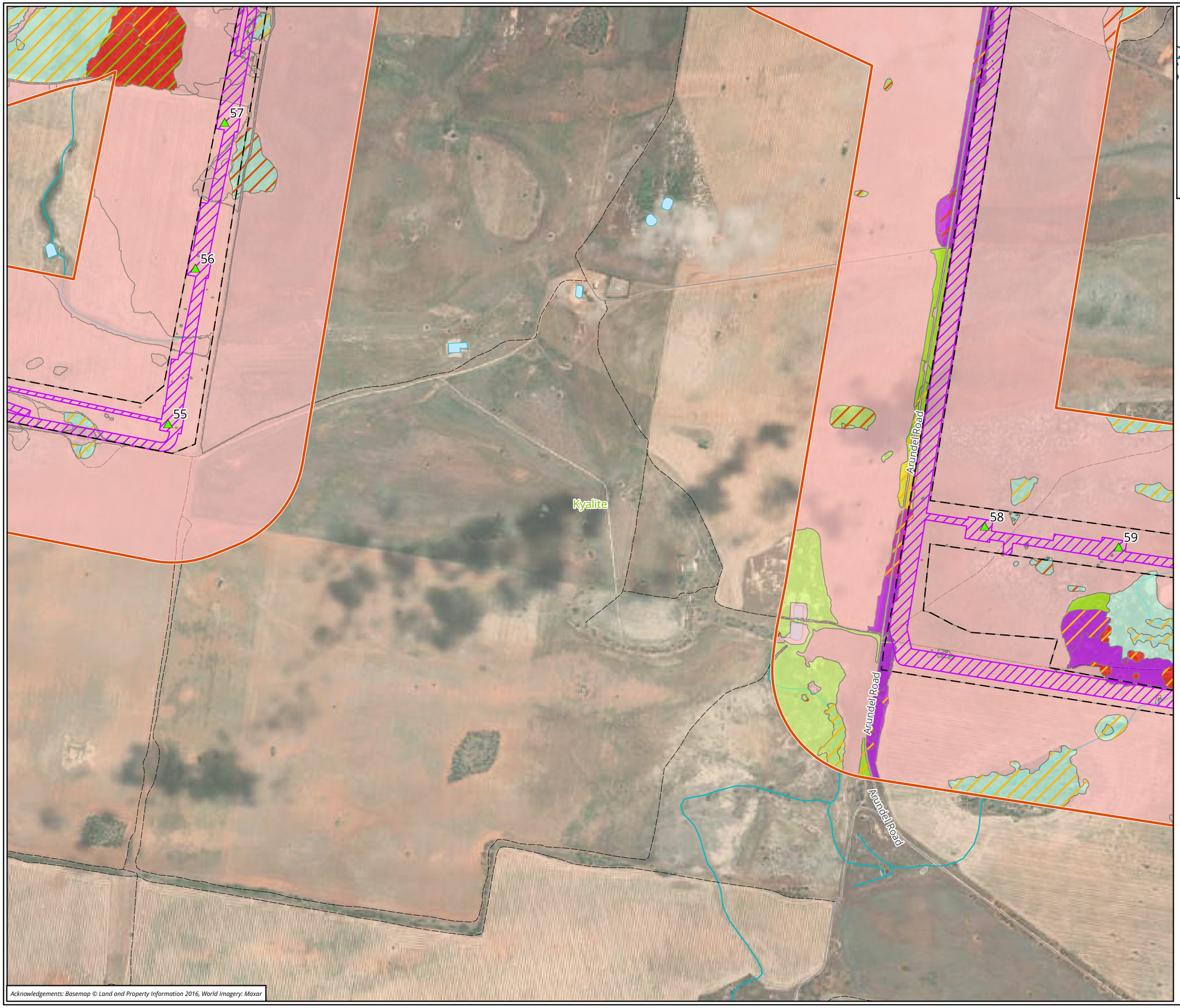
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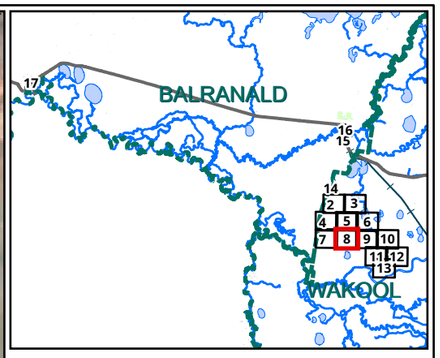
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain

**Condition**

- DNG
- High
- Low
- Moderate

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 57
- 58
- 170

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**Figure 6.8 Vegetation within the subject land**

0 170 340 510 680

Meters

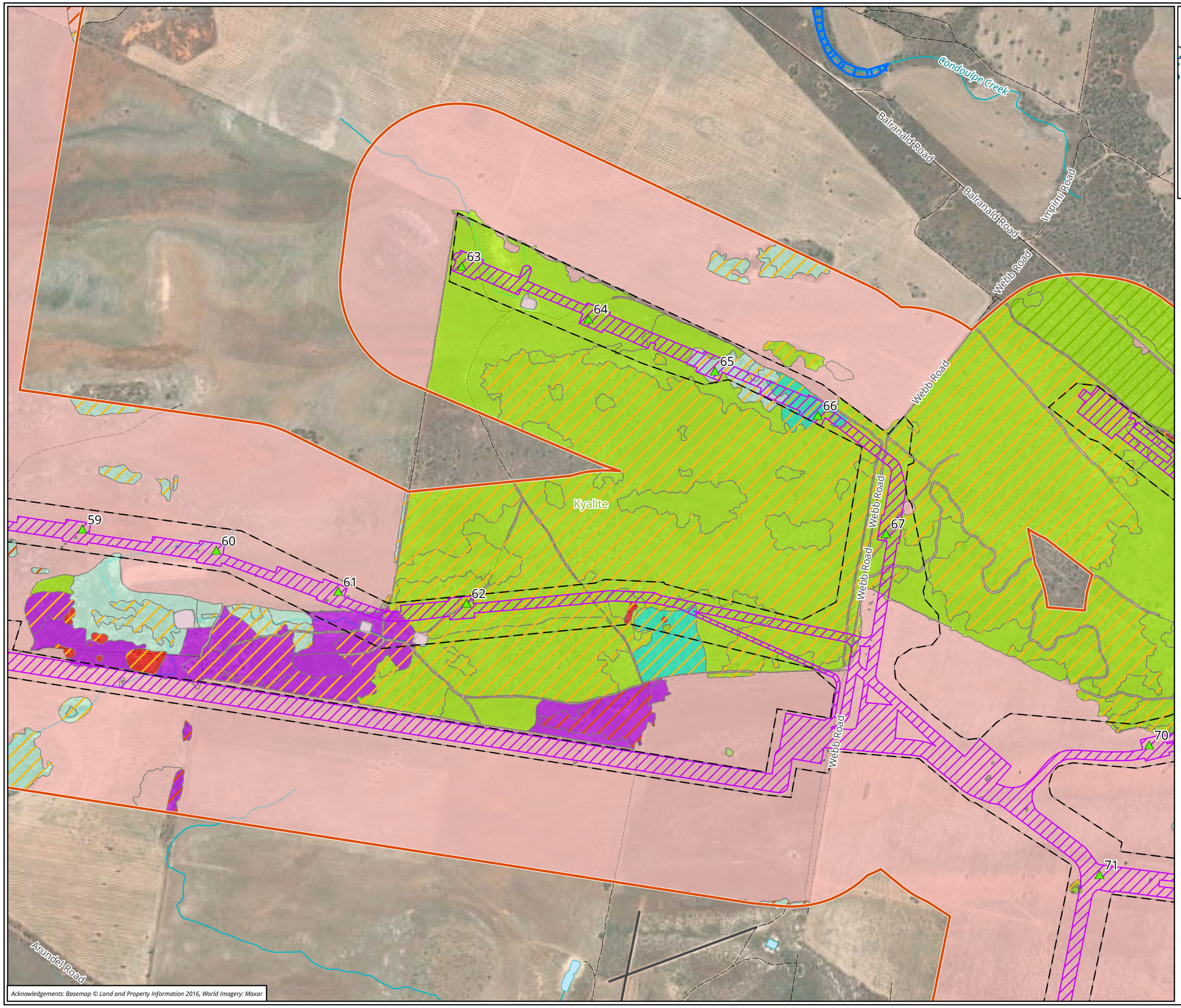
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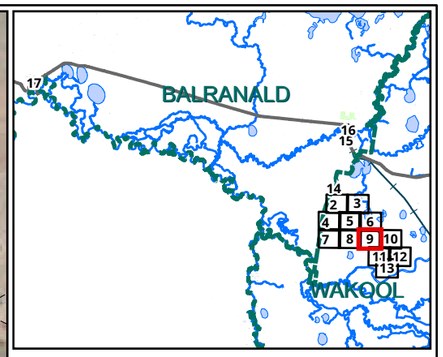
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain
- Hydro area

**Condition**

- DNG
- High
- Low
- Moderate

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 23
- 58
- 163
- 170

**Figure 6.9 Vegetation within the subject land**

0 170 340 510 680

Meters

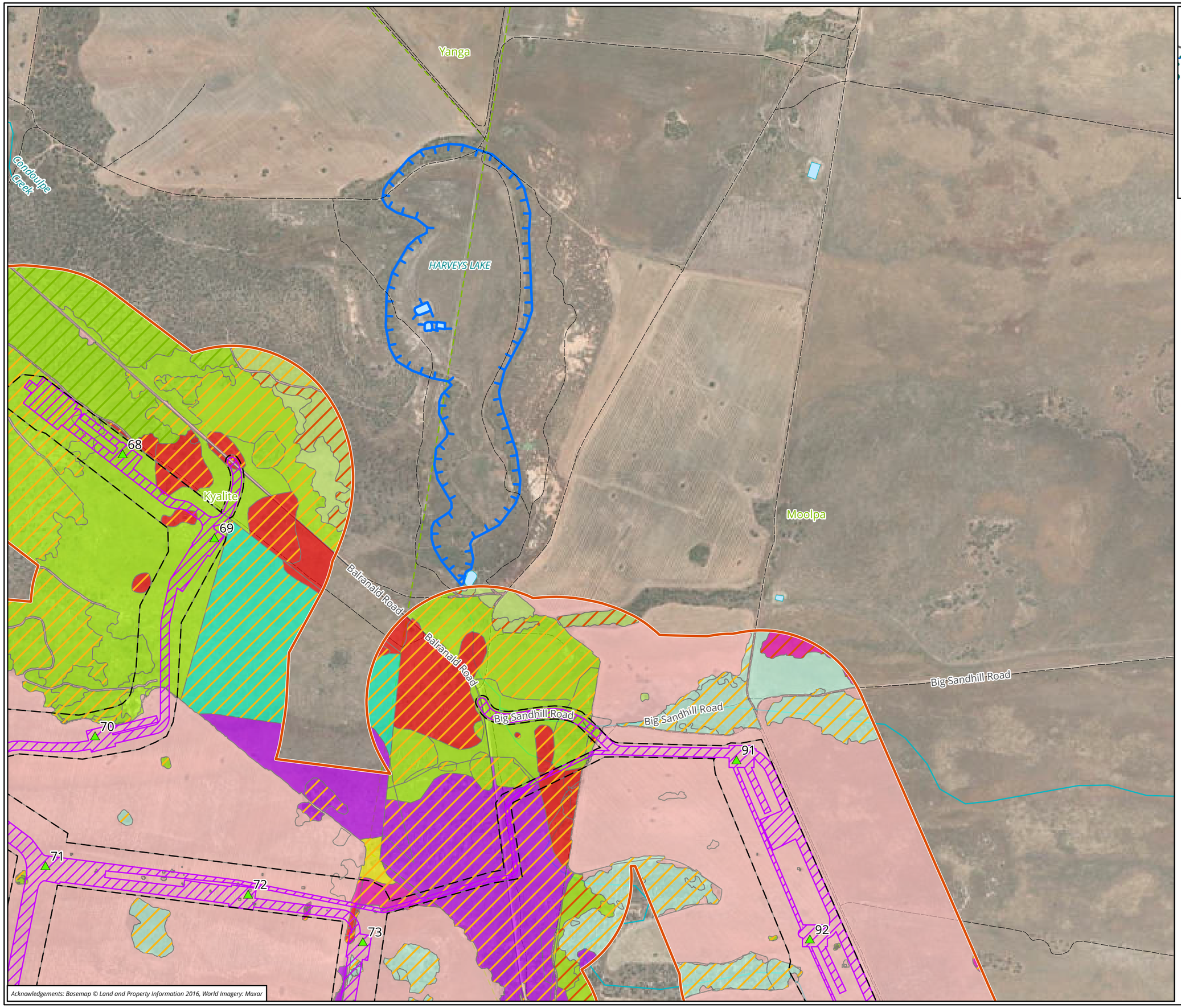
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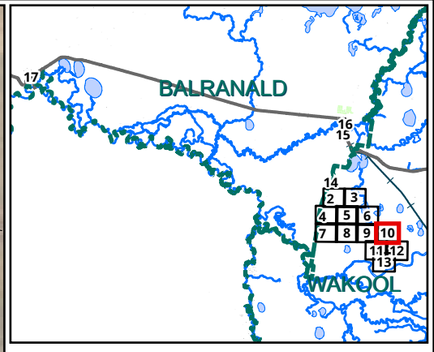
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain
- Hydro area

**Condition**

- DNG
- High
- Low
- Moderate

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 57
- 58
- 163
- 170

**Figure 6.10 Vegetation within the subject land**

0 170 340 510 680

Meters

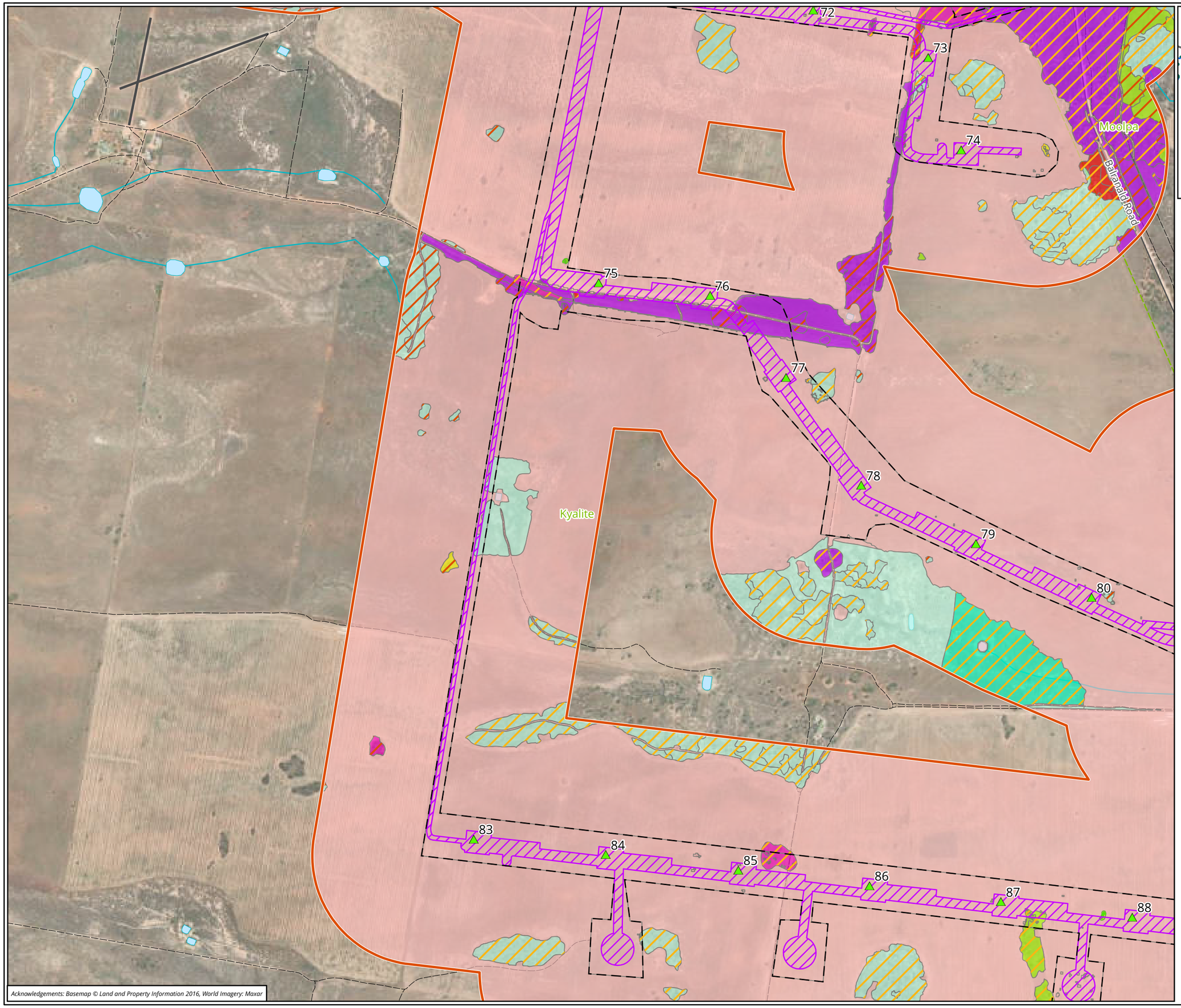
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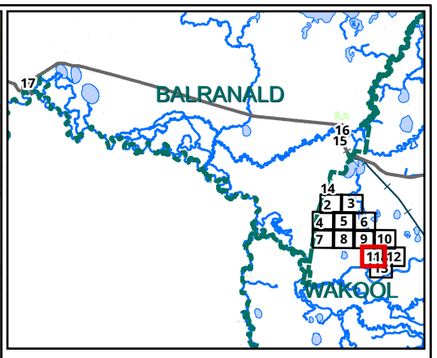
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain

**Condition**

- DNG
- Low
- Moderate
- Paddock trees

**Plant community type**

- Exotic / Cropping / Disturbed
- 16
- 21
- 23
- 57
- 58
- 163
- 170

**Figure 6.11 Vegetation within the subject land**

0 170 340 510 680

Meters

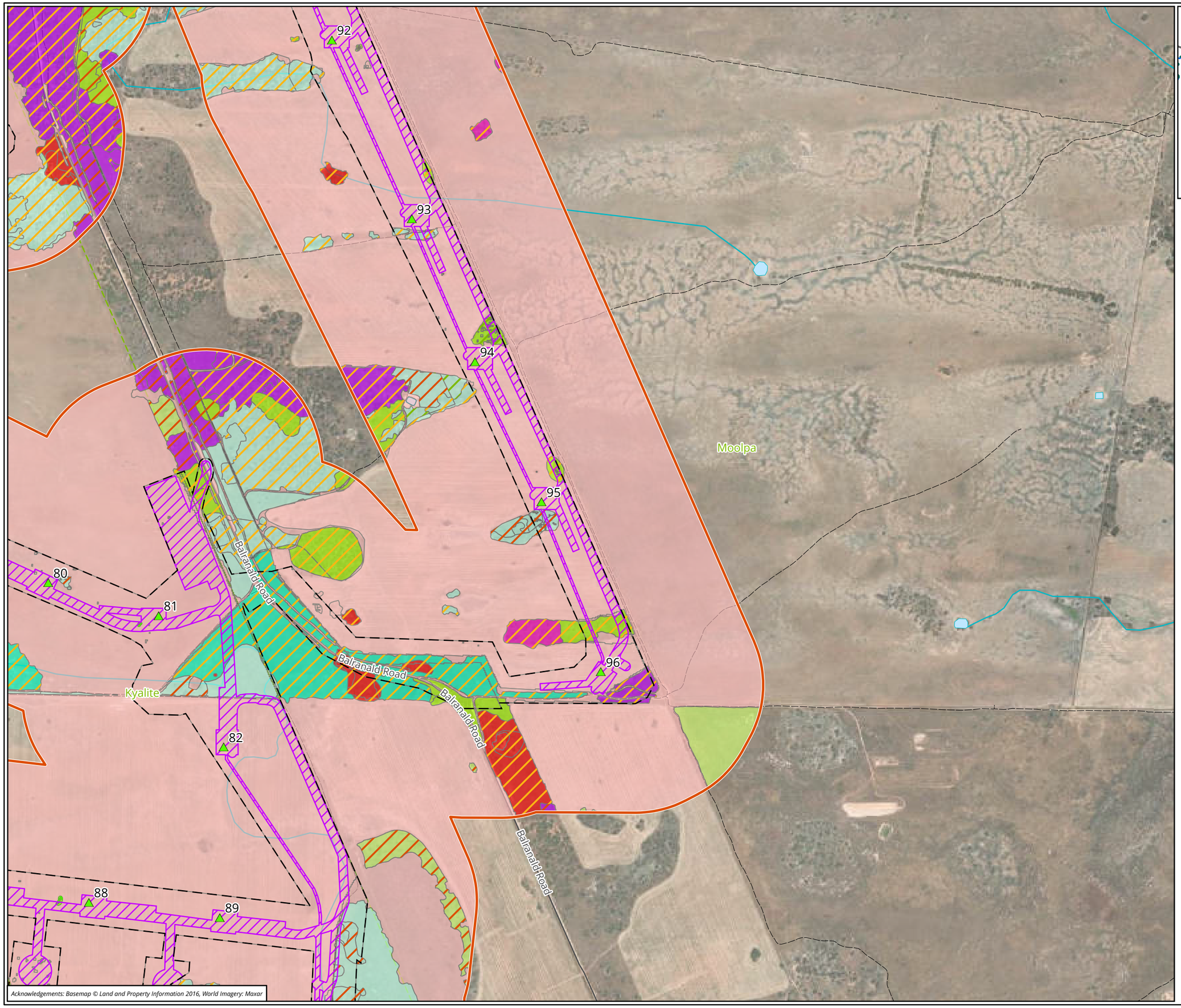
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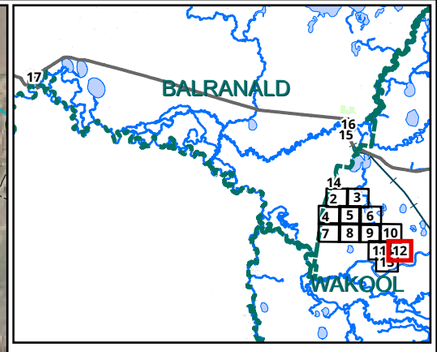
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain

**Condition**

- DNG
- High
- Low
- Moderate
- Paddock trees

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 58
- 163
- 170

**Figure 6.12 Vegetation within the subject land**

0 170 340 510 680

Meters

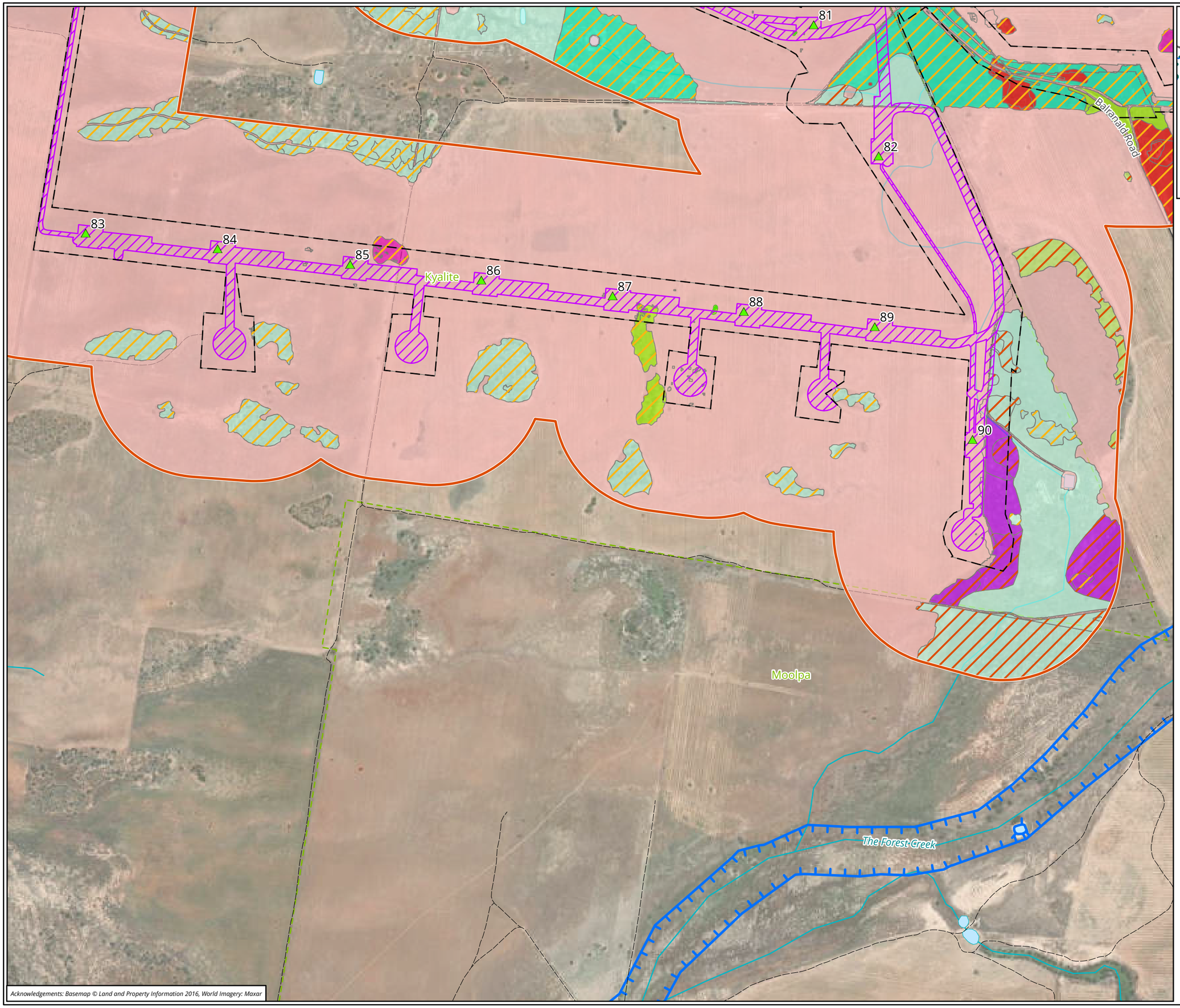
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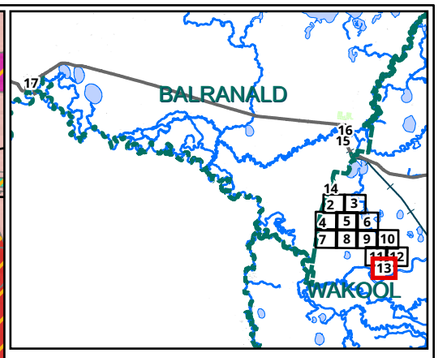
*Coordinate System:*
*GDA2020 MGA Zone 54*

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Matter: 37502, Date: 19 April 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Canal-Drain
- Hydro area

**Condition**

- DNG
- Low
- Moderate
- Paddock trees

**Plant community type**

- Exotic / Cropping / Disturbed
- 15
- 16
- 21
- 23
- 58
- 163
- 170

**Figure 6.13 Vegetation within the subject land**

0 170 340 510 680

Meters

Scale: 1:16,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

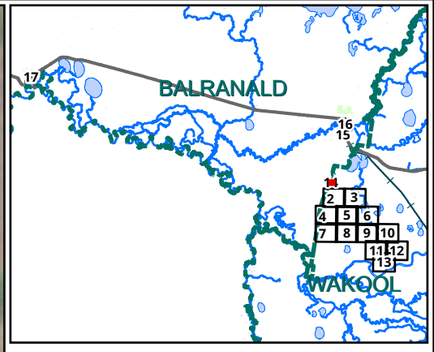
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biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg

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**Legend**

- Subject land
- Development footprint
- Wind turbine generators
- Cleared

**Condition**

- DNG
- Low

**Plant community type**

- Exotic / Cropping / Disturbed
- 170

**Figure 6.14 Vegetation within the subject land**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

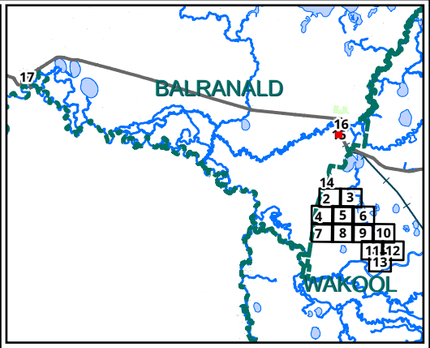
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biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg

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**Legend**

- Subject land
- Development footprint
- Wind turbine generators

**Plant community type**

- Exotic / Cropping / Disturbed

**Figure 6.15 Vegetation within the subject land**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

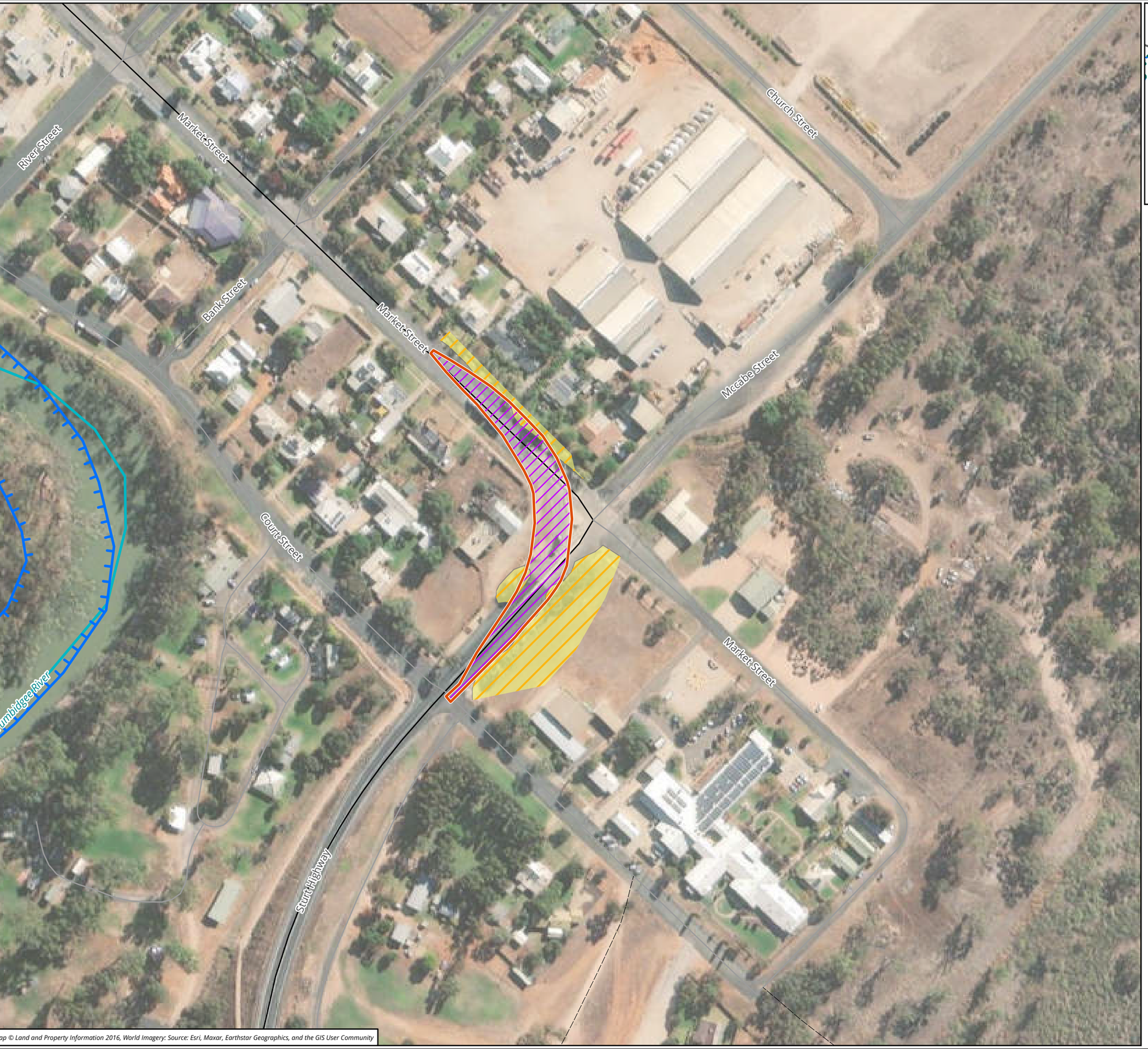
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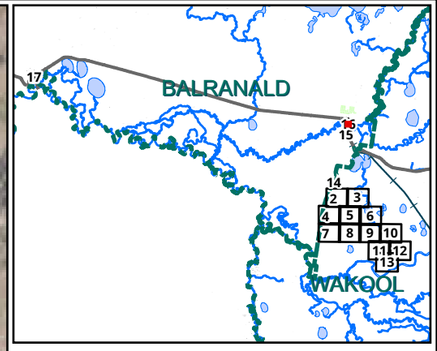
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Matter: 37502, Date: 19 April 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg

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**Legend**

- Subject land
- Development footprint
- Wind turbine generators
- Hydro area

**Condition**

- Moderate

**Plant community type**

- Planted vegetation

**Figure 6.16 Vegetation within the subject land**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

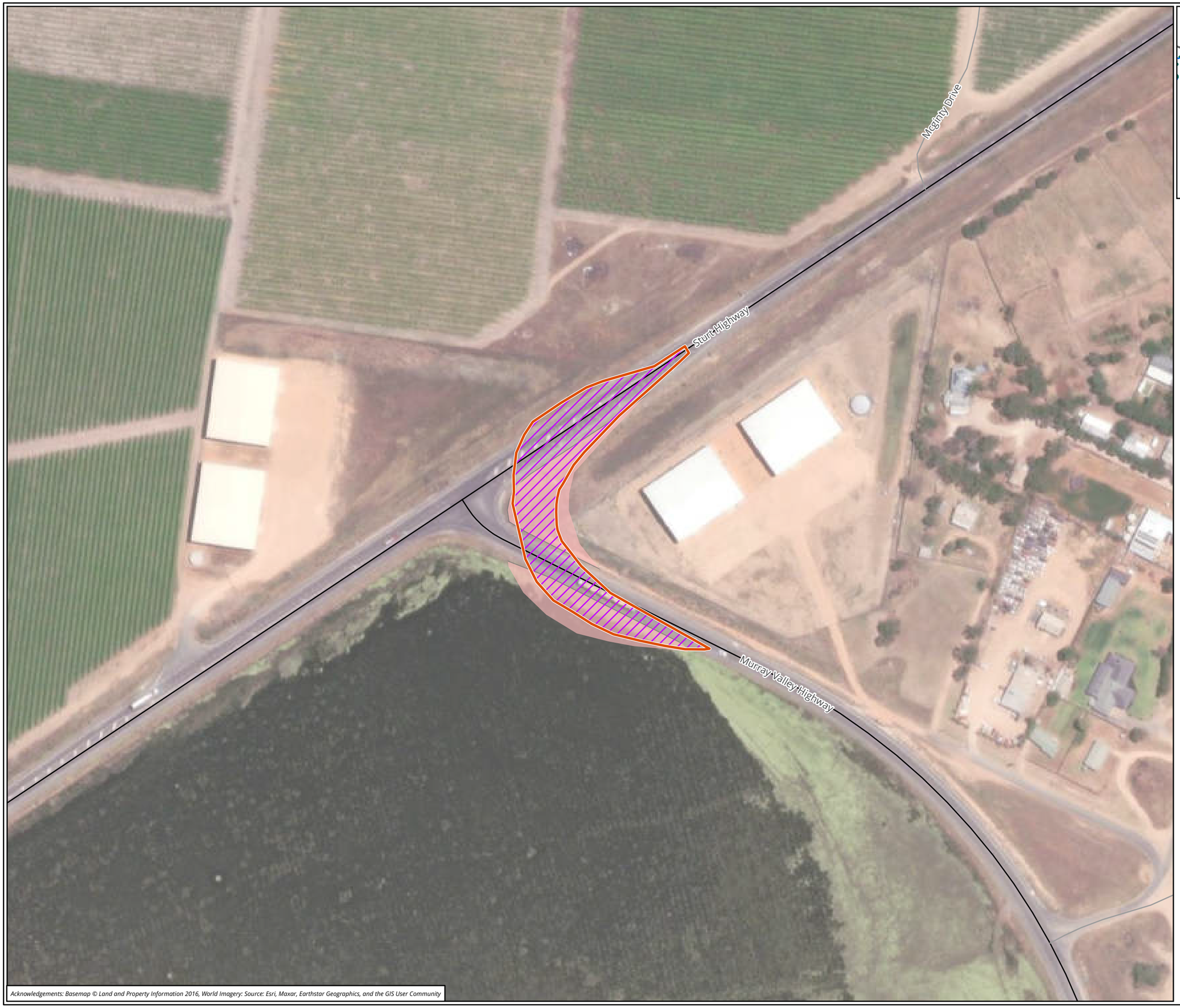
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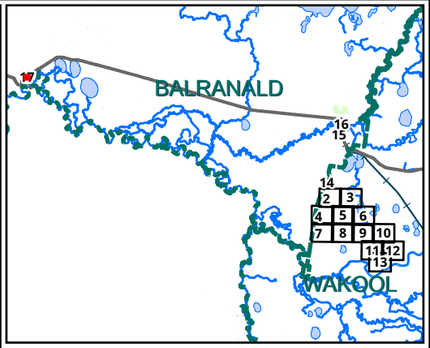
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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg

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**Legend**

- Subject land
- Development footprint
- Wind turbine generators

**Plant community type**

- Exotic / Cropping / Disturbed

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**Figure 6.17 Vegetation within the subject land**

0 20 40 60 80

Meters

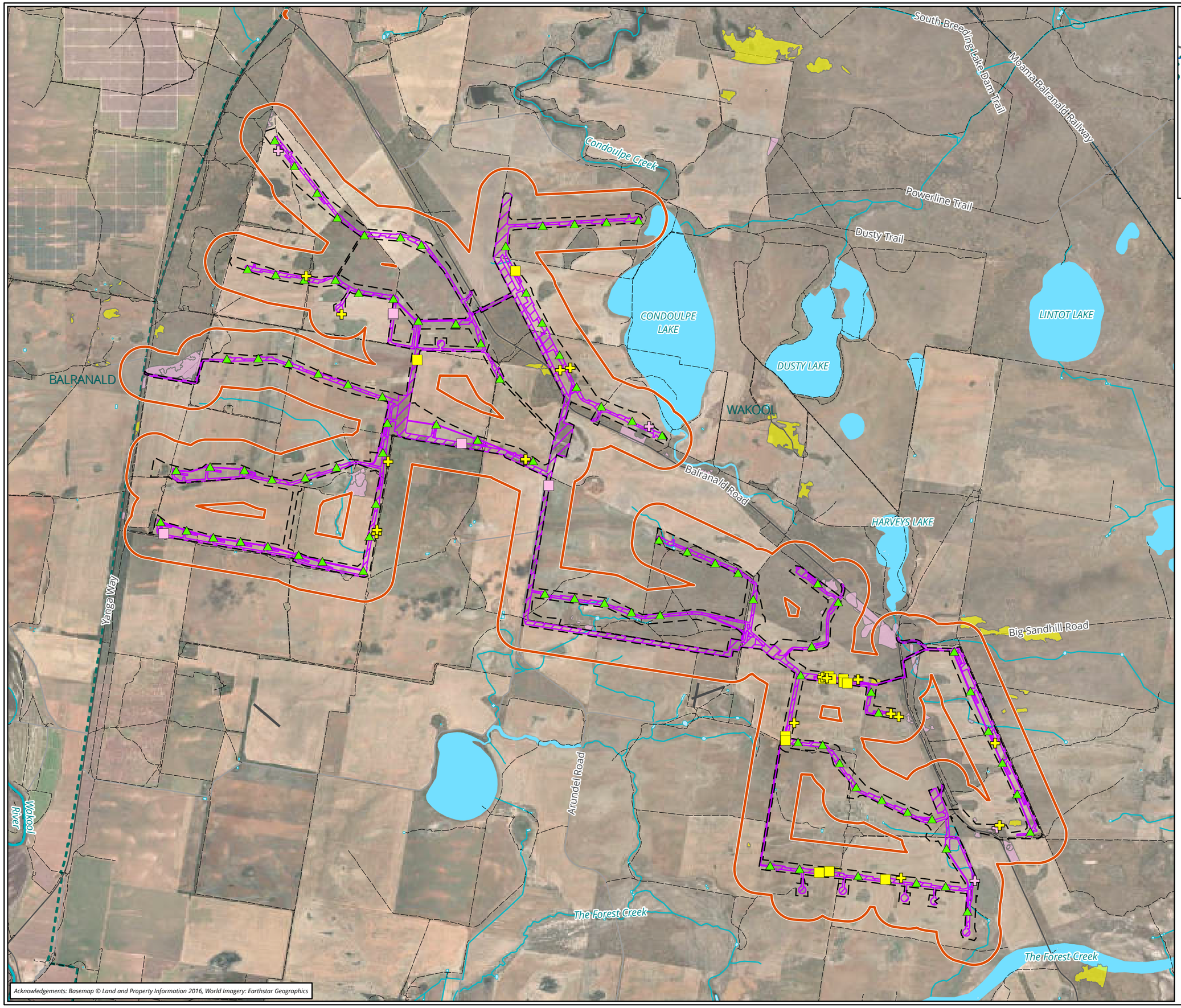
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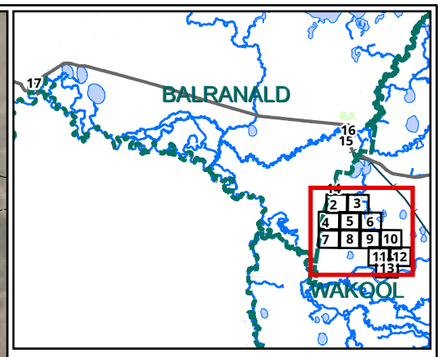
*Coordinate System:*
*GDA2020 MGA Zone 54*

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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F6_BiosisVeg




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock Trees - To be removed**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Figure 7.1 Threatened ecological communities within the subject land**

0 1,000 2,000 3,000

Meters

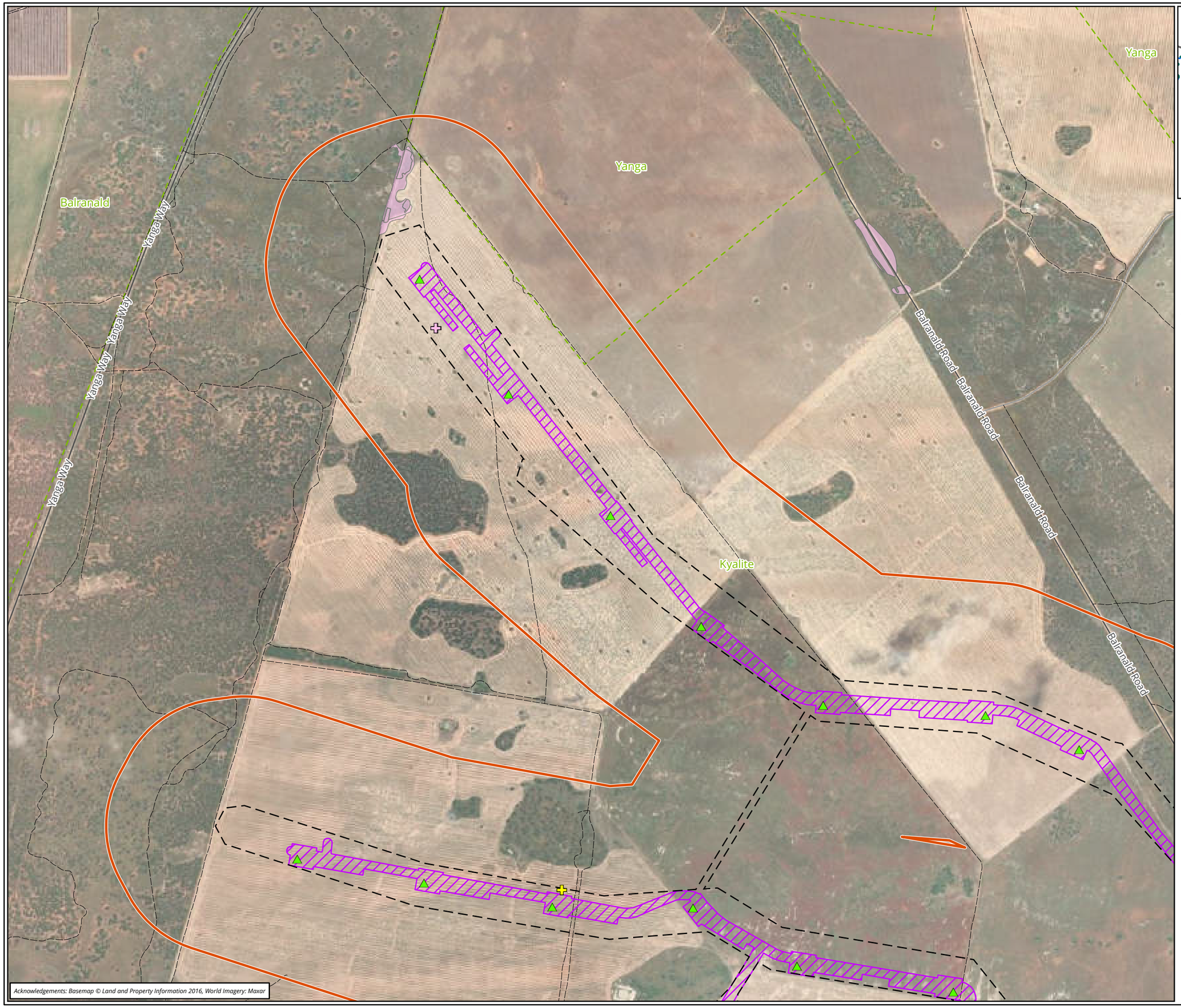
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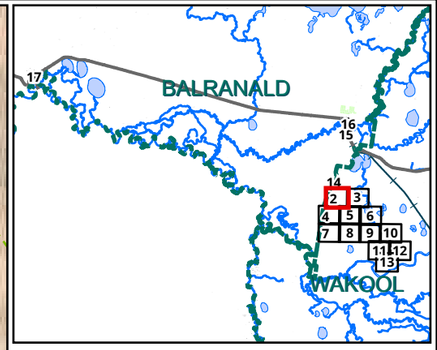
*Coordinate System: GDA2020 MGA Zone 54*

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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland

**Paddock trees - Retained**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Figure 7.2 Threatened ecological communities within the subject land**

0 230 460 690

Meters

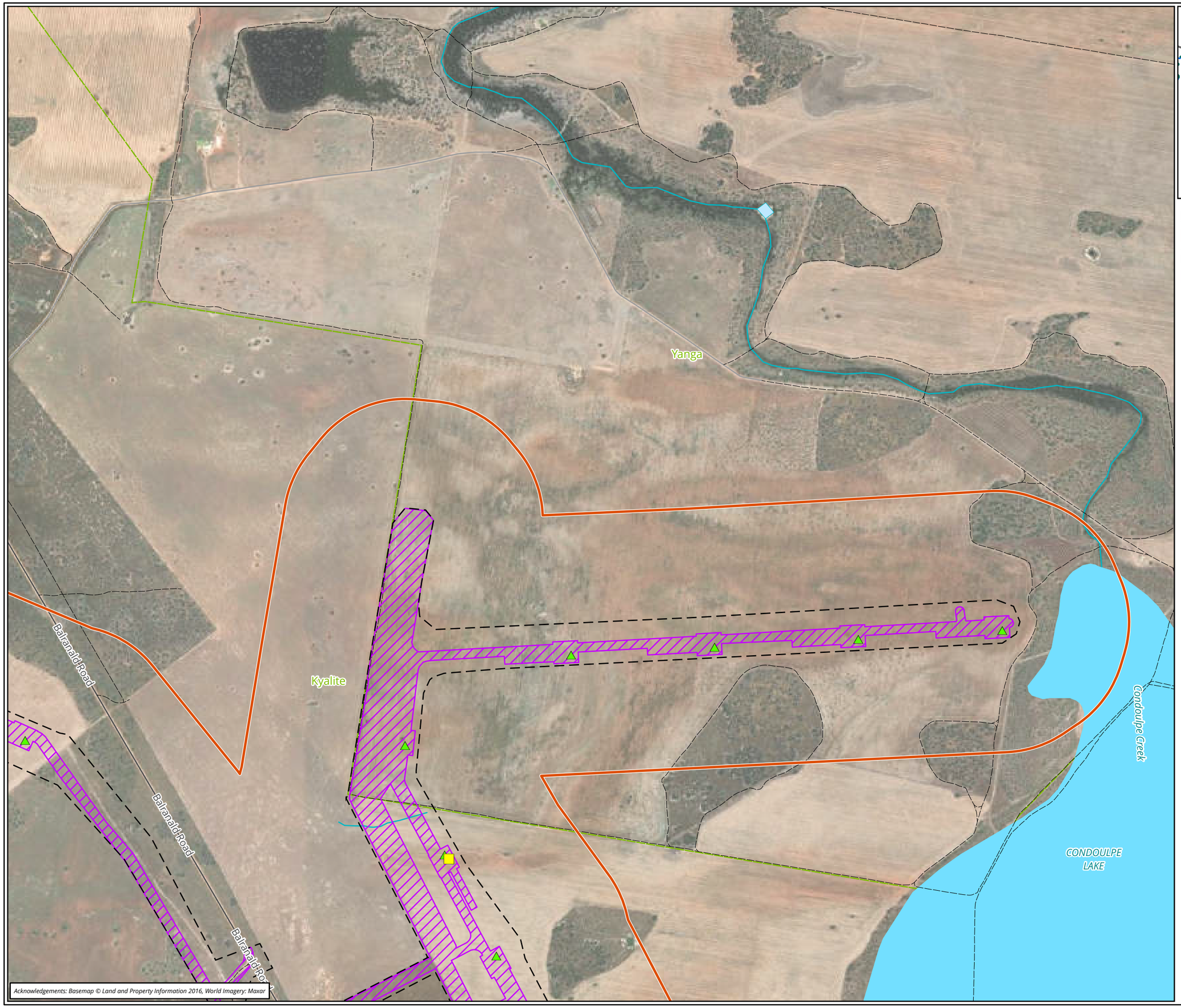
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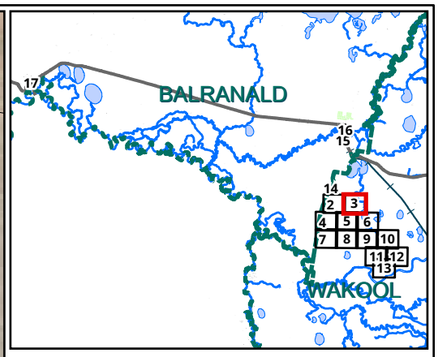
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biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Paddock Trees - To be removed**

- Sandhill Pine Woodland

**Figure 7.3 Threatened ecological communities within the subject land**

0 230 460 690

Meters

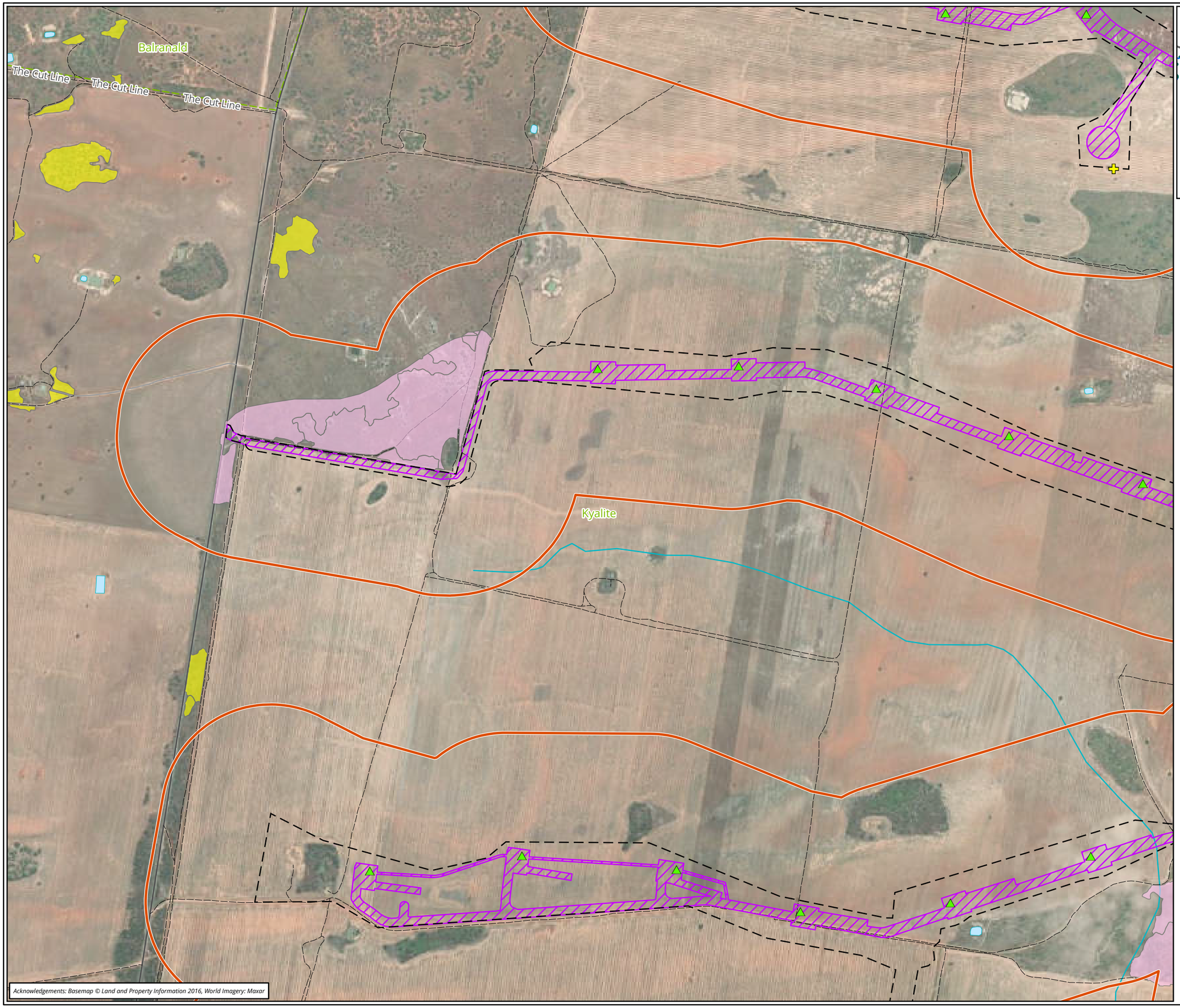
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*Coordinate System:*
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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- Sandhill Pine Woodland

**Figure 7.4 Threatened ecological communities within the subject land**

0 230 460 690

Meters

Scale: 1:16,000 @ A3

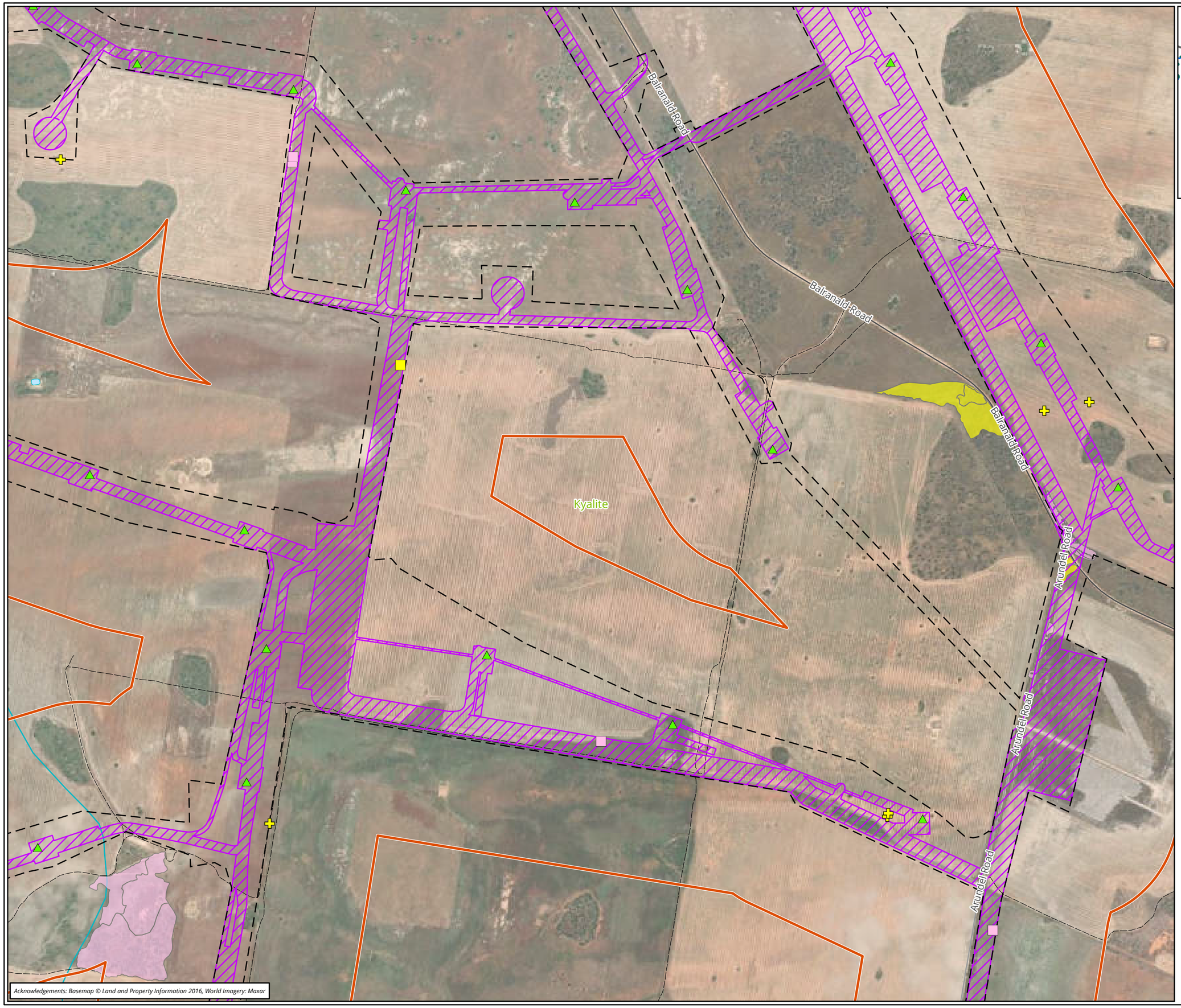
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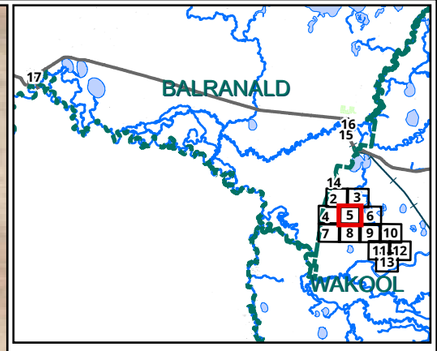
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biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- Sandhill Pine Woodland

**Paddock Trees - To be removed**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Figure 7.5 Threatened ecological communities within the subject land**

0 230 460 690

Meters

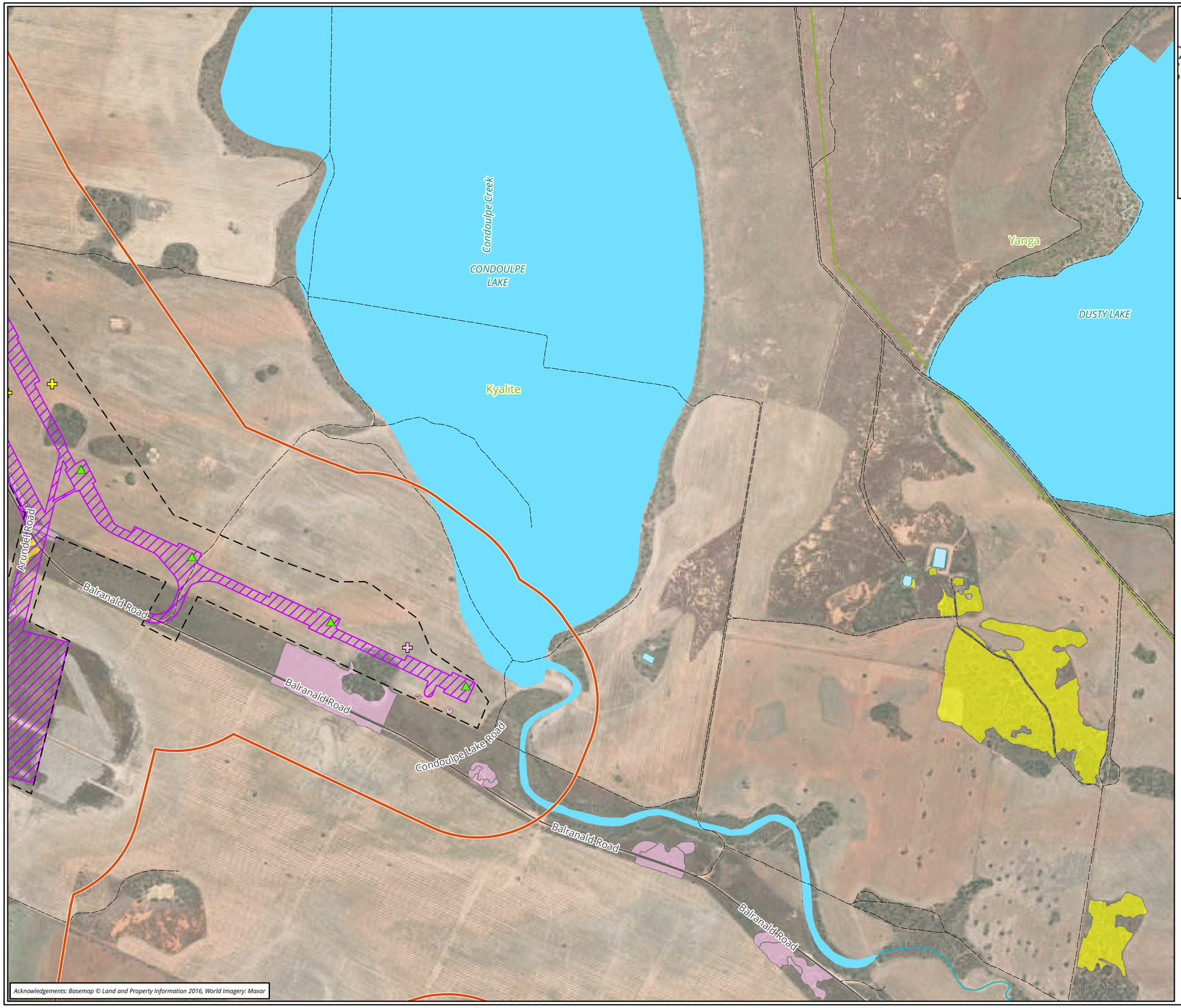
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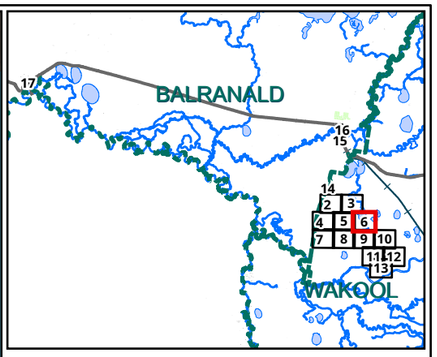
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Matter: 37502, Date: 15 March 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Figure 7.6 Threatened ecological communities within the subject land**

0 230 460 690

Meters

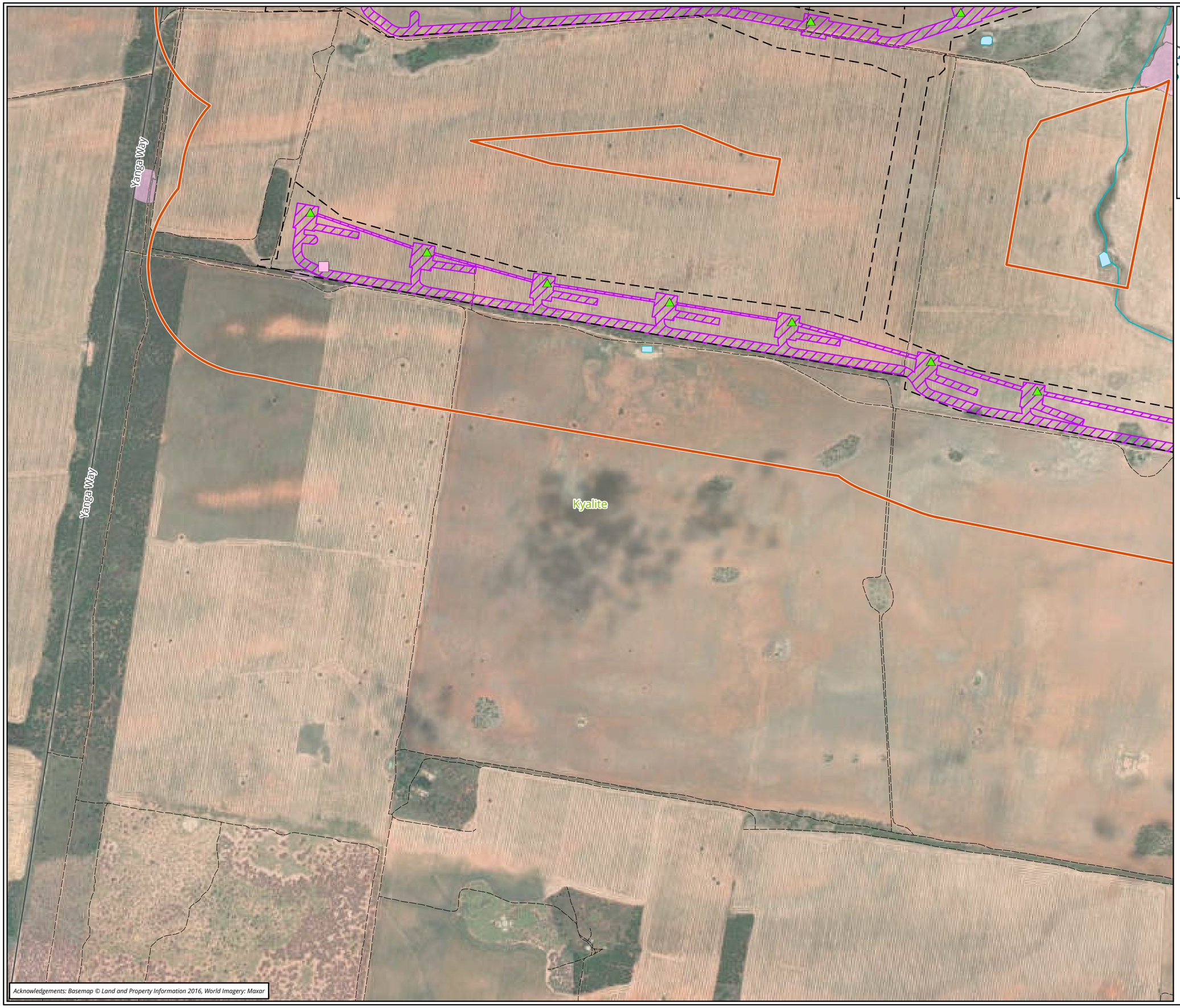
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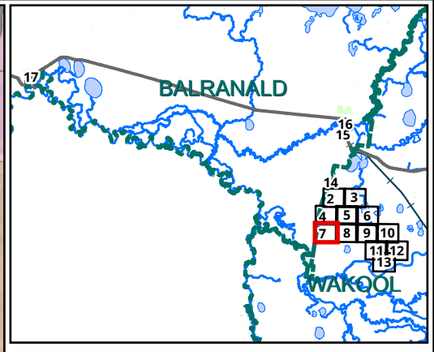
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biosis

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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland

**Paddock Trees - To be removed**

- *Acacia melvillei* Shrubland

**Figure 7.7 Threatened ecological communities within the subject land**

0 230 460 690

Meters

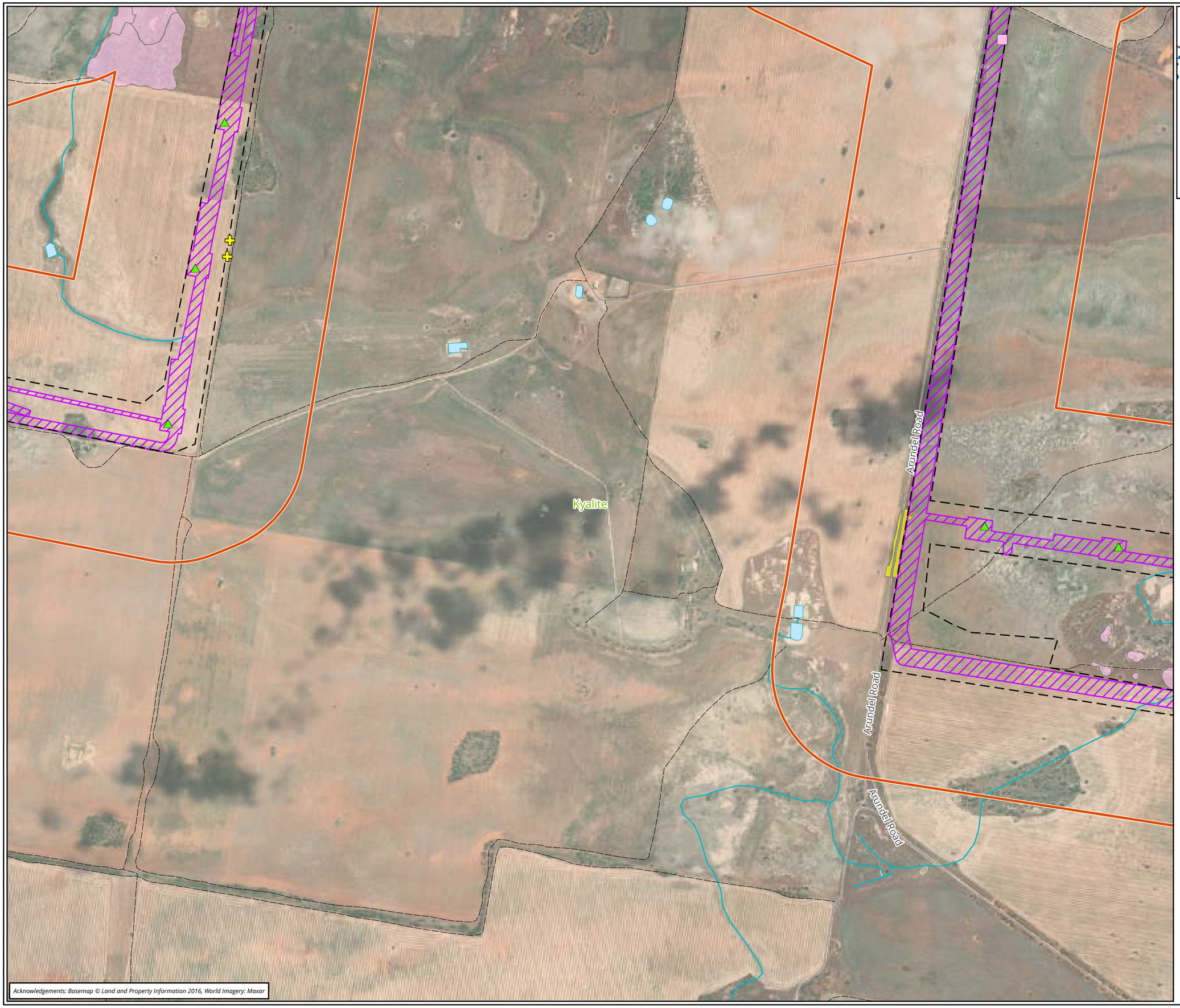
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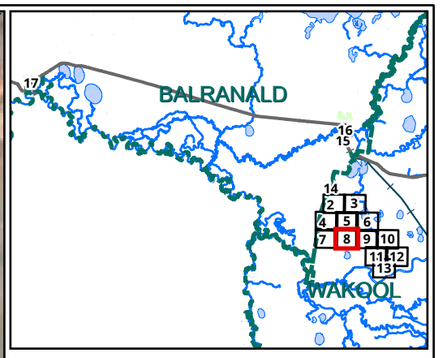
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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- Sandhill Pine Woodland

**Paddock Trees - To be removed**

- *Acacia melvillei* Shrubland

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**Figure 7.8 Threatened ecological communities within the subject land**

0 230 460 690

Meters

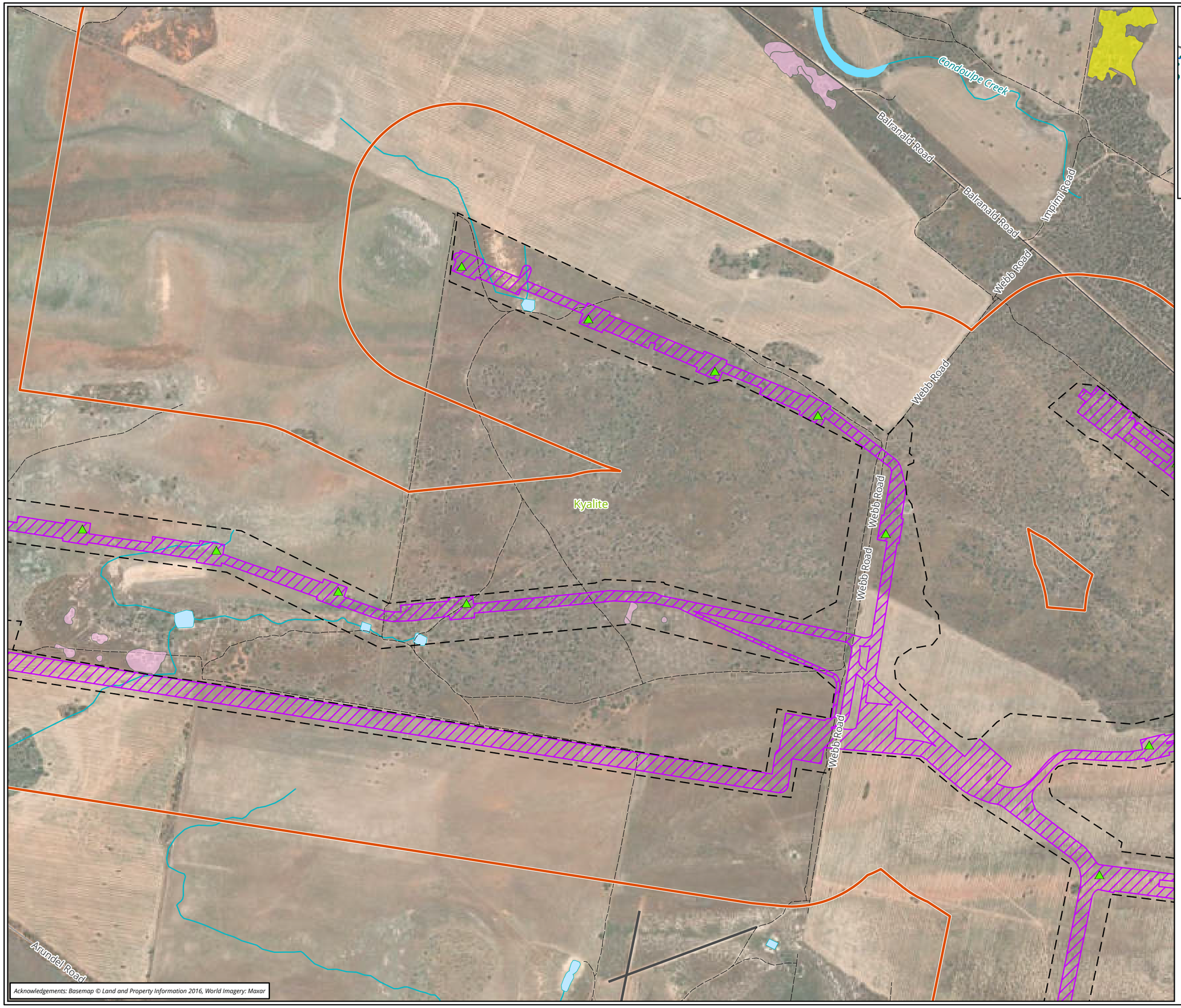
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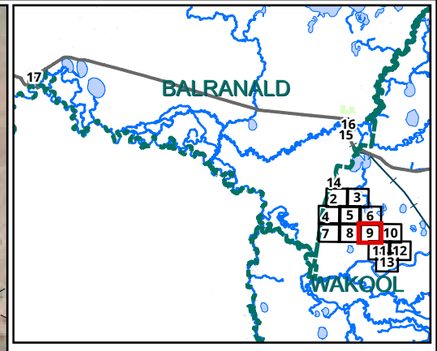
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Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Figure 7.9 Threatened ecological communities within the subject land**

0 230 460 690

Meters

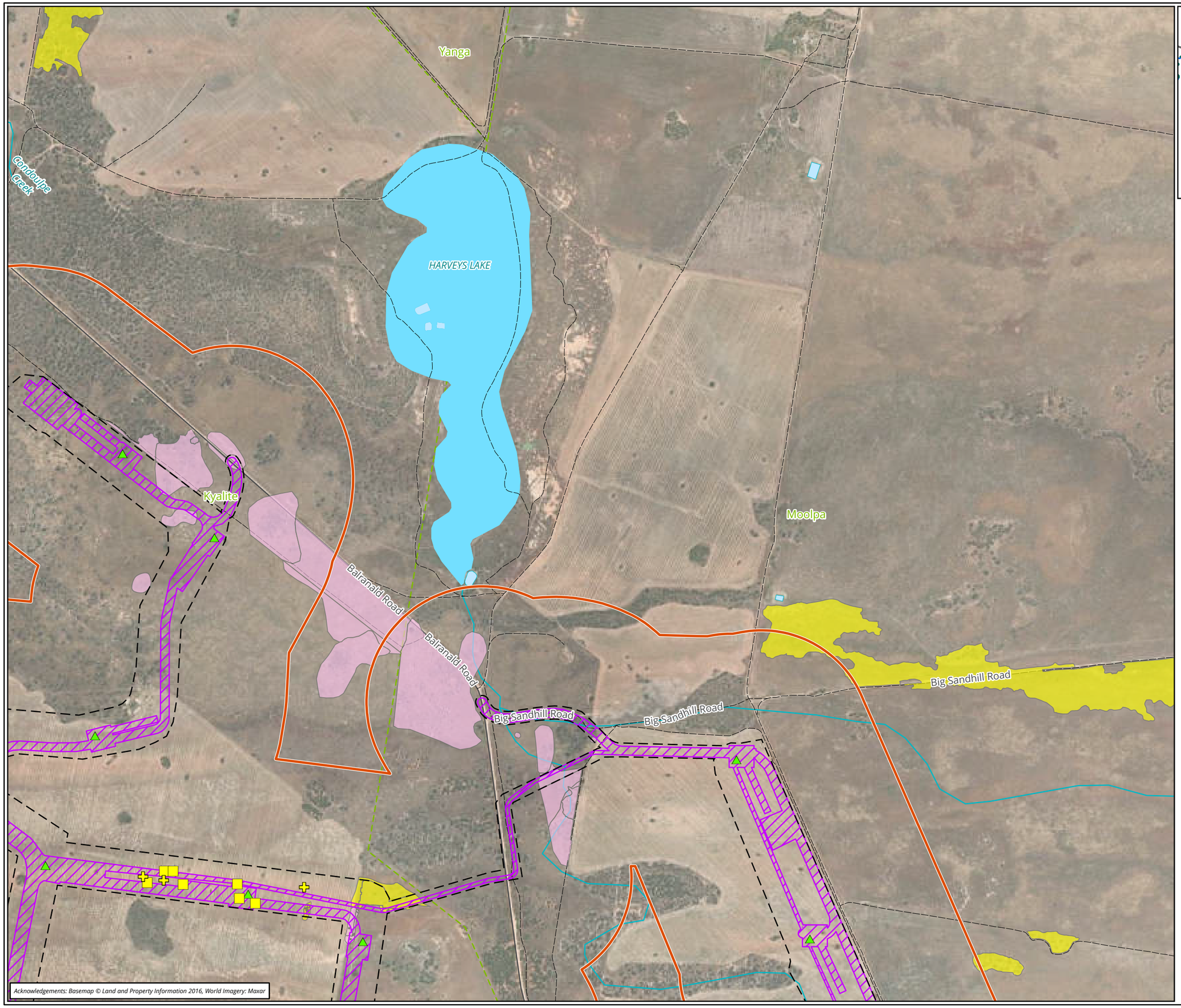
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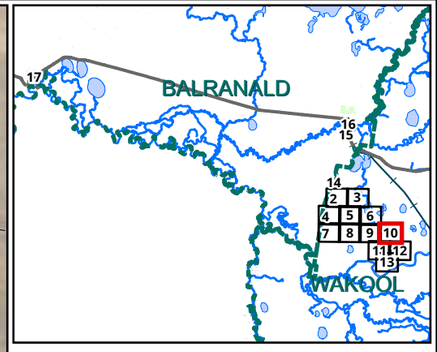
*Coordinate System:*
*GDA2020 MGA Zone 54*

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Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- Sandhill Pine Woodland

**Paddock Trees - To be removed**

- Sandhill Pine Woodland

**Figure 7.10 Threatened ecological communities within the subject land**

0 230 460 690

Meters

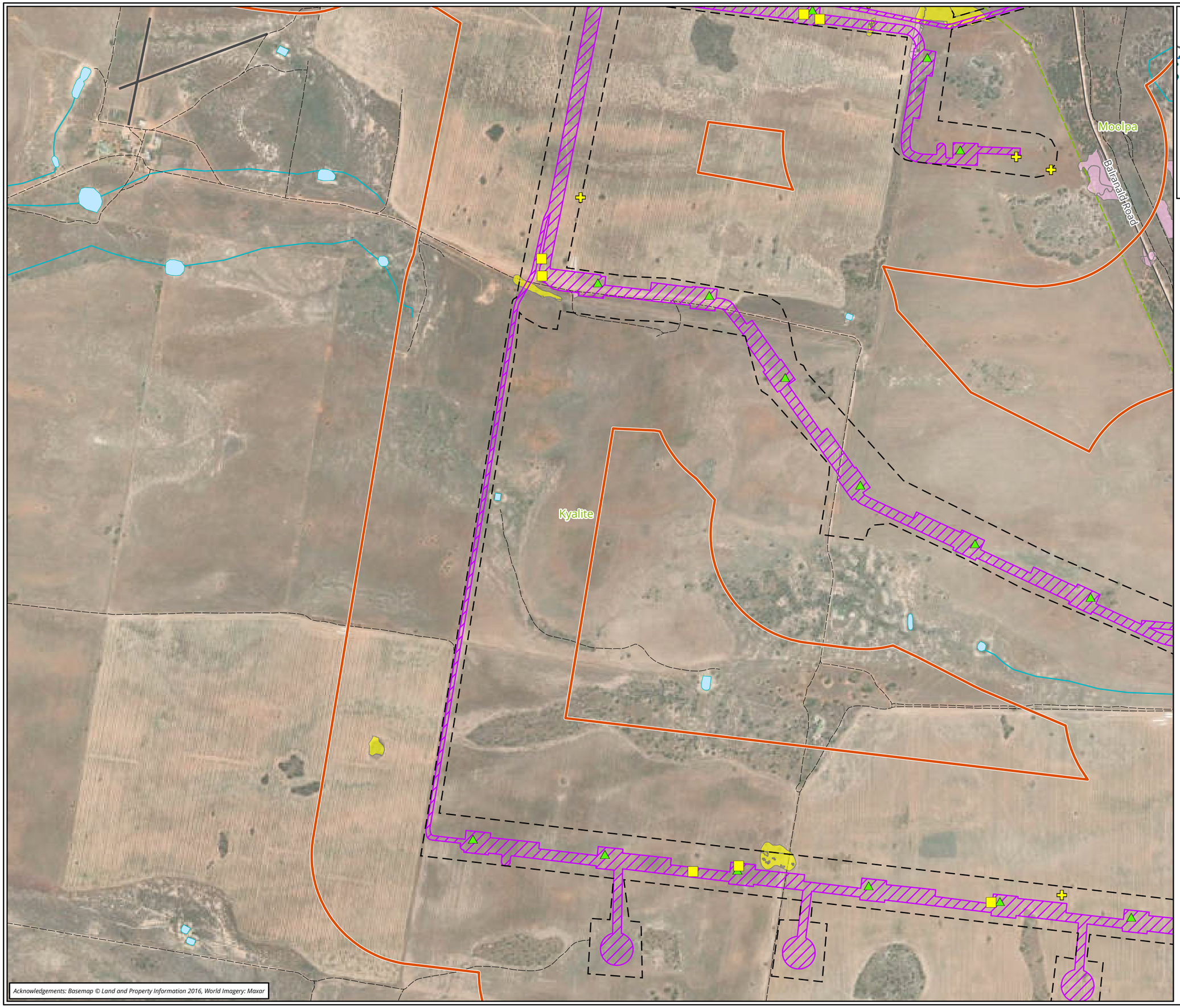
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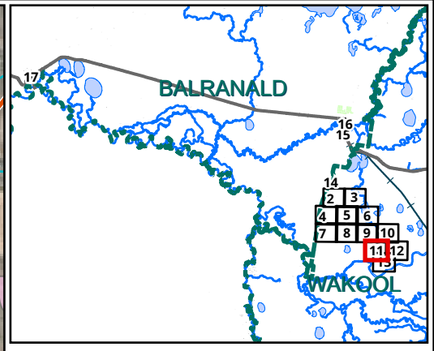
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biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- Sandhill Pine Woodland

**Paddock Trees - To be removed**

- Sandhill Pine Woodland

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 7.11 Threatened ecological communities within the subject land**

0 230 460 690

Meters

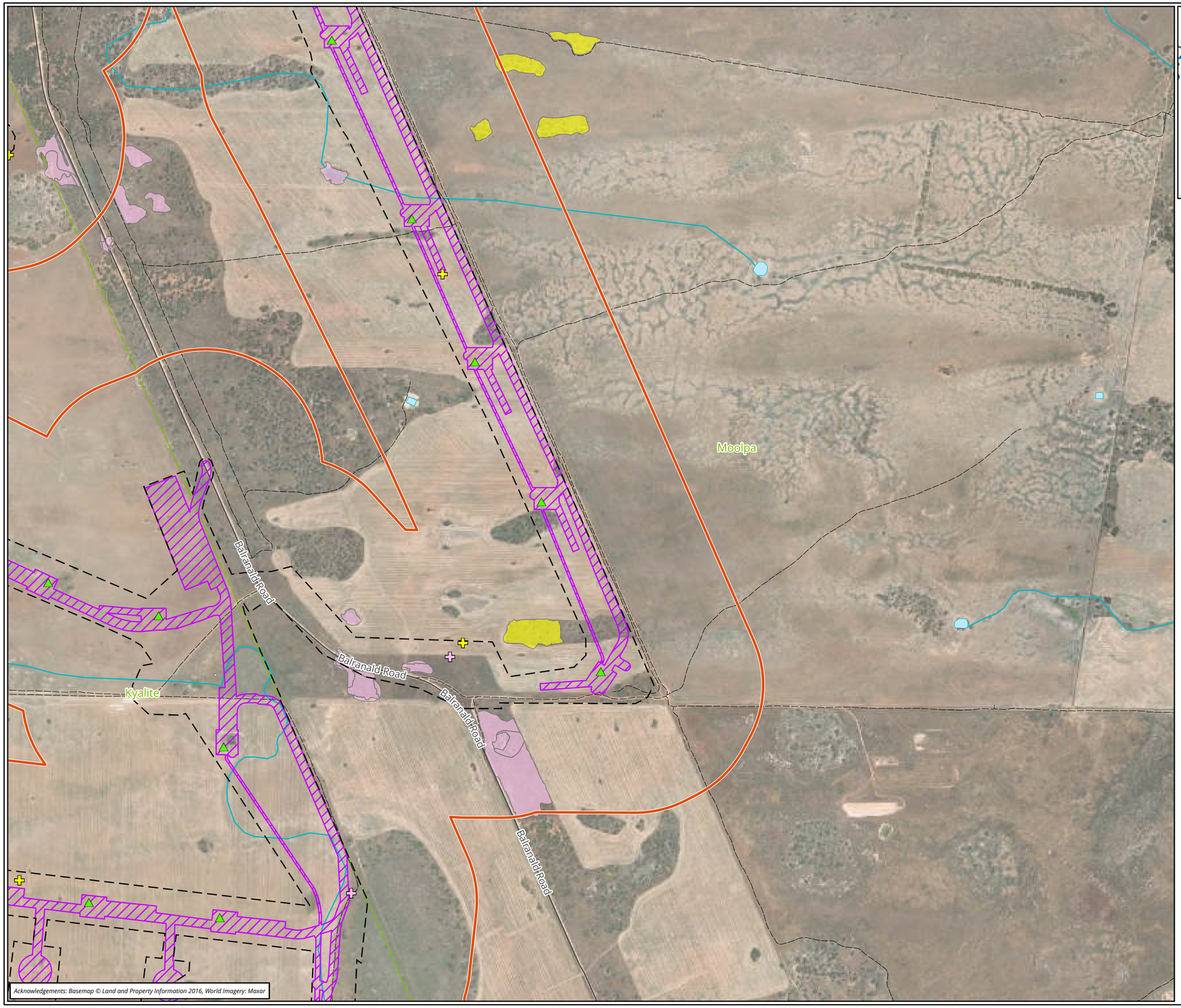
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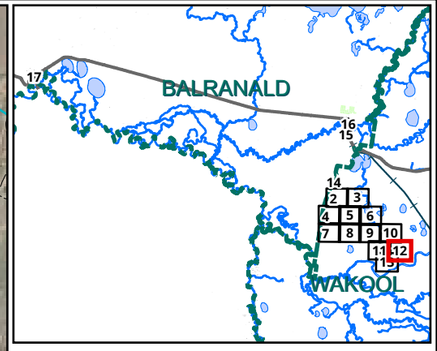
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Figure 7.12 Threatened ecological communities within the subject land**

0 230 460 690

Meters

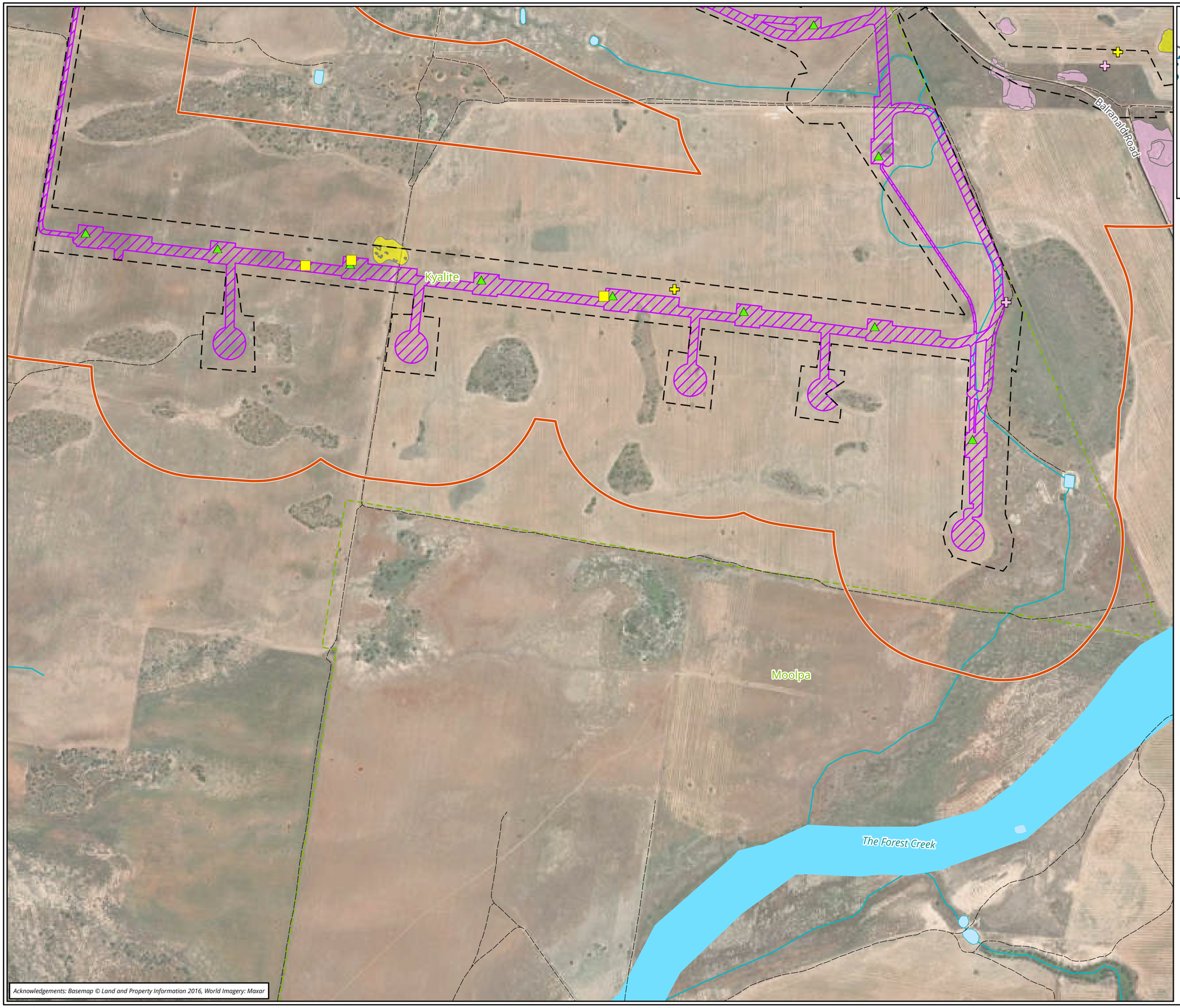
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*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock trees - Retained**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Paddock Trees - To be removed**

- Sandhill Pine Woodland

**Figure 7.13 Threatened ecological communities within the subject land**

0 230 460 690

Meters

Scale: 1:16,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

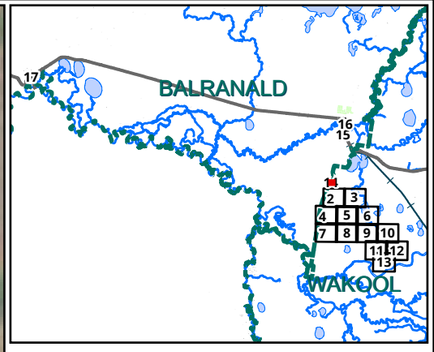
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biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 7.14 Threatened ecological communities within the subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

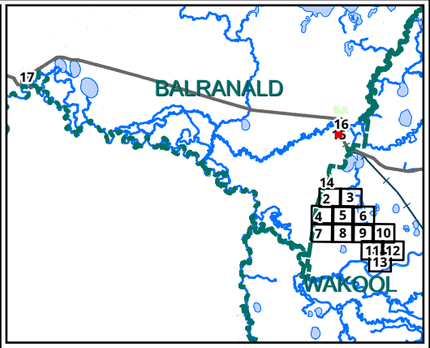
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biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 7.15 Threatened ecological communities within the subject land**

0 25 50 75

Meters

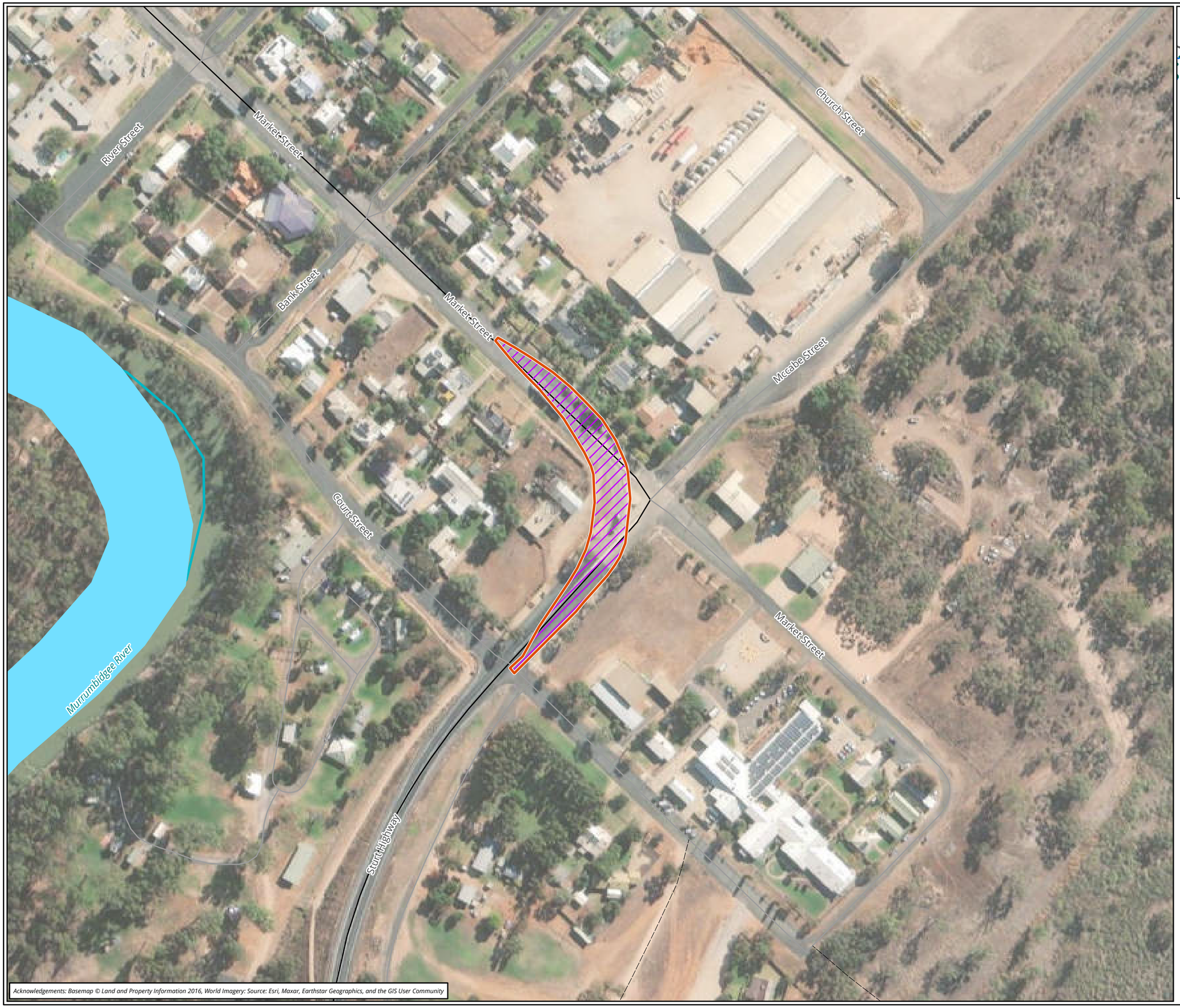
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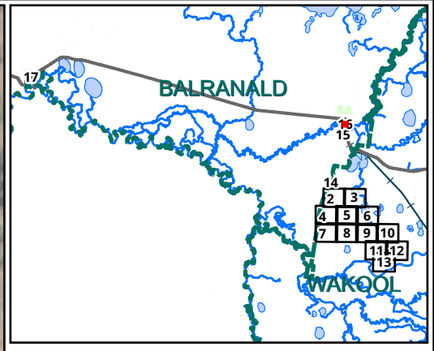
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 7.16 Threatened ecological communities within the subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

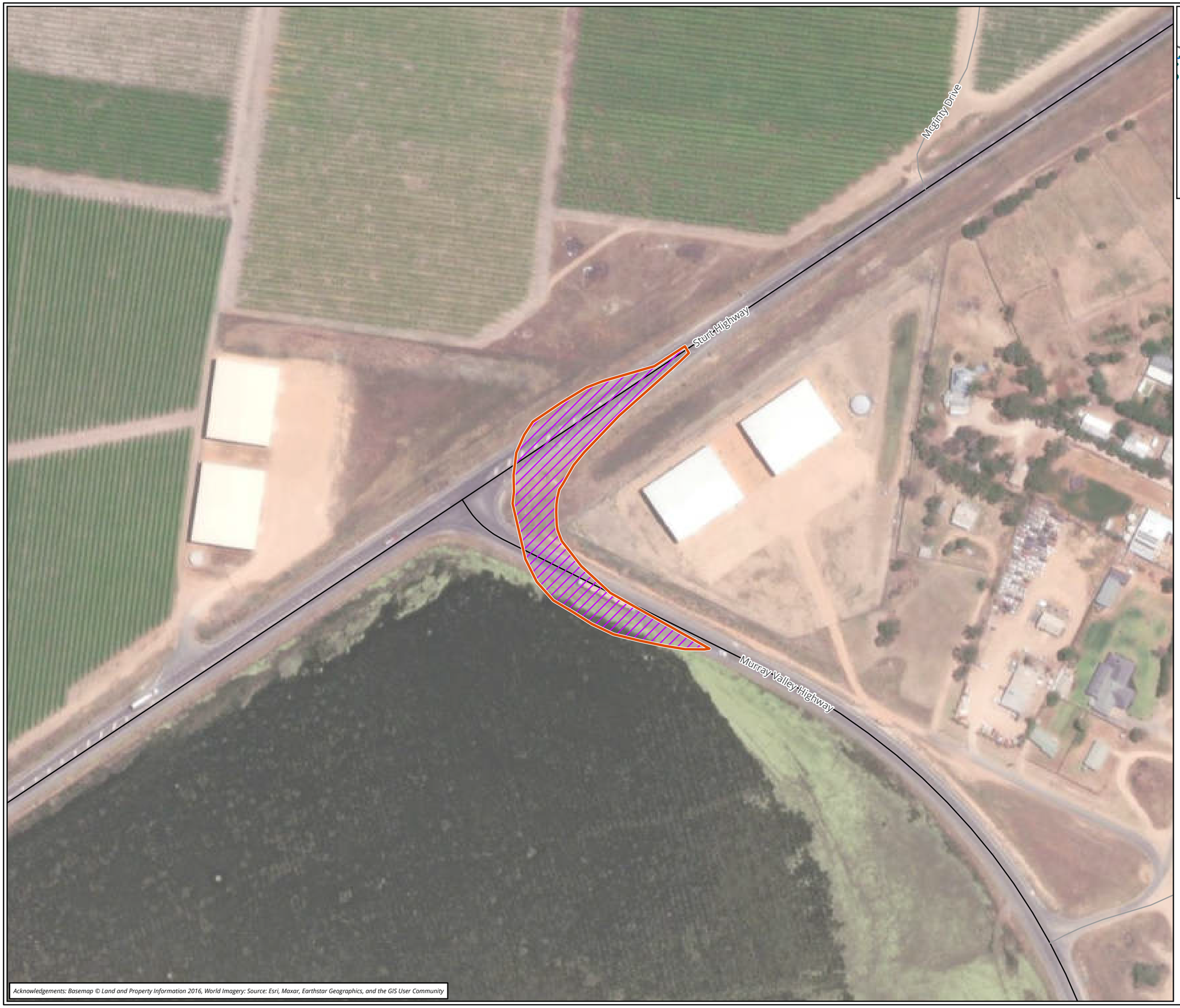
*Coordinate System: GDA2020 MGA Zone 54*

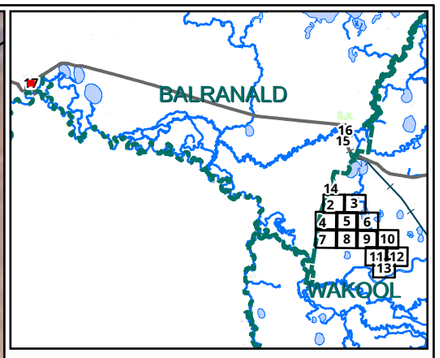
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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 7.17 Threatened ecological communities within the subject land**

0 25 50 75

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F7_TECs

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community*

## 3.3. Vegetation integrity assessment

### 3.3.1. Vegetation zones and patch size class

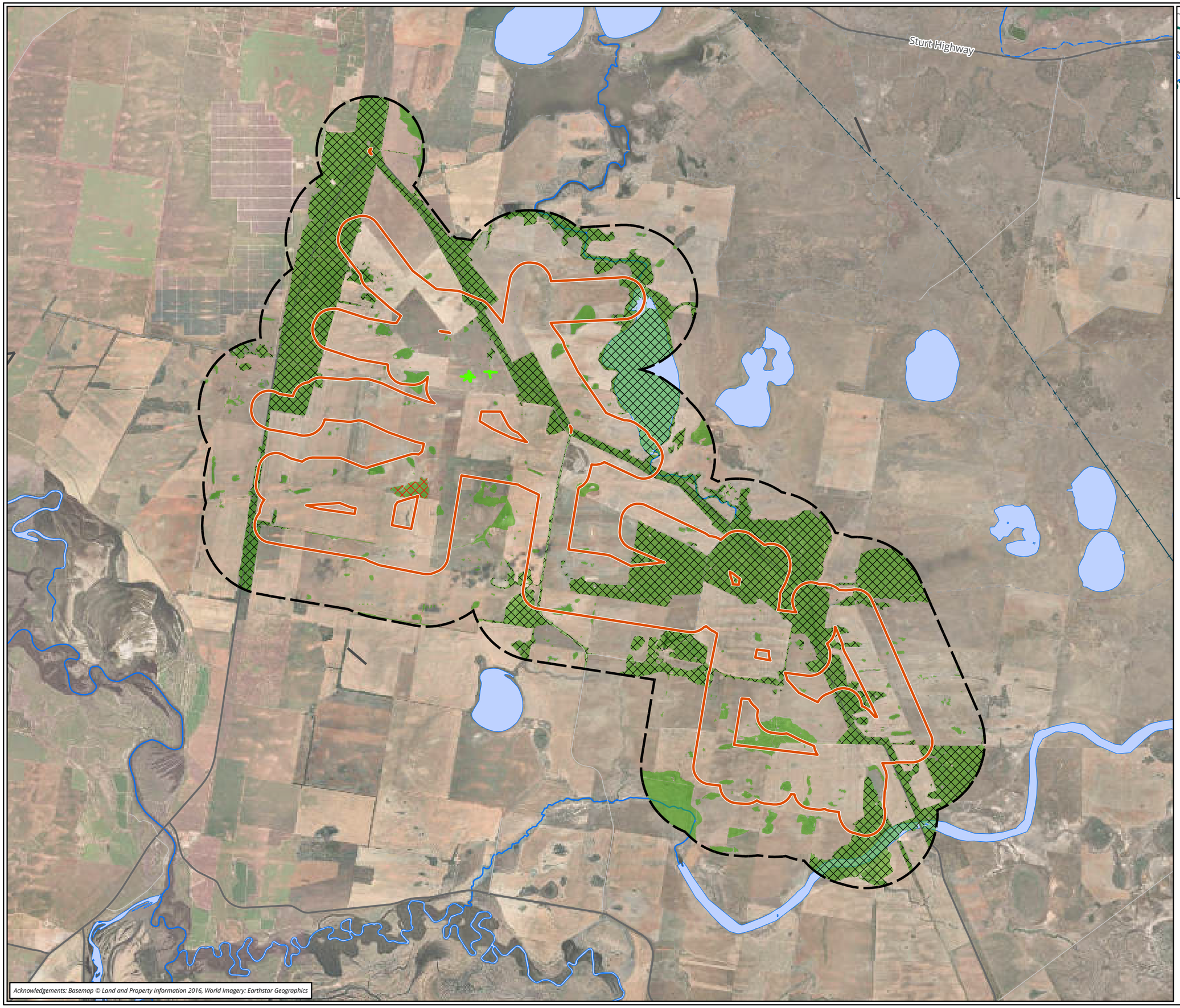
Vegetation within the subject land was assessed and stratified, based on PCT and broad condition state, into vegetation zones in accordance with Section 4.3 of the BAM, and as described in Table 4 to Table 10 above. This resulted in 15 vegetation zones identified within the development footprint. Table 12 describes each of the zones, and provides details on the numbers of BAM floristic plots undertaken in each.

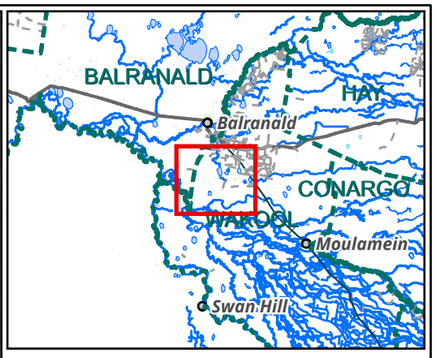
Patch size classes for each vegetation zone present within the subject land were assessed as per Section 4.3.2 of the BAM (DPIE 2020a) using a selection process in ArcGIS. All native vegetation with a gap of less than 100 metres from the next area of native vegetation (or ≤30 metres for non-woody PCTs), is considered a single patch, with a patch able to extend onto adjoining land.

Patch size classes for each vegetation zone are also outlined in Table 12 below.

**Table 12 Vegetation zones within the subject land**

| Plant Community Type | Condition | Vegetation zone | BAM plots completed | Area (ha) | Max. patch size |
|---|---|---|---|---|---|
| **PCT 16 Black Box grassy open woodland wetland** | Moderate | PCT 16_Moderate | 4 | 3.80 | >100 ha |
| | Low | PCT 16_Low | 5 | 0.36 | >100 ha |
| | DNG | PCT 16_DNG | 4 | 2.78 | >100 ha |
| | Paddock trees | PCT 16_Paddock trees | 1 | 0.21 | <5 ha |
| **PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland** | Moderate | PCT 21_Moderate | 4 | 1.17 | >100 ha |
| **PCT 23 Yarran tall open shrubland** | Moderate | PCT 23_Moderate | 5 | 2.03 | >100 ha |
| **PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland** | Moderate | PCT 57_Moderate | 1 | 0.19 | >100 ha |
| **PCT 58 Black Oak - Western Rosewood open woodland** | High | PCT 58_High | 2 | 0.85 | >100 ha |
| | Moderate | PCT 58_Moderate | 8 | 20.91 | >100 ha |
| | DNG | PCT 58_DNG | 9 | 30.01 | >100 ha |
| | Paddock trees | PCT 58_Paddock trees | 2 | 0.07 | <5 ha |
| **PCT 163 Dillon Bush shrubland** | Moderate | PCT 163_Moderate | 6 | 3.58 | >100 ha |
| **PCT 170 Chenopod sandplain mallee woodland** | Moderate | PCT 170_Moderate | 5 | 4.67 | >100 ha |
| | Low | PCT 170_Low | 2 | 0.56 | >100 ha |
| | DNG | PCT 170_DNG | 5 | 3.50 | >100 ha |




**Legend**

- Assessment area
- Subject land
- Native vegetation

**Patch size**

- Patch size >=100ha (15 - High, 16 - DNG, 16 - High, 16 - Low, 16 - Moderate, 16 - Paddock Trees, 21 - Moderate, 23 - Moderate, 23 DNG, 57 - Moderate, 58 - DNG, 58 - High, 58 - Moderate, 58 - Low, 163 - Moderate, 170 - DNG, 170 - Paddock Trees, 170 - Low, 170 - Moderate)
- Patch size 25-100ha (23 - High)
- Patch size <5ha (16 - Paddock Trees, 58 - Paddock Trees)

**Figure 8 Patch size**

0 1 2 3 4

Kilometers

Scale: 1:100,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 March 2024GIS: JET, Checked by: CW, Last edited by: jtownsendLocation: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F8_PatchSize

### 3.3.2. Vegetation integrity

Vegetation integrity was assessed using data obtained from BAM plots undertaken within the mapped vegetation zones across the development corridor, as per Section 4.3.4 of the BAM (DPIE 2020a). Plot data was collected via:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes and function.
- A 20 metre x 20 metre quadrat, nested within the larger quadrat for full floristic survey to determine composition and structure of the PCT.

The minimum number of BAM plots per vegetation zone was determined using Table 3 of the BAM (DPIE 2020a). In total, 63 BAM plots have been completed within the vegetation zones present in the development corridor and development footprint, details are provided in Table 13, with locations shown on Figure 9.

**Table 13 BAM plots completed within the Subject Land**

| BAM plot reference | Vegetation zone | BAM plot reference | Vegetation zone |
|---|---|---|---|
| **37502.P.02** | 16_Low | **37502_B42** | 163_Moderate |
| **37502.P.06** | 163_Moderate | **37502_B43** | 170_Moderate |
| **37502_B04** | 58_Moderate | **37502_B44** | 170_Moderate |
| **37502_B06** | 16_Moderate | **37502_B46** | 170_Moderate |
| **37502_B07** | 16_Low | **37502_B47** | 170_Moderate |
| **37502_B08** | 16_Low | **37502_B50** | 16_DNG |
| **37502_B09** | 16_Low | **37502_B51** | 16_DNG |
| **37502_B10** | 16_Moderate | **37502_B52** | 170_DNG |
| **37502_B11** | 16_Moderate | **37502_B53** | 58_DNG |
| **37502_B12** | 16_Moderate | **37502_B54** | 21_Moderate |
| **37502_B13** | 16_Low | **37502_B55** | 23_Moderate |
| **37502_B15** | 21_Moderate | **37502_B56** | 170_DNG |
| **37502_B17** | 23_Moderate | **37502_B57** | 57_Moderate |
| **37502_B18** | 23_Moderate | **37502_B58** | 58_Moderate |
| **37502_B19** | 23_Moderate | **37502_B60** | 58_DNG |
| **37502_B20** | 58_DNG | **37502_B63** | 163_Moderate |
| **37502_B21** | 170_DNG | **37502_B64** | 163_Moderate |
| **37502_B25** | 58_DNG | **37502_B65** | 163_Moderate |
| **37502_B26** | 58_DNG | **37502_B902** | 23_Moderate |
| **37502_B27** | 58_DNG | **37502_B903** | 58_DNG |
| **37502_B28** | 21_Moderate | **37502_B904** | 16_DNG |
| **37502_B29** | 58_Moderate | **37502_B905** | 170_DNG |
| **37502_B30** | 58_Moderate | **37502_B906** | 170_Low |
| **37502_B31** | 58_Moderate | **37502_B907** | 16_DNG |
| **37502_B32** | 58_High | **37502_B908** | 170_DNG |

| BAM plot reference | Vegetation zone | BAM plot reference | Vegetation zone |
|---|---|---|---|
| **37502_B33** | 58_High | **37502_B909** | 170_Low |
| **37502_B35** | 58_Moderate | **37502_B910** | 58_Paddock trees |
| **37502_B37** | 58_Moderate | **37502_B911** | 21_Moderate |
| **37502_B38** | 170_Moderate | **37502_B912** | 58_Moderate |
| **37502_B39** | 163_Moderate | **37502_B914** | 16_Paddock trees |
| **37502_B40** | 58_DNG | **37502_B915** | 58_Paddock trees |
| **37502_B41** | 58_DNG | **-** | - |

Assessment of vegetation integrity was undertaken using standard benchmark data as outlined in the BAM and held in the BioNet Vegetation Classification database. A list of flora species was compiled for each BAM plot completed and is included in Appendix 3, BAM plot field data sheets (excel format), and a summary of BAM plot data are also provided. Records of all flora species will be submitted for incorporation into the BioNet Atlas of NSW Wildlife, as per the requirements of Biosis' Scientific Licence.

A number of the BAM plots listed in the table above are not located within the final development footprint. The reasons for this are as follows:

- Vegetation and condition mapping (i.e. to determine vegetation zones) has been undertaken at the subject land scale, and as such areas within the subject land, development corridor and development footprint have all been mapped to the same definition, based on areas of specific PCTs occurring in the same broad condition state.
- As outlined in Section 1.3 this assessment has been undertaken to include the concept of a development corridor to allow for assessment of indirect impacts and to allow for micro-siting flexibility during future detailed design stages. The assessment of vegetation integrity has been designed based on the vegetation zones within the broader development corridor (rather than the more refined development footprint) to ensure that sufficient data has been collected to allow for accurate description of the biodiversity values across the entire development corridor area.
- A number of BAM plots were collected in areas within the development corridor (and subject land) that were not within the development footprint to ensure this larger volume of data could be collected across the appropriate (larger) spatial area.
- BAM plots were preferentially located within the development corridor and development footprint, however numerous layout design iterations have been worked through during the data collection phase of this BDAR. This includes changes as a direct result of efforts to avoid and minimise impacts to biodiversity values. This means some plots that were originally within the development corridor and/or development footprint, in an early version of the project layout, are no longer with the final development corridor and/or development footprint.
- As vegetation zone mapping has been undertaken at the subject land scale, collection of BAM plots across the broader subject land and development corridor areas is aligned with the requirements of the BAM to collect data from within mapped vegetation zones.
- Of the 63 total BAM plots collected for the vegetation integrity assessment, all 63 occur within the subject land, 42 BAM plots occur within the final development corridor, and 14 BAM plots occur in the final development footprint.

### 3.3.3. Vegetation integrity score

Plot data was entered into the BAM-C to determine vegetation integrity scores for each vegetation zone. Plot data are provided in Appendix 3 , with vegetation integrity scores for each vegetation zones provided in Table 14.

**Table 14 Vegetation zone integrity scores**

| Vegetation zone | Composition score | Structure score | Function score | VI score* | HBTs present |
|---|---|---|---|---|---|
| **PCT 16_Moderate** | 91.4 | 20.3 | 82.2 | 53.4 | Yes |
| **PCT 16_Low** | 75.6 | 6.5 | 47.5 | 28.6 | Yes |
| **PCT 16_DNG** | 84.8 | 4.1 | 9.1 | 14.7 | No |
| **PCT 16_Paddock trees** | 71.8 | 4.1 | 4.2 | 10.7 | Yes |
| **PCT 21_Moderate** | 87.8 | 92.0 | 33.4 | 64.6 | Yes |
| **PCT 23_Moderate** | 95.2 | 94.4 | 27.4 | 62.7 | No |
| **PCT 57_Moderate** | 89.5 | 53.5 | 47.8 | 61.1 | No |
| **PCT 58_High** | 86.3 | 90.1 | 96.9 | 91.0 | Yes |
| **PCT 58_Moderate** | 86.7 | 73.8 | 65.5 | 74.8 | Yes |
| **PCT 58_DNG** | 74.2 | 7.5 | 10.1 | 17.7 | No |
| **PCT 58_Paddock trees** | 52.1 | 78.6 | 24.8 | 46.6 | Yes |
| **PCT 163_Moderate** | 93.5 | 37.9 | - | 59.5 | No |
| **PCT 170_Moderate** | 69.8 | 43.4 | 69.3 | 59.5 | Yes |
| **PCT 170_Low** | 68.4 | 23.1 | 16.6 | 29.7 | Yes |
| **PCT 170_DNG** | 77.7 | 6.3 | 6.8 | 15.0 | No |

***Benchmark (pristine) condition vegetation would receive a VI score of 100.**

As outlined in Section 9.2.1 of the BAM (DPIE 2020a), an offset is required for impacts on native vegetation where the vegetation integrity score is:

- ≥15 where the PCT is representative of an endangered or critically endangered ecological community.
- ≥17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or is representative of a vulnerable ecological community.
- ≥20 where the PCT is not representative of a TEC or associated with threatened species habitat.

As such, ecosystem credit offsets are not required for vegetation zones; PCT 16_DNG, PCT 16_Paddock trees or PCT 170_DNG due to VI scores of <17.0.

### 3.3.4. Scattered paddock trees

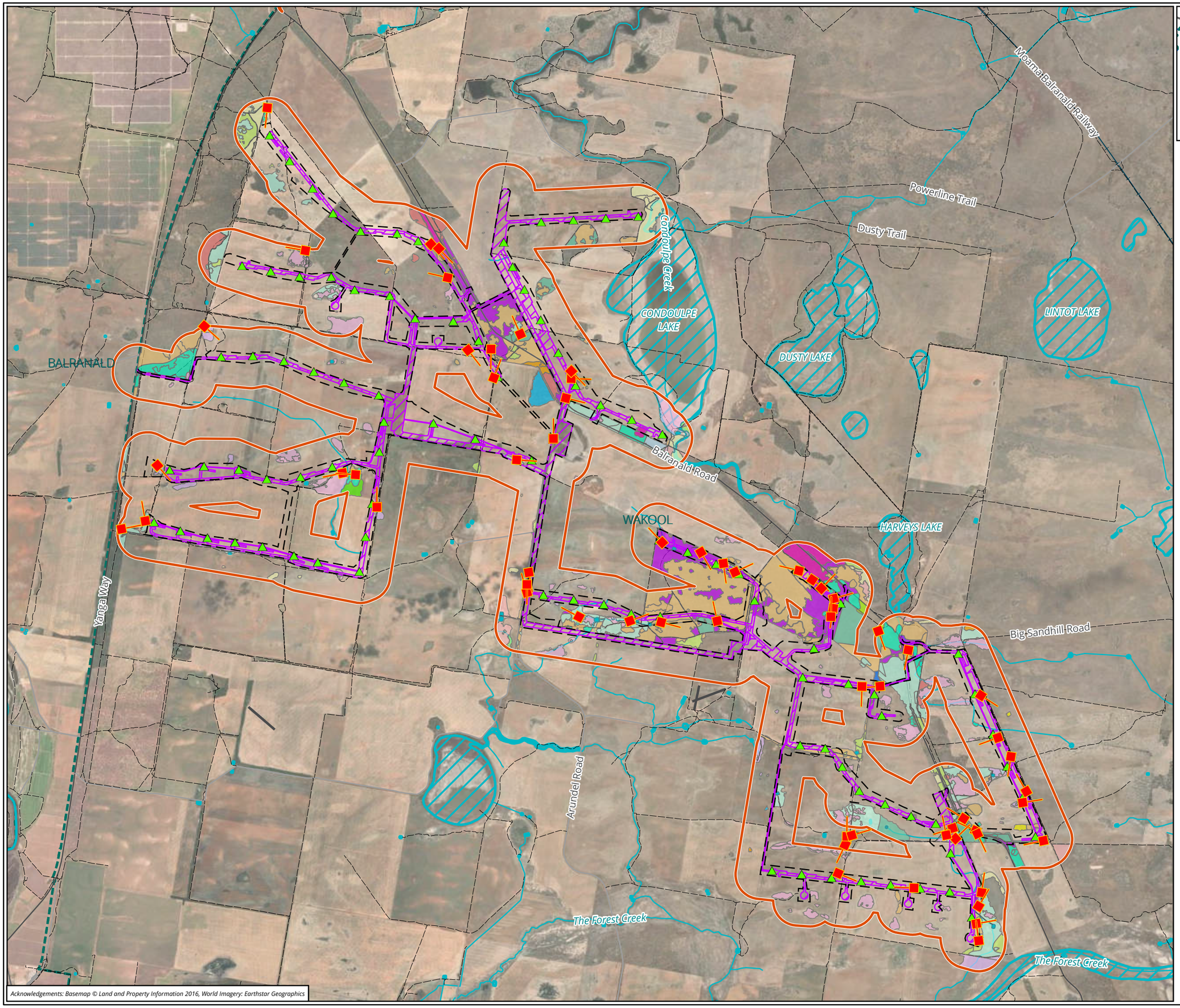
A total of 77 scattered paddock trees have been assessed under Streamlined assessment module – Scattered trees assessment (Appendix B of the BAM) and were entered into the scattered tree assessment module of the BAM-C. Scattered paddock tree were determined to have:

- A percent foliage cover that is less than 25% of the benchmark for tree cover for the most likely plant community type and are on Category 2-regulated land and surrounded by Category 1-exempt land on the Native Vegetation Regulatory Map.

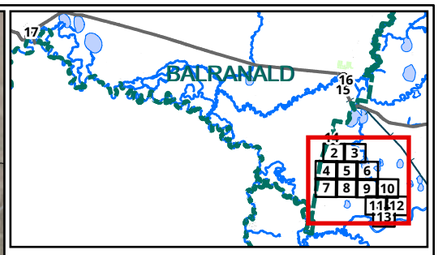
The Streamlined assessment module – Scattered trees assessment was used only to assess the part of the subject land that contained scattered trees. Any proposed clearing of native vegetation that did not meet the definition of scattered trees was assessed in accordance with Section 4 of the BAM (DPIE 2020a).

The assessment of the project's impact to scattered trees is provided as Appendix 7 of this BDAR.

It should be noted that examples of species assigned to the Shrub growth form group, were recorded as growing in a manner characteristic of scattered paddock trees within the development corridor, an example being *Pittosporum angustifolium*. However, as these individuals do not occur in the Tree growth form group, they do not form part of the assessment.




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## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - DNG
- 15 - High
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - High
- 16 - Low
- 16 - Moderate
- 16 - Paddock trees
- 21 - Low
- 21 - Moderate
- 23 - DNG
- 23 - High
- 23 - Moderate
- 57 - Low
- 57 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 165 - Moderate
- 170 - DNG
- 170 - High
- 170 - Low
- 170 - Moderate
- 170 - Paddock trees
- 238 - Moderate

**Figure 9.1 Vegetation zones and plot locations**

0 750 1,500 2,250 3,000

Meters

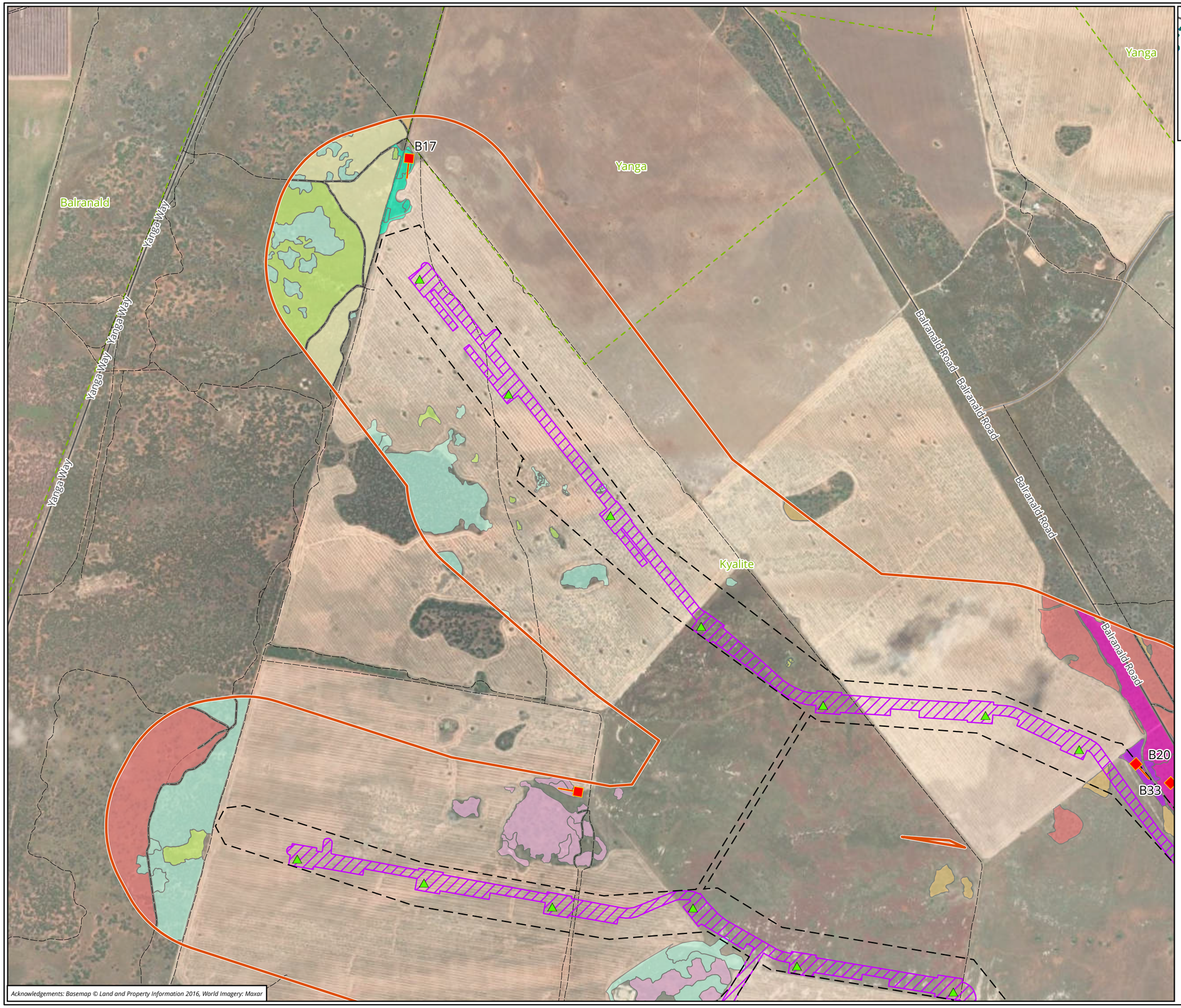
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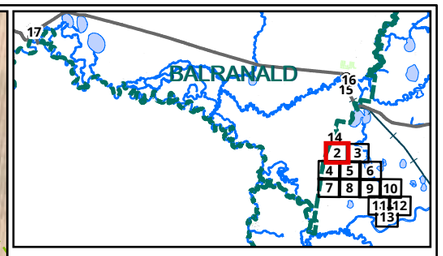
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N

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - Moderate
- 16 - DNG
- 16 - Moderate
- 23 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 170 - DNG
- 170 - High
- 170 - Low
- 170 - Moderate

**Figure 9.2 Vegetation zones and plot locations**

0 170 340 510 680

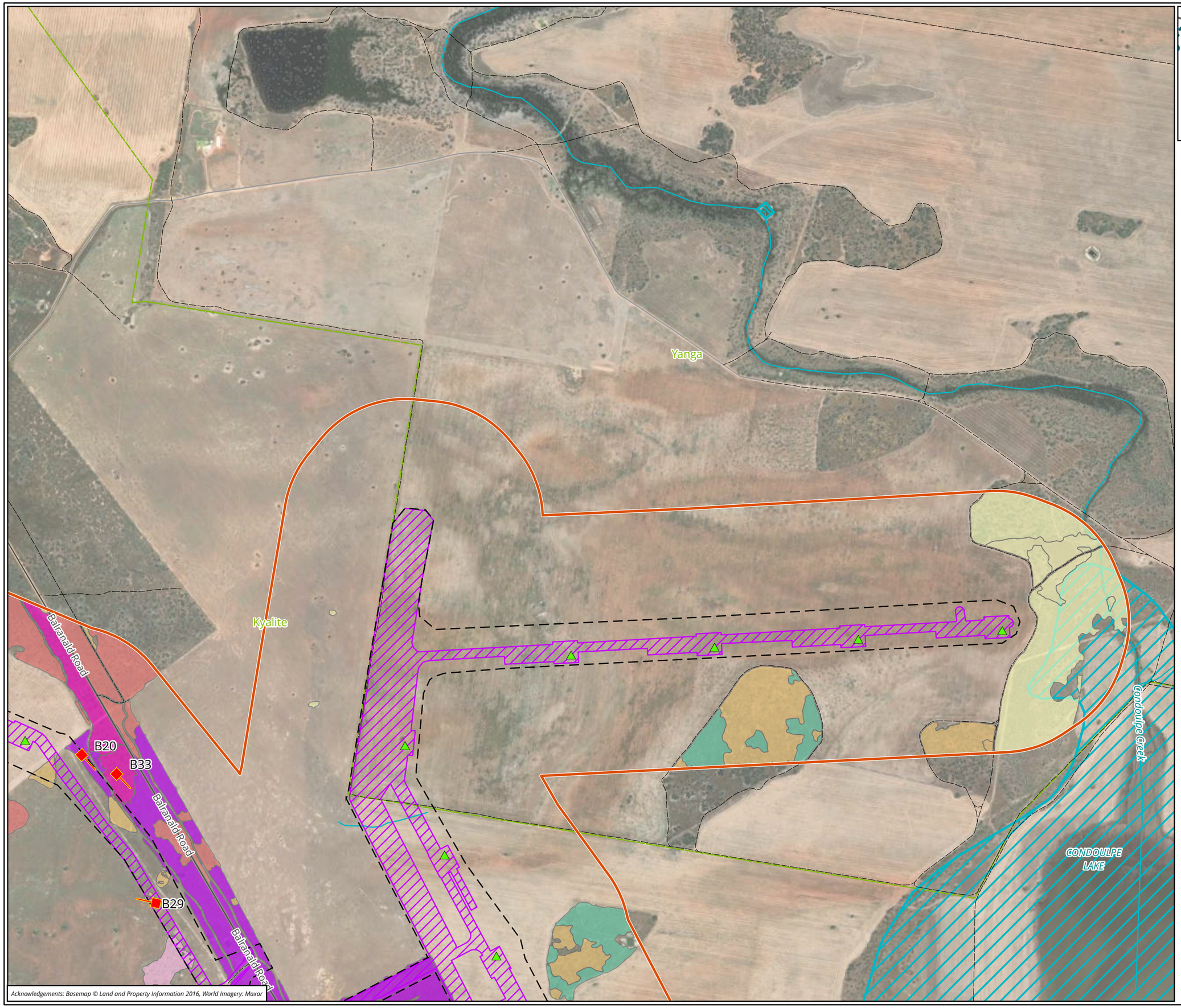
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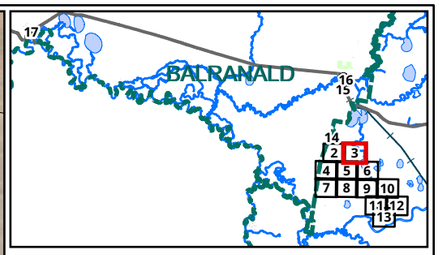
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*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - Low
- 16 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 165 - Moderate

**Figure 9.3 Vegetation zones and plot locations**

0 170 340 510 680

Meters

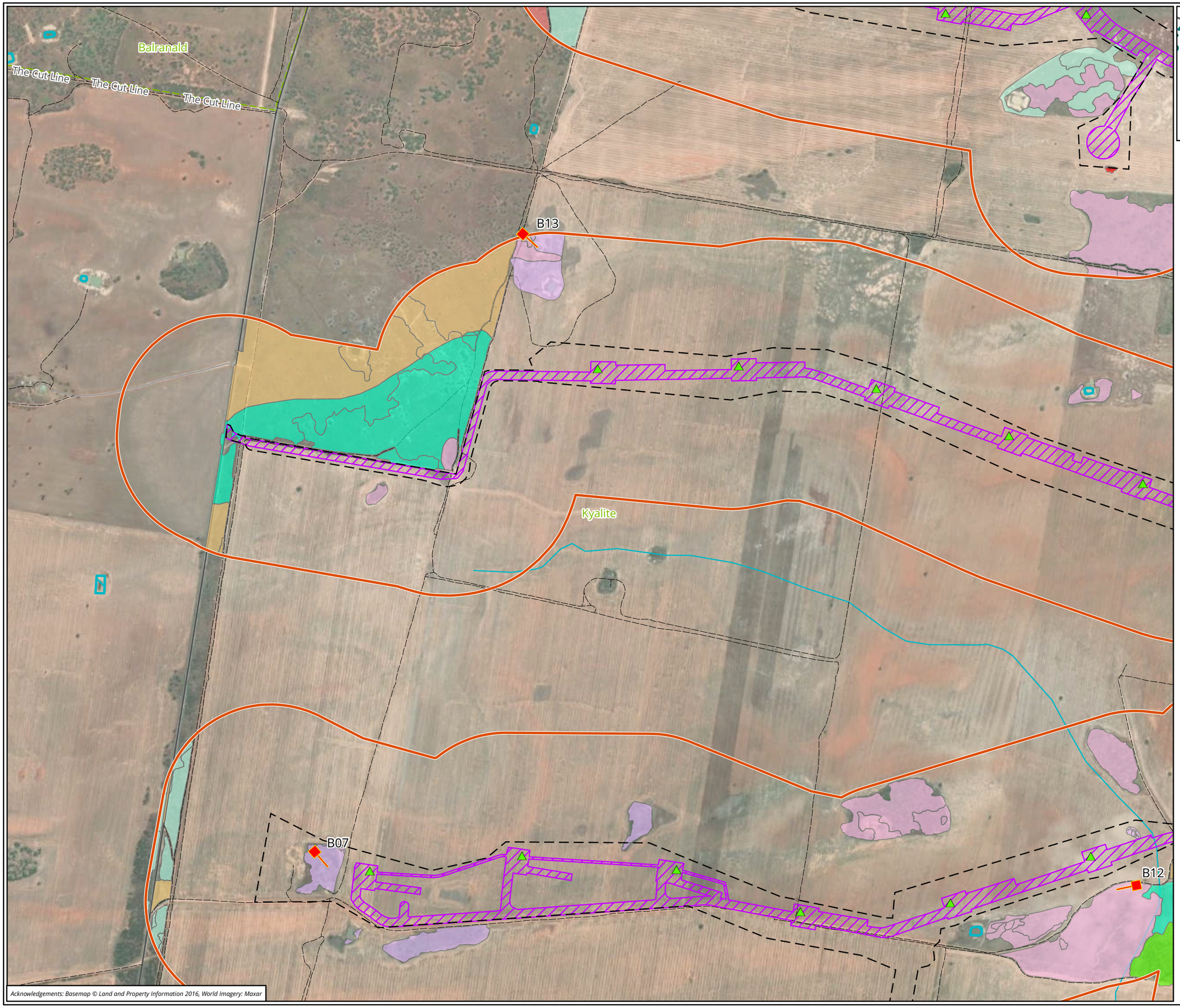
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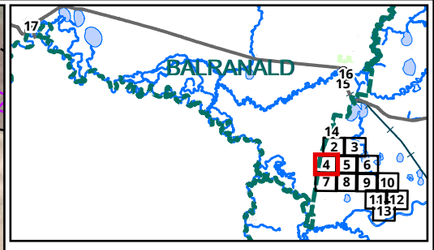
*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 16 - DNG
- 16 - Low
- 16 - Moderate
- 16 - Paddock trees
- 23 - High
- 23 - Moderate
- 58 - Low
- 58 - Moderate
- 170 - DNG
- 170 - Moderate

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 9.4 Vegetation zones and plot locations**

0 170 340 510 680

Meters

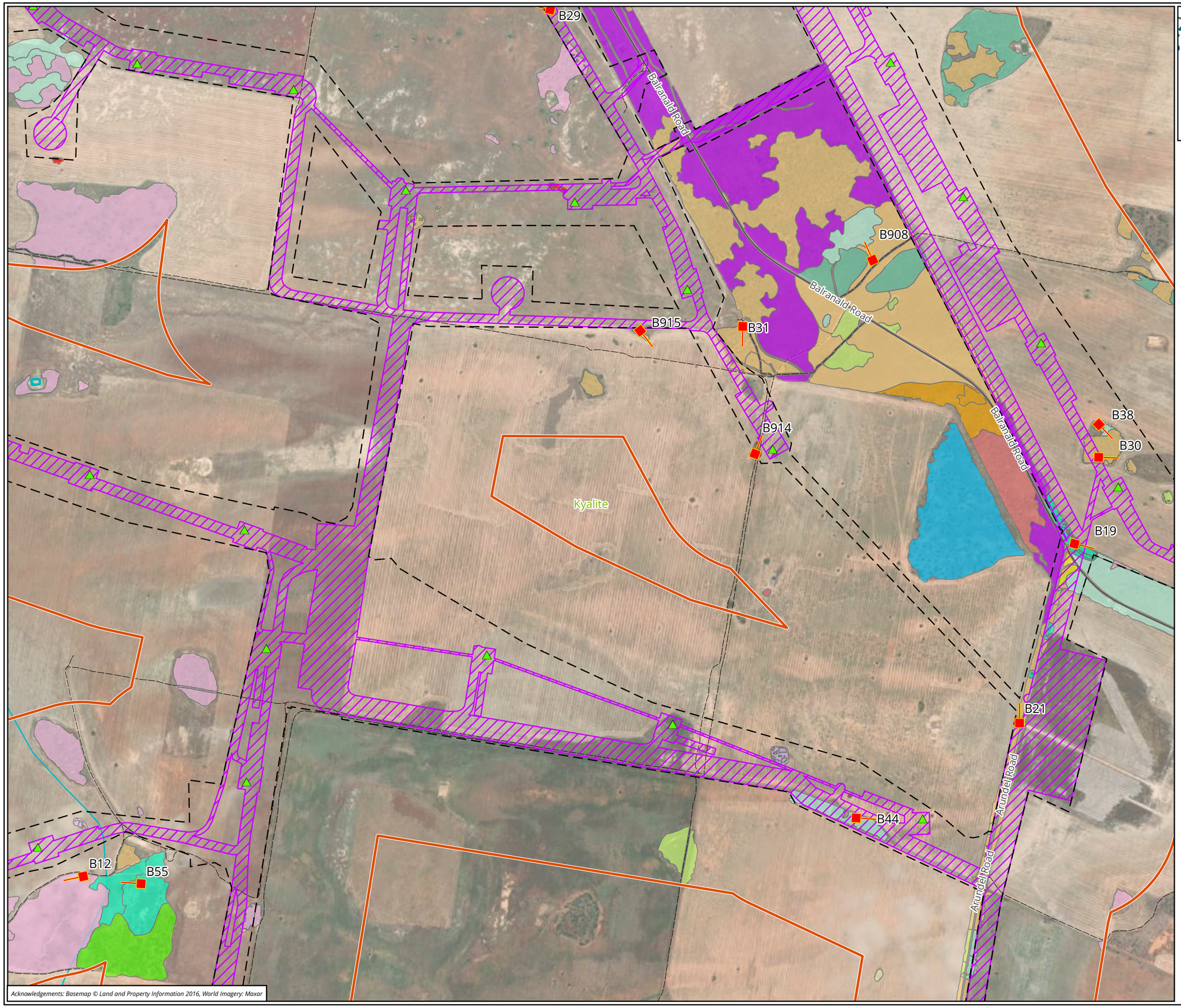
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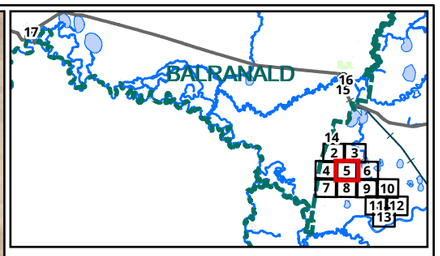
Scale: 1:16,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 16 - Paddock trees
- 21 - Low
- 21 - Moderate
- 23 - High
- 23 - Moderate
- 57 - Low
- 58 - DNG
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 9.5 Vegetation zones and plot locations**

0 170 340 510 680

Meters

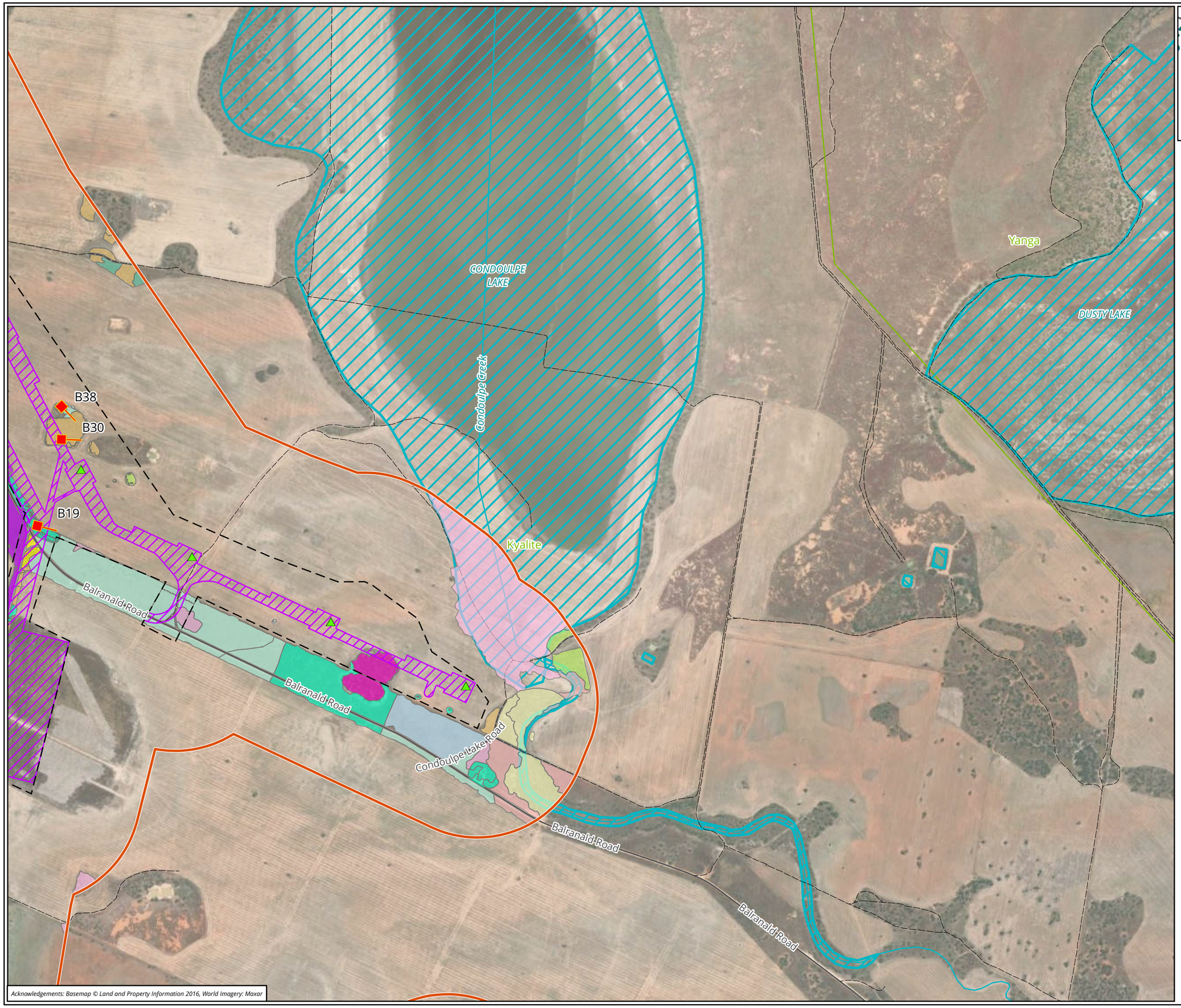
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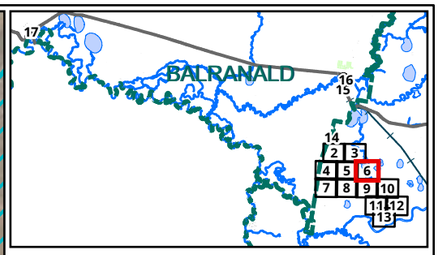
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - DNG
- 15 - High
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - High
- 16 - Moderate
- 21 - Moderate
- 23 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 170 - Low
- 170 - Moderate
- 170 - Paddock trees
- 238 - Moderate

**Figure 9.6 Vegetation zones and plot locations**

0 170 340 510 680

Meters

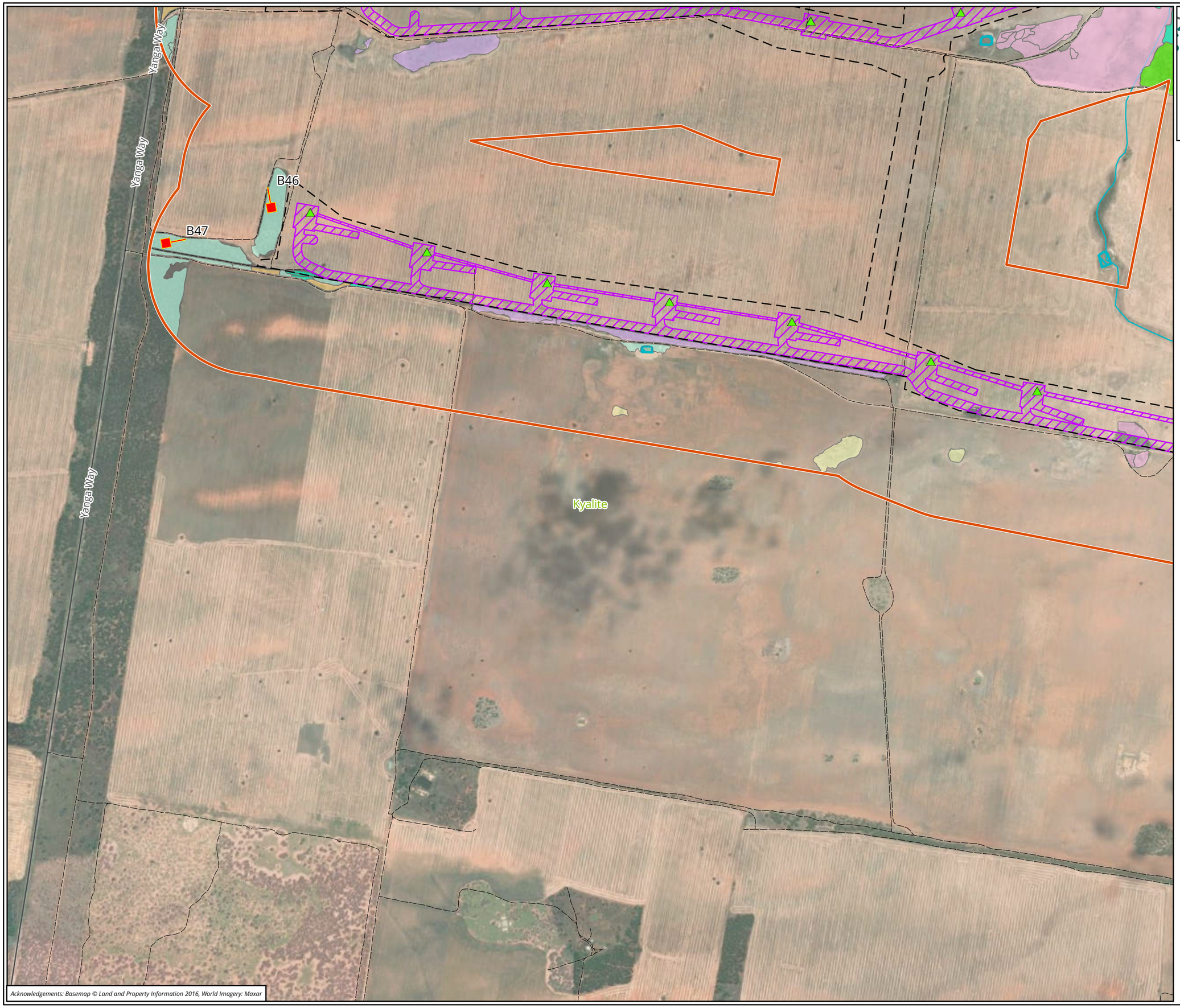
Scale: 1:16,000 @ A3

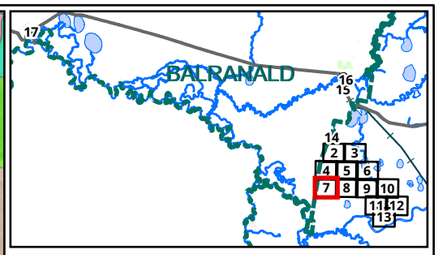
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - Low
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 23 - High
- 23 - Moderate
- 170 - DNG
- 170 - Moderate

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 9.7 Vegetation zones and plot locations**

0 170 340 510 680 N

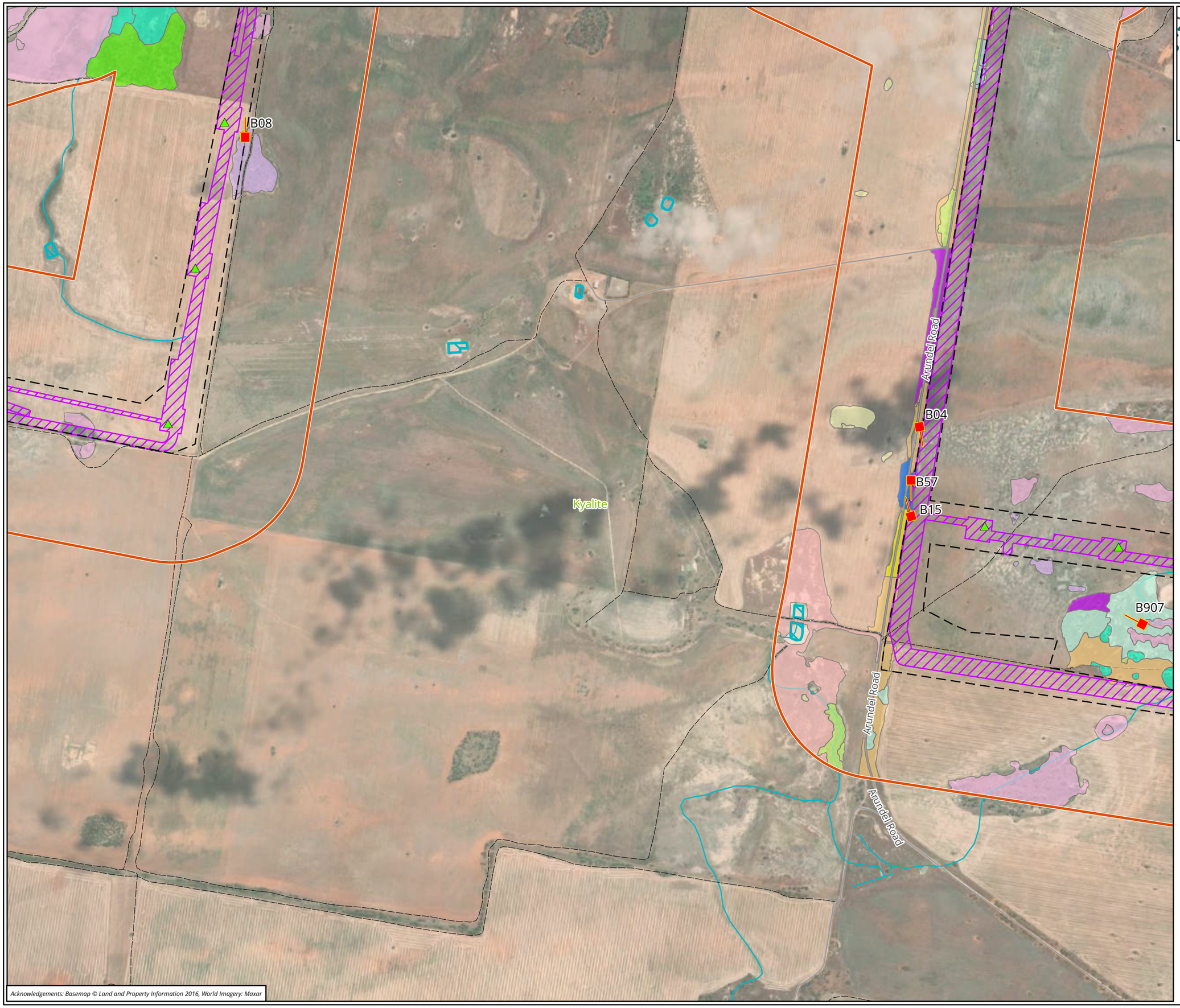
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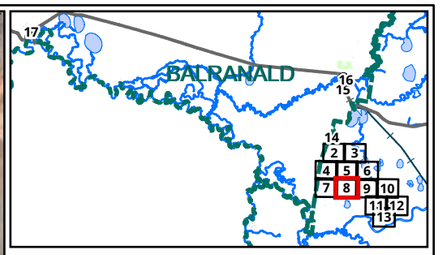
Scale: 1:16,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Moderate
- 23 - High
- 23 - Moderate
- 57 - Moderate
- 58 - DNG
- 58 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 9.8 Vegetation zones and plot locations**

0 170 340 510 680

Meters

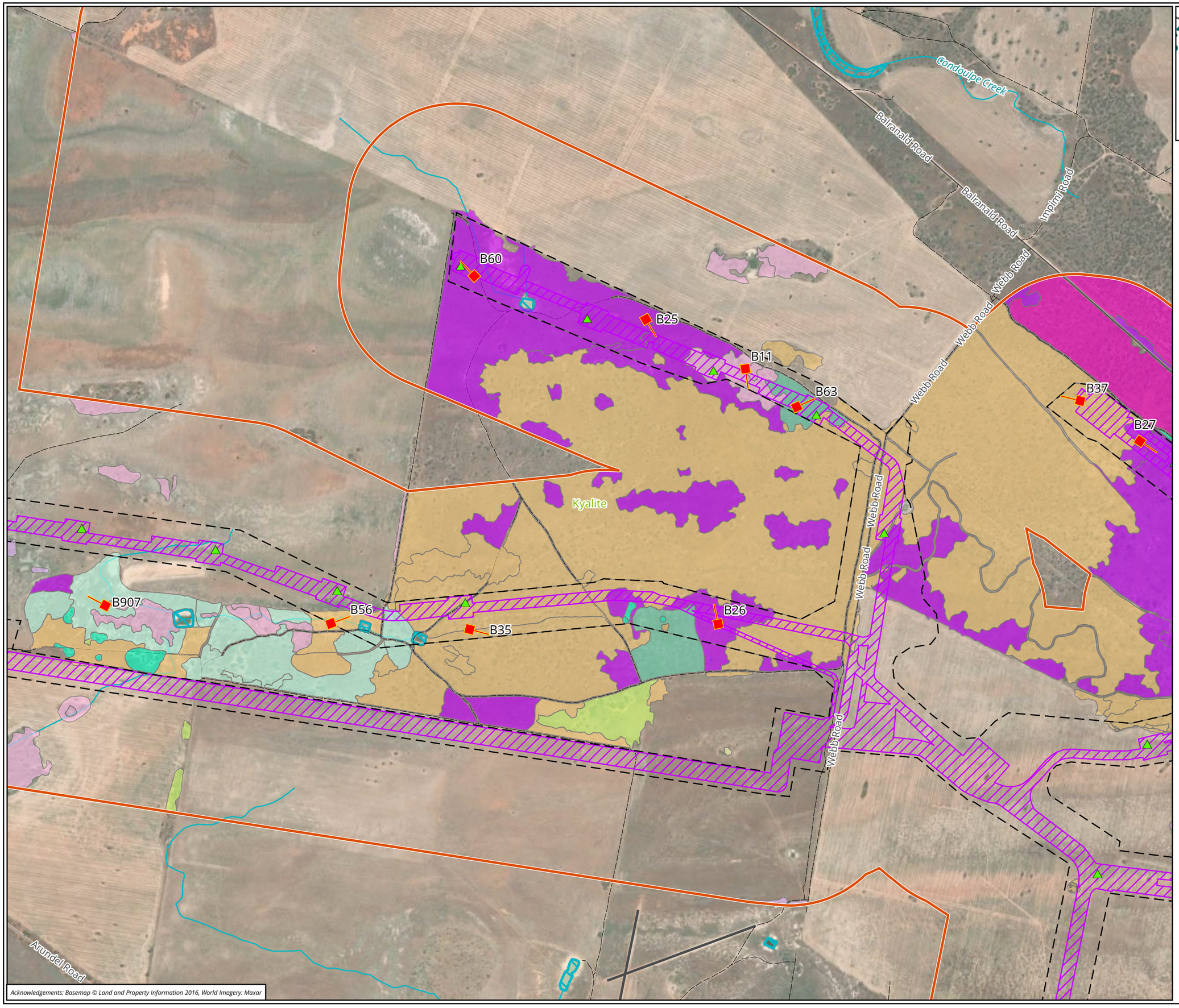
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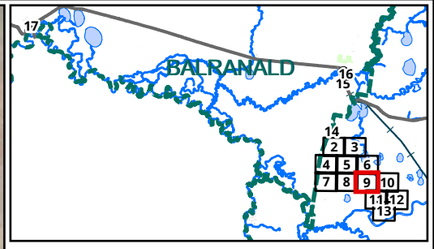
Scale: 1:16,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - Low
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 23 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 9.9 Vegetation zones and plot locations**

0 170 340 510 680

Meters

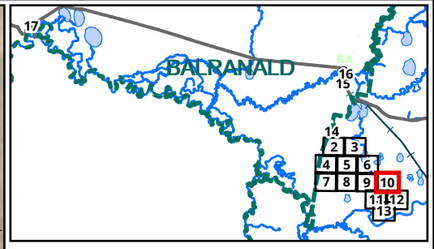
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*Coordinate System: GDA2020 MGA Zone 54*

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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Moderate
- 21 - Low
- 21 - Moderate
- 23 - DNG
- 23 - Moderate
- 57 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 170 - DNG
- 170 - Moderate

Yanga
Condoulpe Creek
HARVEYS LAKE
Moolpa
Kyalite
B37
B27
B40
B18
B903
B41
Balranald Road
Balranald Road
Big Sandhill Road
Big Sandhill Road
Big Sandhill Road
B53
B911
B28
B912

Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar

**Figure 9.10 Vegetation zones and plot locations**

0 170 340 510 680

Meters

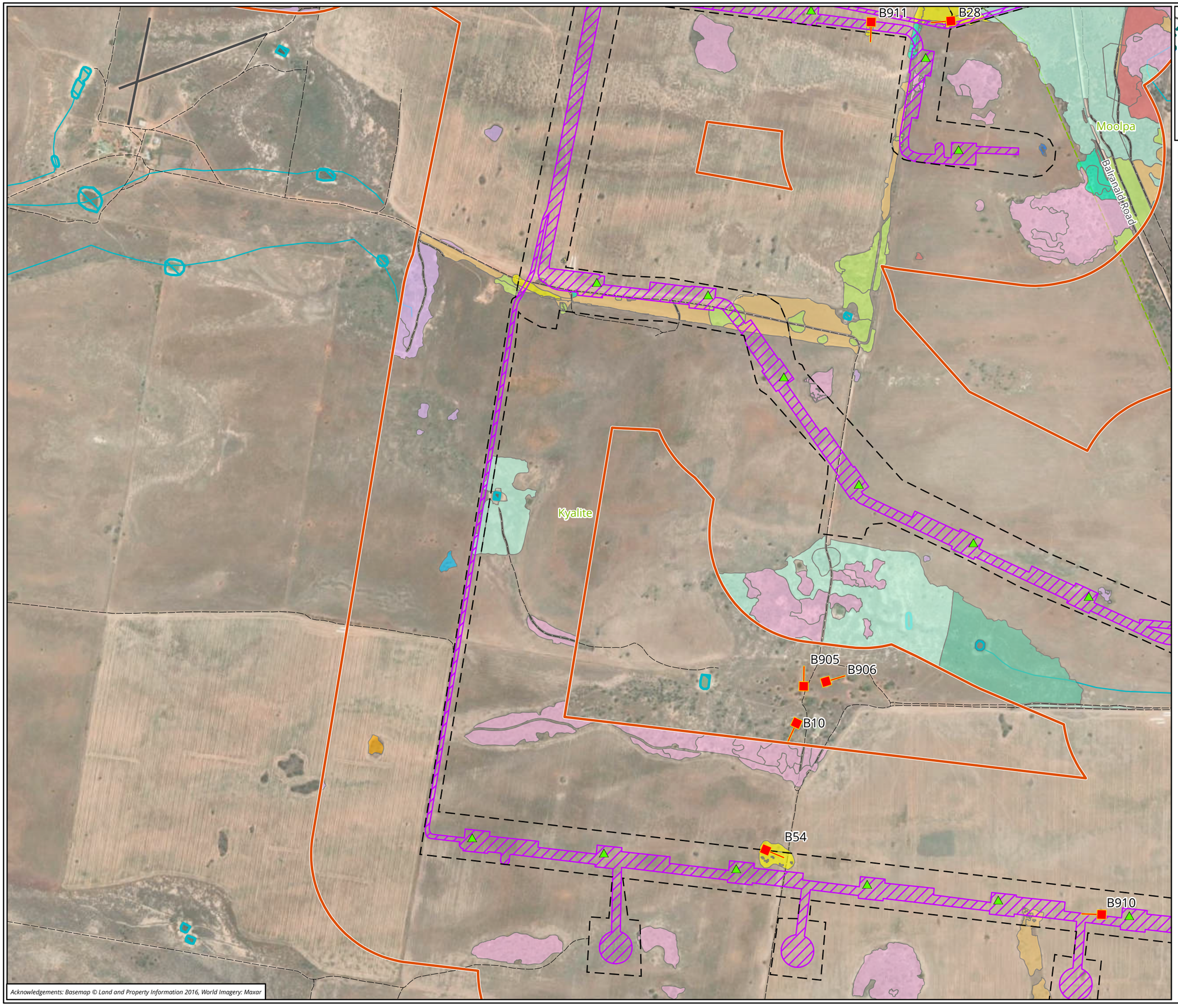
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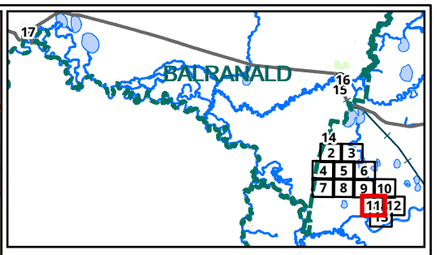
*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Low
- 21 - Moderate
- 23 - Moderate
- 57 - Low
- 57 - Moderate
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 9.11 Vegetation zones and plot locations**

0 170 340 510 680

Meters

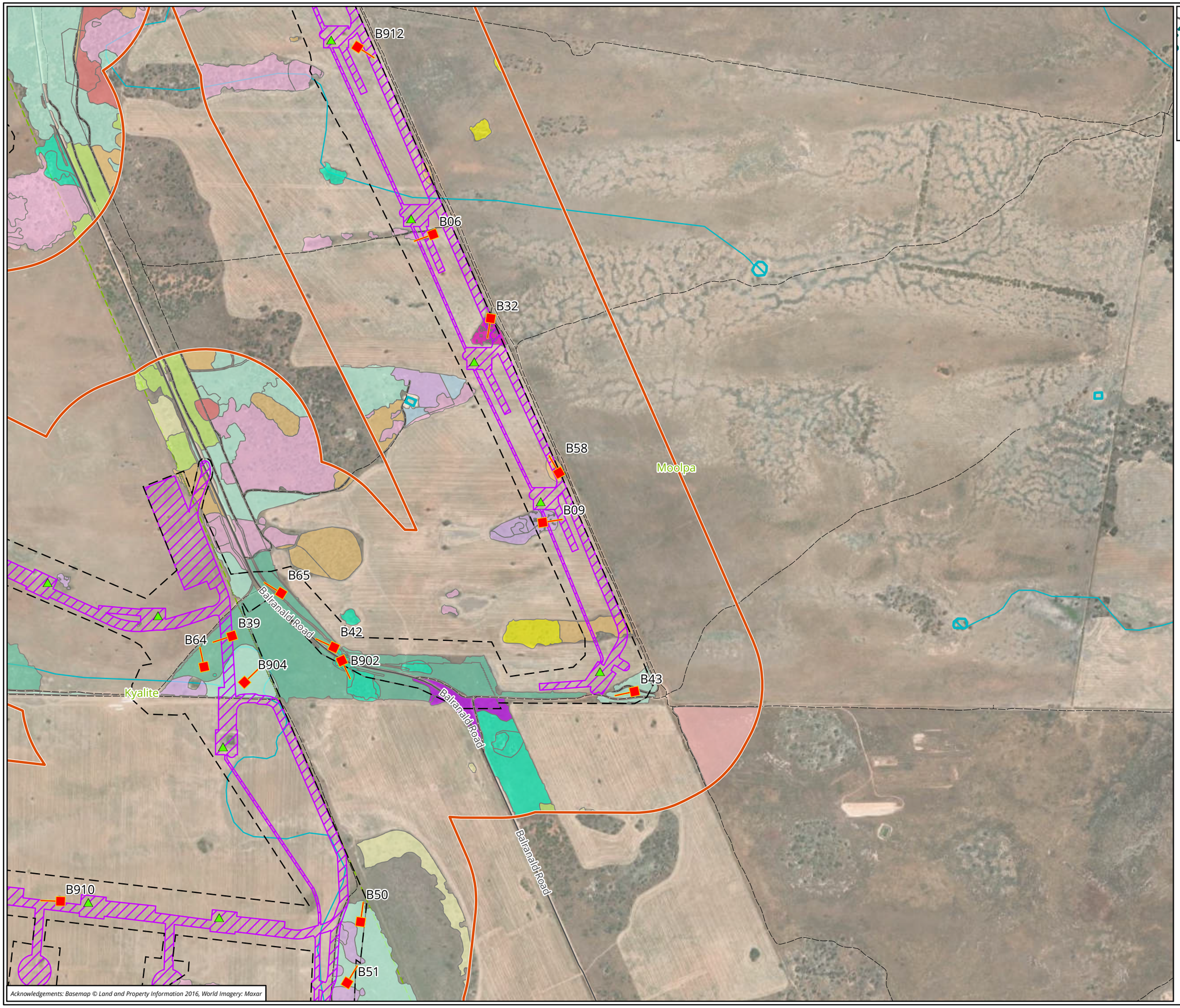
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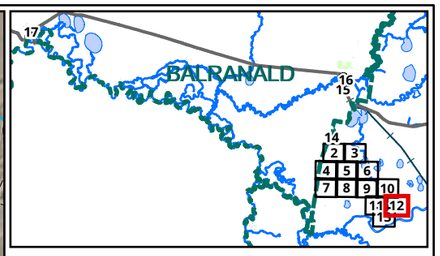
*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 16 - DNG
- 16 - High
- 16 - Low
- 16 - Moderate
- 21 - Moderate
- 23 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 9.12 Vegetation zones and plot locations**

0 170 340 510 680

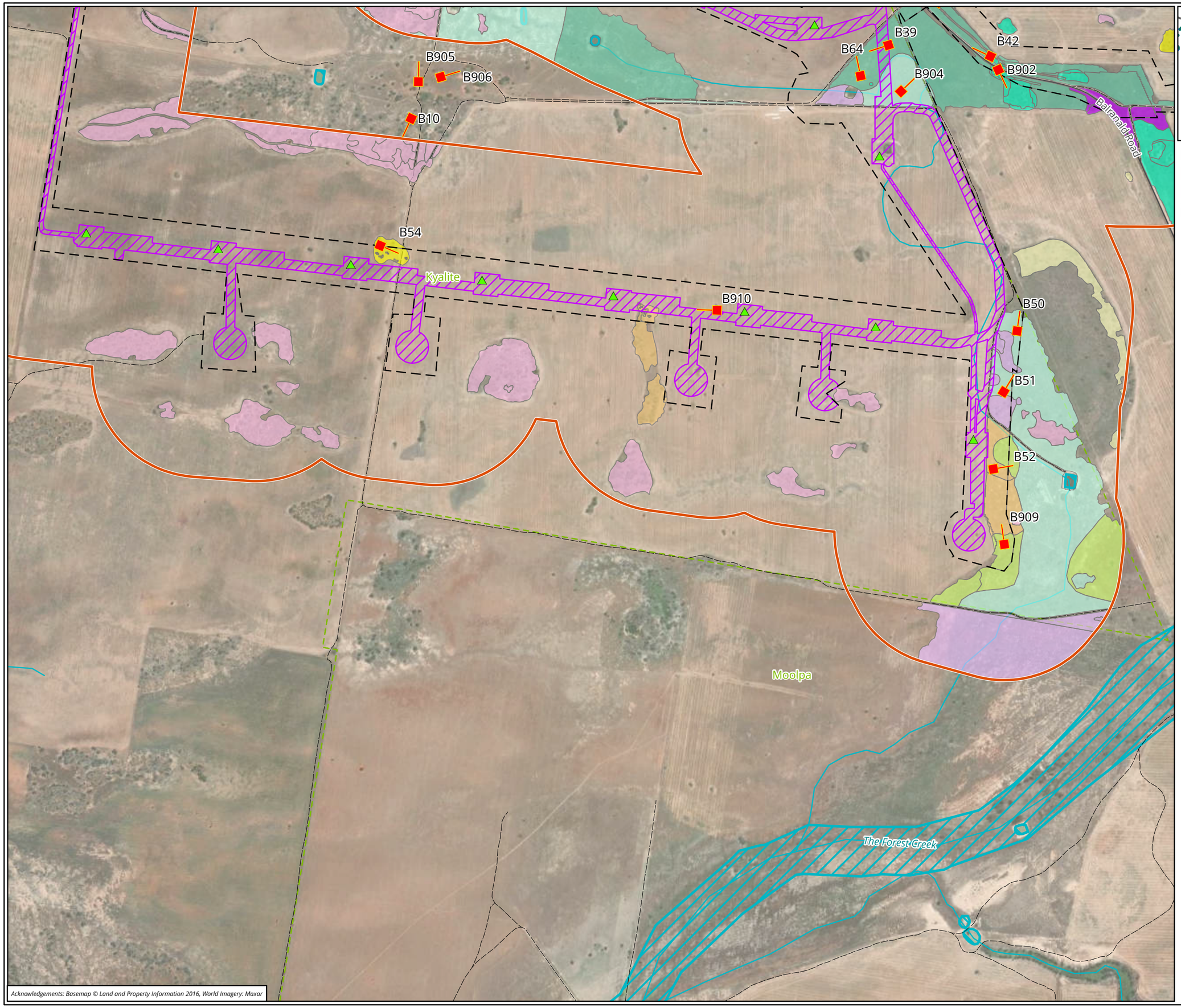
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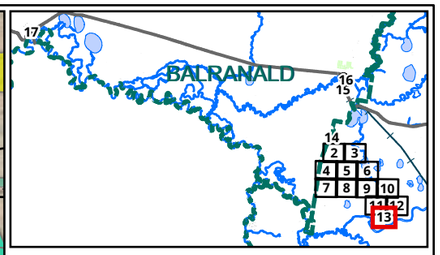
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*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- BAM plot

**Vegetation zones**

- 15 - Low
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Moderate
- 23 - Moderate
- 58 - DNG
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 9.13 Vegetation zones and plot locations**

0 170 340 510 680

Meters

Scale: 1:16,000 @ A3

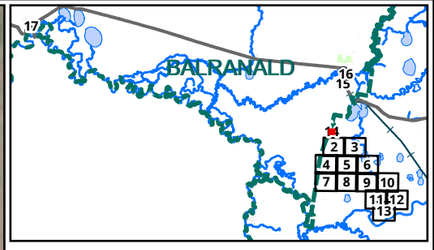
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




**Legend**

- Subject land
- Development footprint

**Vegetation zones**

- 170 - DNG
- 170 - Low

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## Figure 9.14 Vegetation zones and plot locations

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

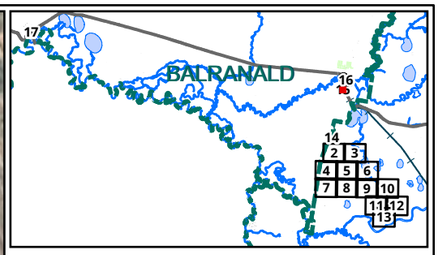
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




**Legend**

- Subject land
- Development footprint

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## Figure 9.15 Vegetation zones and plot locations

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

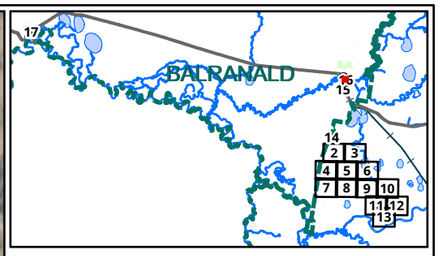
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




**Legend**

- Subject land
- Development footprint

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**Figure 9.16 Vegetation zones and plot locations**

0 20 40 60 80

Meters

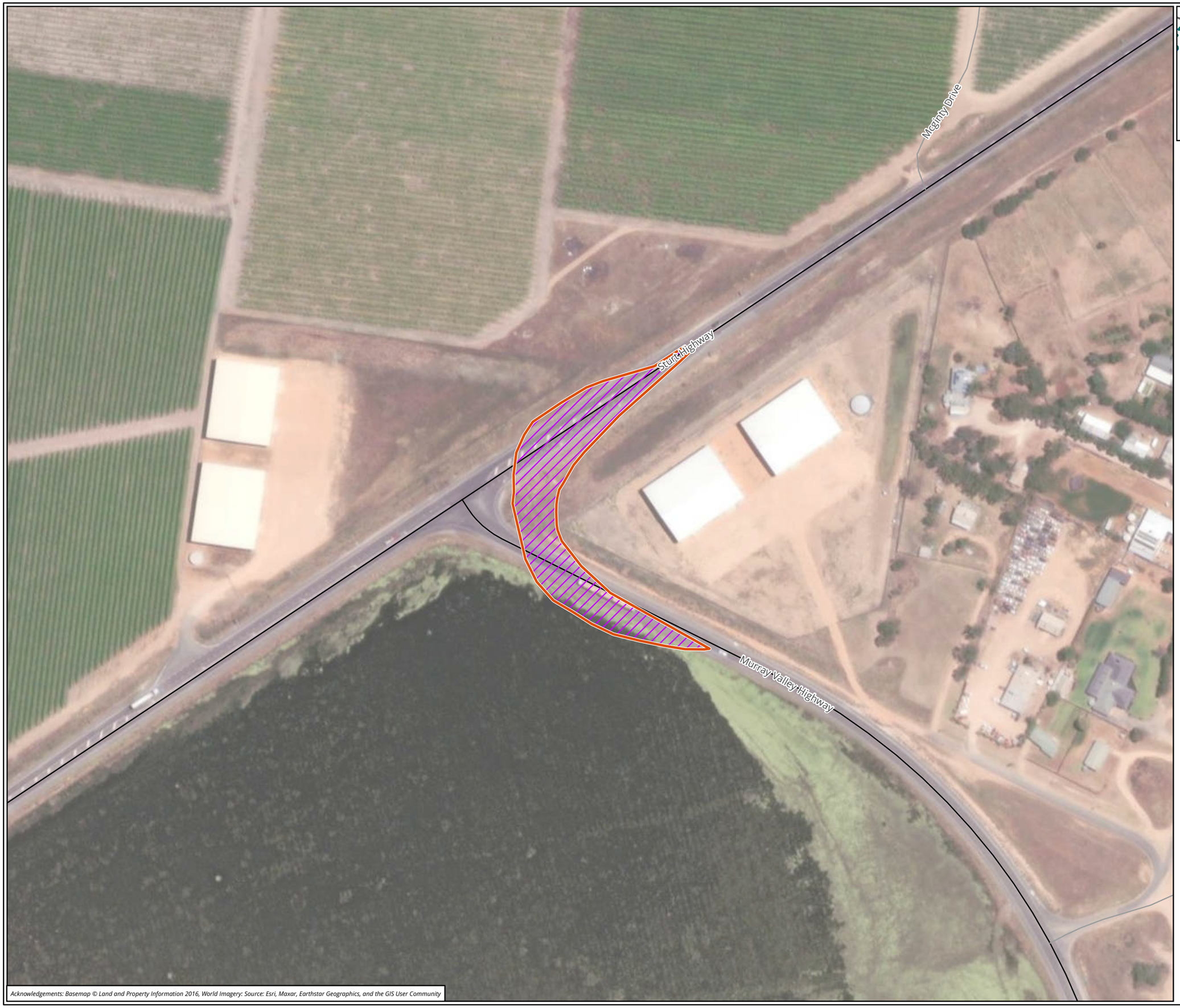
Scale: 1:2,000 @ A3

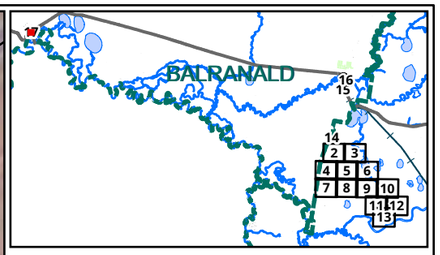
*Coordinate System:*
*GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones




**Legend**

- Subject land
- Development footprint

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**Figure 9.17 Vegetation zones and plot locations**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F9_VegZones

# 4. Threatened species

## 4.1. General habitat types and features

The subject land supports a mosaic of cleared cropping land with scattered paddock trees and small patches, and areas of native vegetation subject to varying levels of disturbance associated with grazing and historical clearing and thinning of trees.

Cropping land covers the vast majority of the subject land, and equates to approximately 86% of the area, or 8591 hectares in total. These areas support limited opportunities for biodiversity due to the broadscale historical vegetation removal and regular disturbance to the soil from seasonal agricultural activities (cultivation, fertilising and chemical application). Areas left fallow for a number of seasons are likely to have some natural regeneration of native coloniser species, however the habitat values supported by these areas is also limited. Paddock trees are somewhat common in cropped areas and provide forage, perching, roosting and potential breeding opportunities for native birds and microbats, and an assessment of the habitat values supported by scattered paddock trees has been undertaken. Patches of three or more paddock trees also occur where some level of resilience is maintained in the understorey and associated woody debris also provides habitat of value for smaller birds, mammals and reptiles. Areas of cropping provide hunting opportunities for raptors due to long uninterrupted lines of sight, and the greater abundance of prey species (e.g. introduced rodents).

Areas not subject to cropping support one of the following broad habitat types; mallee woodland, semi-arid open woodland, occasionally flooded woodlands in depressions, *Acacia* shrublands, patchy grassland/chenopod shrubland areas, or generally disturbed and non-natural areas.

Mallee woodland occurs on rolling remnant sand dunes and ridges and supports a generally lower and denser canopy than other wooded areas. These areas provide habitat for small to medium sized passerine birds, as well as cockatoos and parrots utilising the relatively high density of, generally smaller-sized, tree hollows present, as well as blossom produces by the mallee eucalypt species. The understorey ranges from dense to sparse depending on the level of grazing activity, and woody debris is often present providing habitat for reptiles and small mammals.

Semi-arid open woodlands occur as a low to mid-tall woodland with Black Oak the most common canopy species with a general sub-dominance of the smaller Wilga and Western Rosewood in areas of PCT 58, occurring in the flatter areas between sandhills and watercourses and depressions. Patchy areas of Cypress Pine woodland occur on the larger sandhills, however these areas are generally highly disturbed and mainly comprise mature (and semi-mature) trees over a degraded understorey. Open woodland habitats support larger-sized tree hollows, higher in trees, when compared to mallee woodland, and were found to be occupied more consistent by larger cockatoo species. As with mallee the condition and composition of the understory habitat are largely dependent on the grazing history with grassy habitats more common in less heavily grazed areas, and chenopods found to be more common where sheep and cattle had been kept for longer, more regular periods of time.

Mallee woodland and open woodland are most likely to support habitat for threatened flora species known and with the potential to occur within the subject land such as Major Mitchell's Cockatoo, Regent Parrot and Bush Stone-curlew.

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Black Box dominated woodlands occur in areas associated with depression in the landscape and proximal to watercourses where soils are more regularly inundated or waterlogged. Grazing history was again found to be the most apparent driver of habitat condition, although patches of Black Box woodland isolated by surrounding cropped areas were generally found to be heavily weed infested. Depressional woodlands were found to support large amounts of woody debris providing habitat on the ground layer, with the midstorey being generally sparse, and the low canopy providing habitat for smaller birds. Tree hollows are common throughout Black Box woodland, with some large hollows recorded, Black Box trees also provide nectar and blossom feed opportunities for birds.

*Acacia* shrublands generally occur as small patches of low trees with an open understory surrounded by other woodland types. Habitat values within *Acacia* shrublands are generally quite limited as a result of grazed understorey, a paucity of small tree hollows and limited woody debris. Grasslands and chenopod shrublands (dominated by Dillon Bush) generally occur as small to medium sized patches interspersed between or adjacent to patches of woodland communities. Habitats provided by these areas are limited to shelter habitat for smaller and ground-dwelling fauna species, and open hunting opportunities for raptors.

All wooded areas support forage opportunities for insectivorous microbat species, that are likely to forage above and below the canopies. Open areas between wooded patches provide flyways, however larger open areas or cropping and grasslands / low chenopod shrublands provide limited opportunities for bats.

As outlined above, livestock grazing and historical vegetation removal are the key drivers for habitat condition and the associated potential for threatened flora species to occur. Areas of highest condition occur in areas where these practices have been generally excluded or occur at lower intensity such as roadsides and travelling stock routes.

Natural waterbodies are generally absent from the subject land, with larger ephemeral lakes occurring in the surrounding landscape and associated watercourses generally also occurring outside the subject land. Condoulpe Lake and Condoulpe Creek occur just inside the subject land, but outside the development corridor, in the north-east of the subject land. The Forest Creek occurs close to the project's south-eastern extent and the Wakool River occurs approximately 5 kilometres to the south-west. Within the subject land aquatic habitats are limited to farm dams and ephemeral flooded depressions and drainage line and provide limited habitat opportunities to biodiversity values due to their generally degraded nature. Areas of highest condition habitat are associated with areas of Black Box woodland that has been less subject to grazing and trampling of stock, however these areas are infrequent within the subject land.

The subject land does not support areas of habitat associated with caves, karsts, rock outcropping or other geologically unique areas.

### 4.1.1. Flora habitat assessments

Flora habitat assessments were undertaken during the stratification of vegetation communities and vegetation zones. Habitat assessment was undertaken to determine if PCTs supported the critical habitat components for flora species, or contained degraded habitat that would not support threatened flora species identified as candidate species (species credit species) by the BAM Calculator. An assessment of the potential for candidate flora species was undertaken following completion of initial habitat assessments and the results are outlined in Table A 1, Appendix 2.

### 4.1.2. Fauna habitat assessments

Fauna habitat assessments were undertaken to determine the presence, microhabitats and other critical habitat components (habitat constraints) suitable for all threatened fauna species considered predicted species (ecosystem credit species) or candidate species (species credit species) under the BAM. Habitat assessments focussed on the presence of the features such as those listed below:

- Habitat trees including large and/or hollow-bearing trees, stick nests, availability of flowering shrubs and canopy/understorey feed tree species.
- Condition and type of native vegetation and the presence of exotic species.
- Presence and condition of pools and waterways.
- Quantity of ground litter and woody debris.
- Searches for indirect evidence of fauna (i.e., feathers, tracks and scats).
- General degradation of the site as a result of past and current disturbances such as grazing, vegetation clearing and rural land management practices.
- Abundance of introduced predators such as cats and foxes.
- Topography and landscape morphology.
- Soil type and presence of cliffs, overhangs and other rocky areas.

Several habitat features with potential to support threatened species credit species were identified during these habitat assessments, including tree hollows, stick nests, woody debris, flowering shrub/tree species, and an assessment of the suitability for these features to support the presence of potential candidate species is presented in Table A 2, Appendix 2.

Field capture of detailed fauna habitat information allowed for confirmation of presence/absence of habitat features and microhabitats for the range of candidate species across surveyed portions of the subject land. Fauna habitat assessments were captured using ArcGIS polygons attributed with specific habitat criteria that allowed for planning of further targeted survey for select species, or the exclusion of the potential for occurrence of various candidate species from the subject land.

## 4.2. Ecosystem credit species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was generated as per Section 5 of the BAM (DPIE 2020a). Impacts to these species require assessment, however targeted surveys are not required as these species are assumed to occur, based on the occurrence of the PCTs, habitat constraints, native vegetation cover in the landscape and calculated patch sizes. These species are identified as ecosystem credit species under the Threatened Biodiversity Data Collection (TBDC). Table 15 lists the ecosystem credit species that could not be discounted, based on geographical restrictions or a lack of suitable habitat, from using the subject land on occasion.

These species were considered when prescribing management and mitigation measures for the project, and a number have been specifically considered as part of the assessment of prescribed impacts and under the Commonwealth EPBC Act.

No ecosystem credit species have been discounted from occurring within the subject land. All ecosystem credit species are considered relevant to the project.

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**Table 15 Ecosystem credit species (predicted species) with potential to occur**

| Common name | Species name | Recorded in the subject land |
|---|---|---|
| **Barking Owl** | *Ninox connivens* | - |
| **Black Falcon** | *Falco subniger* | Yes |
| **Black-breasted Buzzard** | *Hamirostra melanosternon* | - |
| **Bolam's Mouse** | *Pseudomys bolami* | - |
| **Brolga** | *Grus rubicunda* | - |
| **Chestnut Quail-thrush** | *Cinclosoma castanotum* | - |
| **Corben's Long-eared Bat** | *Nyctophilus corbeni* | Yes (Potential) |
| **Diamond Firetail** | *Stagonopleura guttata* | - |
| **Dusky Woodswallow** | *Artamus cyanopterus cyanopterus* | - |
| **Gilbert's Whistler** | *Pachycephala inornata* | - |
| **Grey Falcon** | *Falco hypoleucos* | - |
| **Grey-crowned Babbler (eastern subspecies)** | *Pomatostomus temporalis temporalis* | - |
| **Hooded Robin (south-eastern form)** | *Melanodryas cucullata cucullata* | - |
| **Inland Forest Bat** | *Vespadelus baverstocki* | - |
| **Interior Blind Snake** | *Ramphotyphlops endoterus* | - |
| **Jewelled Gecko** | *Strophurus elderi* | - |
| **Kultarr** | *Antechinomys laniger* | - |
| **Little Eagle** | *Hieraaetus morphnoides* | - |
| **Little Pied Bat** | *Chalinolobus picatus* | - |
| **Major Mitchell's Cockatoo** | *Lophochroa leadbeateri* | Yes |
| **Mallee Worm-lizard** | *Aprasia inaurita* | - |
| **Malleefowl** | *Leipoa ocellata* | - |
| **Marble-faced Delma** | *Delma australis* | - |
| **Painted Honeyeater** | *Grantiella picta* | - |
| **Pied Honeyeater** | *Certhionyx variegatus* | - |
| **Purple-crowned Lorikeet** | *Glossopsitta porphyrocephala* | - |
| **Purple-gaped Honeyeater** | *Lichenostomus cratitius* | - |
| **Redthroat** | *Pyrrholaemus brunneus* | - |
| **Regent Parrot (eastern subspecies)** | *Polytelis anthopeplus monarchoides* | Yes |
| **Ringed Brown Snake** | *Pseudonaja modesta* | - |
| **Sandy Inland Mouse** | *Pseudomys hermannsburgensis* | - |
| **Scarlet-chested Parrot** | *Neophema splendida* | - |
| **Shy Heathwren** | *Hylacola cautus* | - |

| Common name | Species name | Recorded in the subject land |
|---|---|---|
| **Southern Ningaui** | *Ningaui yvonneae* | - |
| **Spotted Harrier** | *Circus assimilis* | Yes |
| **Square-tailed Kite** | *Lophoictinia isura* | - |
| **Stripe-faced Dunnart** | *Sminthopsis macroura* | - |
| **Varied Sittella** | *Daphoenositta chrysoptera* | - |
| **Western Blue-tonged Lizard** | *Tiliqua occipitalis* | - |
| **Western Pygmy Possum** | *Cercartetus concinnus* | - |
| **White-bellied Sea-Eagle** | *Haliaeetus leucogaster* | - |
| **White-fronted Chat** | *Epthianura albifrons* | Yes |
| **Yellow-bellied Sheathtail-bat** | *Saccolaimus flaviventris* | - |
| **Yellow-tailed Plain Slider** | *Lerista xanthura* | - |

## 4.3. Species credit species

Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence, or components of their habitat. These candidate species are identified as species credit species in the TBDC. A targeted survey or an expert report is required to confirm the presence of those species with potential habitat present within the subject land, or alternatively the species can be assumed to be present (DPIE 2020a).

Appendix 2 provides the complete lists of species credit species predicted to occur within the subject land based on the presence of the Murray Darling Depression IBRA region and South Olary Plain IBRA subregion within which the project occurs, as well as the Riverina IBRA region and Murrumbidgee IBRA subregion, which occurs in close proximity to the project's eastern boundary. The native vegetation cover present within the 1500 metre buffer area, the PCTs present within subject land, and patch sizes listed in Table 12, are also considered when deriving a list of predicted species credit species.

The potential for a species to occur within the subject land was assessed in accordance with Section 5.2 of the BAM (DPIE 2020a) and species with geographical restrictions, or habitat constraints not present, were not required to be assessed. The following candidate species were excluded, based on the parameters listed below:

- Regent Parrot (eastern subspecies) *Polytelis anthopeplus monarchoides* (**Breeding**).
  - Habitat constraint: Living or dead *E. camaldulensis* with hollows greater than 5 centimetres diameter, greater than 5 metres above the ground OR trees with DBH of greater than 40 centimetres, within 1 kilometre of watercourses or billabongs. Trees can be isolated but within 20 kilometres of mallee.

Although Regent Parrots were recorded during numerous survey periods, no *E. camaldulensis* are present within the subject land, therefore this species is assessed as an ecosystem species only as well as for prescribed impacts (collision risk). Further assessment of Regent Parrots use of the subject land is included in Appendix 9.

A detailed assessment of potential for occurrence, and potential for impact, for all species credit species predicted to occur within the subject land (based on species associated with both the South Olary Plain and Murrumbidgee IBRA subregions) is provided in Appendix 2. Species credit species considered to potentially occur within the subject land, and thus considered 'candidate species credit species' have been subject to targeted species surveys detailed below.

No species credit species not predicted by the BAM Calculator or BioNet to occur within the subject land were added to the assessment as candidate species credit species.

Candidate species credit species considered as part of this assessment, and their associated method of assessment, are listed in Table 16 (flora species) and Table 17 (fauna species).

### Threatened flora candidate species

Habitats for threatened flora species within the subject land are considered to range from moderate to low quality based on the level of, and natural response to, historical and ongoing influences/disturbances, such as historical clearing and subsequent levels of re-growth/regeneration, soil disturbance and grazing (including soil compactions and nutrification) and agricultural processes associated with cropped areas. Habitats within areas of more intact PCTs are of a higher quality where vegetation occurs that has been less disturbed. These areas support a range of open woodlands, and where higher levels of native understorey cover, create a range of potential habitats for threatened species. Such areas generally occur along roadsides, such as along Balranald-Moulamein Road running north-west to south-east through the subject land, and travelling stock routes such as along Yanga Way to the west of the subject land.

Areas of relatively higher condition and lower associated negative pressure do also occur throughout the subject land on the private properties that comprise the subject land, however they are generally patchy and isolated, with the exception of the large area of PCT 58 Black Oak – Western Rosewood open woodland in the central portion of the subject land. It should be noted however that no candidate flora species are associated with PCT 58, and as such habitats for the suite of candidate flora assessed within the development corridor generally fall into the categories of being more patchy and isolated, with a high proportion of impacts occurring to degraded edge habitats.

Areas subject to historical vegetation removal which have formed derived versions of their natural PCTs, or existing as areas subject to ongoing agricultural activities, support moderate to low (and negligible) levels of habitat suitability for threatened species due to a lack of floristic structure and a more exhausted seedbank.

Table 16 provides a list of candidate flora species credit species considered in this assessment, each species' required survey period and the relevant method of assessment. Further detail of the targeted surveys undertaken are provided below. Species not considered candidates are not listed, and the rationale for exclusion from the assessment is presented in Table A 1, Appendix 2.

**Table 16 Candidate flora species credit species**

| Species name | Common name | Survey period (BioNet) | Method of assessment |
|---|---|---|---|
| ***Acacia acanthoclada*** | Harrow Wattle | August – November | Targeted survey September and October. |
| ***Austrostipa metatoris*** | A spear-grass | October – November | Targeted survey October and December. |
| ***Brachyscome papillosa*** | Mossgiel Daisy | September – November | Targeted survey September and October. |

| Species name | Common name | Survey period (BioNet) | Method of assessment |
|---|---|---|---|
| ***Calotis moorei*** | A burr-daisy | September – November | Targeted survey September and October. |
| ***Lasiopetalum behrii*** | Pink Velvet Bush | All year | Targeted survey March, September, October and December. |
| ***Lepidium monoplocoides*** | Winged Peppercress | September – December | Targeted survey September, October and December. |
| ***Pimelea serpyllifolia* subsp. *serpyllifolia*** | Thyme Rice-Flower | July – November | Targeted survey September and October. |
| ***Pterostylis cobarensis*** | Greenhood Orchid | October | Targeted survey October. |
| ***Santalum murrayanum*** | Bitter Quandong | All year | Targeted survey March, September, October and December. |
| ***Solanum karsense*** | Menindee Nightshade | September – November | Targeted survey September and October. |
| ***Swainsona pyrophila*** | Yellow Swainson-pea | September – November | Targeted survey September and October. |
| ***Swainsona sericea*** | Silky Swainson-pea | September – November | Targeted survey September and October. |

### Threatened fauna candidate species

Fauna habitat assessment was undertaken to determine whether the habitats to be impacted by the proposed development contained microhabitats suitable to support the candidate fauna species credit species, as outlined in Appendix 2.

As discussed above understorey habitats are generally degraded within the subject land and subject to negative pressures associated with grazing and weed ingress, as such and considered to be of little value to potential candidate fauna species that relay on higher condition understorey habitats for survival. Woody debris is present on the ground throughout the majority of woodland patches and provides a habitat resource for some species. Key habitat components suitable for a range of potential candidate fauna species are associated with woodland vegetation and the presence of tree hollows and larger nest trees, potentially utilised for breeding. As previously mentioned, wooded habitats within the subject land are generally patchy and somewhat isolated meaning patch sizes are generally smaller and likely to be generally less suitable for birds that require larger tracts of habitats for breeding and nesting purposes. Again, the larger patch of PCT 58 Black Oak – Western Rosewood open woodland in the central portion of the subject land provides a relatively larger and less disturbed patch of habitat, however tree hollows are relatively sparse in this location and nest tress were not recorded.

Table 17 provides a list of candidate fauna species credit species considered in this assessment, each species' required survey period and the relevant method of assessment. Further detail of the targeted surveys undertaken are provided below. Species not considered candidates are not listed, and the rationale for exclusion from the assessment is presented in Table A 2, Appendix 2.

**Table 17 Candidate fauna species credit species**

| Species name | Common name | Survey period | Method of assessment |
|---|---|---|---|
| ***Ardeotis australis*** | Australian Bustard | All year | All biodiversity surveys completed within the subject land |
| ***Hamirostra melanosternon*** **(Breeding)** | Black-breasted Buzzard | September – November | Diurnal bird surveys* - November 2021 and October 2022 |
| ***Burhinus grallarius*** | Bush Stone-curlew | All year | Nocturnal bird surveys – February 2023 |
| ***Hieraaetus morphnoides*** **(Breeding)** | Little Eagle | August – October | Diurnal bird surveys * - August, November 2021 and July, October 2022 |
| ***Lophochroa leadbeateri*** **(Breeding)** | Major Mitchell's Cockatoo | September – December | Diurnal bird surveys * - November 2021 and October 2022 |
| ***Lophoictinia isura*** **(Breeding)** | Square-tailed Kite | September – January | Diurnal bird surveys * - November 2021 and October 2022 |
| ***Haliaeetus leucogaster*** **(Breeding)** | White-bellied Sea-Eagle | July – December | Diurnal bird surveys * - August, November 2021 and July, October 2022 |

*** Surveys completed by Nature Advisory as part of bird utilisation studies**

### 4.3.1. Threatened species survey details

Targeted threatened species surveys of the subject land were undertaken by Biosis between 26 September 2022 and 31 March 2023. Weather observations for each survey date are shown in Table 18.

**Table 18 Weather observations during targeted flora and fauna surveys (Balranald, NSW)**

| Survey undertaken | Survey date | Temperature (°C) | | Rain (mm) |
|---|---|---|---|---|
| | | Min. | Max. | |
| **September threatened flora surveys** | 26/09/2022 | 12.0 | 20.2 | 2.2 |
| | 27/09/2022 | 7.9 | 17.0 | 1.6 |
| | 28/09/2022 | 10.9 | 19.8 | 22.6 |
| | 29/09/2022 | 8.0 | 19.6 | 0 |
| | 30/09/2022 | 7.9 | 23.1 | 0 |
| **October threatened flora surveys** | 24/10/2022 | 16.6 | 20 | 32.6 |
| | 25/10/2022 | 12.5 | 22.9 | 18.8 |
| | 26/10/2022 | 14.5 | 21.9 | 12.8 |
| | 27/10/2022 | 13.5 | 21.4 | 0 |
| **February nocturnal bird surveys** | 20/02/2023 | 15.5 | 39.0 | 0 |
| | 21/02/2023 | 19.3 | 36.0 | 0 |

| Survey undertaken | Survey date | Temperature (°C) | | Rain (mm) |
|---|---|---|---|---|
| | | Min. | Max. | |
| | 22/02/2023 | 15.7 | 35.0 | 0 |
| | 23/02/2023 | 19.2 | 32.5 | 0 |
| **March threatened flora surveys** | 29/03/2023 | 15.6 | 23.0 | 2.0 |
| | 30/03/2023 | 10.0 | 22.1 | 0 |
| | 31/03/2023 | 11.0 | 22.5 | 0 |

*Information from the Australia Government Bureau of Meteorology website.*

Further to the above, diurnal bird surveys and acoustic microbat surveys have been undertaken by Nature Advisory as part of the Bird and Bat Utilisation Surveys (BBUS) completed for the project, and targeted flora surveys were completed by NHG Consulting in November 2021, during early scoping investigations for the project. Detailed information about weather condition at the times of survey are provided in the Nature Advisory reports, attached as Appendix 9, with further detail on the NGH Consulting survey effort provided below.

Details of surveys undertaken by Biosis as part of the current assessment are provided below.

### Threatened Flora

Targeted threatened flora surveys completed by Biosis, and undertaken on the dates listed in Table 18 above, were completed in accordance with the required BAM survey guideline, *Surveying threatened plants and their habitats* (DPIE 2020b). Targeted threatened flora surveys were undertaken throughout all areas of the development corridor that support potential threatened flora habitat. Areas excluded from survey included areas the understorey was substantially depauperate due to being subject to ongoing grazing, areas with significantly high weed species ingress, and areas disturbed by tracks, dams, erosions, farm infrastructure and other associated vectors substantially impacting upon the soil profile.

Surveys were primarily undertaken via implementing grid-based systematic approach as prescribed in *Surveying threatened plants and their habitats* (DPIE 2020b), with parallel field traverses also utilised in areas where habitats and expected impacted were more linear in nature.

#### Survey method and effort

The grid-based systematic surveys were employed for spring/autumn surveys completed in September and October 2022, and March 2023 due to the large size of the areas of potential threatened flora habitat within the development corridor. *Surveying threatened plants and their habitats* prescribed this method as an alternative option when areas of potential habitat requiring survey are greater than 50 hectares in area (DPIE 2020b). Surveys included areas proposed to be impacted (i.e. within the development footprint) as well as a broader area within the development corridor, to allow for assessment for potential indirect impacts, and potentially allow for design flexibility during future detailed design stages.

The following survey effort was able to be completed by Biosis botanists in spring 2022 (September / October) and autumn 2023 (March):

- September 2022: 270 grid points, 40 metre x 40 metre in area, plus 10 metre wide parallel traverses between 90% of grids – 57.8 hectares surveyed at 10 metre wide traverses.

- October 2022: 165 grid points, 40 metre x 40 metre in area, plus 10-metre-wide parallel traverses between 90% of grids – 35.3 hectares surveyed at 10 metre wide traverses.
- March 2023: 119 grid points, 40 metre x 40 metre in area, plus 10-metre-wide parallel traverses between 90% of grids – 25.5 hectares surveyed at 10 metre wide traverses.

It should be noted that surveying these 40 x 40 metre squares resulted in surveys achieving a 25 – 30 % higher level of survey coverage than is prescribed by the guidelines which states each survey location should comprise a 40-metre diameter circular area.

Parallel field traverses were also undertaken in September, October and December 2022, and March 2023, to supplement areas were grid-based surveys were not undertaken. This included follow-up surveys for threatened species recorded during the initial grid surveys in September and October 2022, specifically *Austrostipa metatoris* and Bitter Quandong *Santalum murrayanum.* Field traverses (transects) separated by 10 metres walked throughout all areas of potential habitat within the development corridor, to define the extant of occurrence of the above species, as well as to determine presence of other candidate species in areas not subject to grid searches.

Further to the above surveys completed by Biosis, NGH Consulting undertook targeted flora surveys in spring 2021 (November) targeting a suite of species including all those considered candidates in the current assessment (and outlined in Table 16).

A team of five ecologists from NGH including one BAM Accredited ecologist conducted surveys from the 15 to 19 November 2021. Surveys were conducted in accordance with the *Surveying threatened plants and their habitats* (DPIE 2020b) for each species. The maximum distance between parallel field traverses was 20 metres, due to the open nature of the vegetation, with a total of 170 survey points mapped across the subject land. The survey area for each identified point encompassed a 50 metre (radius) buffer on each point, and 140 points were able to be completed (NGH Consulting 2022).

The above surveys effort equates to a total survey area of a further 110 hectares at 20-metre-wide traverses.

Flora survey effort undertaken for the project by Biosis and NHG Consulting is illustrated on Figure 10.

Despite the flora survey efforts outline above there were a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation in October 2022 (present through to February 2023 in some locations), and areas being cleared for agricultural purposes. This has resulted in a requirement for assumed presence of three flora species, namely; Menindee Nightshade, Mossgiel Daisy and Winged Peppercress.

Survey progress was captured using handheld GPS units, and ArcGIS Tracker enabled on field staff mobile phones or tablet computers, to geospatially log transects walked throughout the targeted threatened species surveys. Spatial locations of all threatened species recorded were captured by either hand-held GPS units, mobile tablet computers running Collector for ArcGIS (both with accuracy of generally ± 5 metres, but potentially higher under denser canopy).

**Grid-based systematic method**

- A grid spaced at 100 square metres was placed over the development footprint using GIS to locate the survey locations at each grid intersect point, which were accessed by GIS tablet computers in the field.

- A minimum of two botanist staff members (Table 19) then undertook detailed surveys at each of the survey location by pacing out a 40 m by 40m square, crossing-over at the grid intersect point.
- This 40 metre square was then surveyed by walking 5 – 10 metre separated parallel transects to ensure a high level of coverage within each survey location.
- When a target threatened species was located, finer scale grid surveys are used to "locate population extent, which will help define the species polygon" in accordance with the Two-phase grid-based systematic survey approach for large areas (DPIE 2020b). This occurred for both the Bitter Quandong and *Austrostipa metatoris* populations recorded.

**Parallel field traverses**

- Parallel field traverses, separated by 10 metres, were undertaken throughout the development footprint when grid-based searches were less suitable, such as in linear areas or small isolated patches.
- To ensure a high level of coverage within areas of suitable habitat within the development footprint, parallel field traverses separated by 10 metres, were selected as the survey method for surveys primarily targeting the follow-up surveys for *Austrostipa metatoris* and Bitter Quandong in October 2022 and March 2023.
- During each survey parallel traverses were walked by a minimum of two botanists working systematically across the development corridor and development footprint.

**Justification of survey method and effort and timing**

Targeted flora surveys followed the methods prescribed in the relevant BAM guidelines *Surveying threatened plants and their habitats* (DPIE 2020b), during the targeted species' survey periods as detailed in BioNet.

**Survey personnel and relevant experience**

Targeted flora surveys were undertaken by the Biosis ecologists listed in Table 19. At all times survey teams consisted of a minimum of one senior botanical specialist staff member, paired on occasion with a botanical specialist with less experience.

**Table 19 Targeted flora survey personnel and relevant experience**

| Staff member | Role | Relevant experience |
|---|---|---|
| ***Matthew Looby*** | Associate Director – Principal Ecologist | Over 20 years' experience undertaking threatened flora surveys in the Riverina and Murrumbidgee Bioregions, and more broadly across southern NSW and throughout Victoria. |
| ***Callan Wharfe*** | Senior Associate Botanist – Major Project and Offset Lead | Over 15 years' experience undertaking targeted threatened flora surveys in NSW, primarily in the Sydney Basin, Riverina and Northern Tablelands. |
| ***Georgina Zacks*** | Senior Botanist | Over 6 years' experience undertaking threatened flora surveys throughout Victoria and semi-arid NSW with a |

| Staff member | Role | Relevant experience |
|---|---|---|
| | | strong knowledgebase of the flora present within the subject land. |
| ***Nicholas Lloyd*** | Botanist | Over two years' experience undertaking targeted flora surveys in NSW and Victoria, combined with an academic background in botany and ecology. |
| ***Todd Horton*** | Botanist | Over two years' experience undertaking targeted flora surveys in NSW, combined with previous experience in semi-arid landscapes in south-eastern Australia. |

## Results

Table 20 provides a summary of the results of the targeted flora surveys completed, survey effort and results are illustrated on Figure 10.

**Table 20 Summary of targeted flora survey method and results**

| Survey method | Target species | Survey results | Species Polygon |
|---|---|---|---|
| **Gird-based method**<br>• September, October 2022 & March 2023 | • *Austrostipa metatoris*<br>• Bitter Quandong<br>• *Calotis Moorei*<br>• Harrow Wattle<br>• Greenhood Orchid<br>• Menindee Nightshade<br>• Mossgiel Daisy<br>• Pink Velvet Bush<br>• Silky Swainson-pea<br>• Thyme Rice-Flower<br>• Winged Peppercress<br>• Yellow Swainson-pea | • Bitter Quandong – 1 location, 12 individuals | • N/A impacts avoided |
| **Parallel field traverses**<br>• September, October, December 2022 & March 2023 | • <u>September, October, December surveys (primary target species)</u><br>  ○ *Austrostipa metatoris*<br>• <u>October, March surveys (primary target species)</u><br>  ○ Bitter Quandong<br>• All candidate species surveyed via parallel field traverses at various locations within the subject land | • *Austrostipa metatoris* – Travelling stock route Yanga Way, 58 individuals.<br>• Bitter Quandong – Population increased to 21 individuals | • N/A impacts avoided. |
| **Assumed presence** | • Menindee Nightshade<br>• Mossgiel Daisy<br>• Winged Peppercress | • Assumed present of adjacent species due to localised lack of survey coverage | • Menindee Nightshade – 2.34 ha of PCT 16 moderate.<br>• Mossgiel Daisy– 2.34 ha of PCT 16 |

| Survey method | Target species | Survey results | Species Polygon |
|---|---|---|---|
| | | | moderate, 1.56 ha of PCT 163 moderate.<br>• Winged Peppercress– 2.15 ha of PCT 16 moderate, 1.50 ha of PCT 163 moderate. |

It should be noted that follow-up surveys for *Austrostipa metatoris* were completed in early December 2022 and the population was found to be still in flower, readily recognisable and able to be positively identified from plant material both in the field and during post-field analysis and species confirmation. As such all surveys completed in December 2022 throughout the development corridor are considered suitable to confirm the presence/absence of the species in surveyed areas.

## Nocturnal birds

### Survey method and effort

Targeted survey was undertaken for Bush Stone-curlew, with incidental surveys completed for Masked Owl, Barking Owl and Plains Wanderer in February 2023. Targeted survey included call playback at six locations within the subject land over a period of four nights. Three call playback points were completed each night, allowing for two replicates at each location. Survey locations were strategically placed at a minimum distance of 2 kilometres apart, ensuring that all suitable habitat within the subject land was targeted (Figure 10). Spotlighting surveys were conducted for the Plains Wanderer during the February survey period in the vicinity of the call playback survey locations, which were undertaken in open woodland vegetation, however these areas represent the largest areas of most intact and grassy habitat that could potentially support the species.

Call playback and detection in suitable habitat for threatened owls, including a two-minute call playback period, followed by five-minute listening period, and two-minute spotlighting period (conducted twice per species), with an initial ten-minute listening period and two-minute spotlighting period before commencing; plus a final ten-minute listening period and five minute spotlighting period following the survey. It is noted that this survey effort is broadly aligned with the updated requirements for targeted surveys for large forest owls, following their change to full species credits under the BAM, which requires a combination of call-playback, listening and spotlighting.

### Justification of survey method and effort

Survey was undertaken in accordance with methodology outlined in the NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004) and Survey guidelines for Australia's threatened birds (DEWHA 2010).

### Timing of survey

Nocturnal bird survey was undertaken in February 2023, in accordance with the survey timeframe for Bush Stone-curlew in BioNet and the recommended survey period during times of higher activity for Plains Wanderer. These surveys were also completed in accordance with the updated timing for Barking Owl and Masked Owl.

### Survey personnel and relevant experience

Nocturnal bird surveys were undertaken by the Biosis ecologists outlined in Table 21, survey effort is illustrated on Figure 10.

**Table 21 Targeted nocturnal bird survey personnel and relevant experience**

| Staff member | Position | Relevant experience |
|---|---|---|
| ***Rosie Gray*** | Ecologist | Over 3 years' experience undertaking nocturnal bird surveys across NSW, with an academic background in fauna (ornithological) surveys. |
| ***Zoe Goold*** | Zoologist | Over 3 years' experience undertaking nocturnal bird surveys across NSW, with an academic background in fauna (ornithological) surveys. |

### Results

Table 22 provides a summary of the results of the nocturnal bird surveys completed.

**Table 22 Summary of nocturnal bird survey method and results**

| Species name | Common name | Survey method | Survey results | Species Polygon (ha) |
|---|---|---|---|---|
| ***Burhinus grallarius*** | Bush Stone-curlew | • 4 nights call-playback and spotlighting across 6 survey locations<br>• 20-23 of February 2023 | Not recorded during surveys | N/A |
| ***Pedionomus torquatus*** | Plains Wanderer | • 4 nights spotlighting across 6 survey locations<br>• 20-23 of February 2023 | Not recorded during surveys | N/A |
| ***Ninox connivens*** | Barking Owl | • 4 nights call-playback and spotlighting across 6 survey locations<br>• 20-23 of February 2023 (outside survey period) | Not recorded during surveys | N/A |
| ***Tyto novaehollandiae*** | Masked Owl | • 4 nights call-playback and spotlighting across 6 survey locations<br>• 20-23 of February 2023 (outside survey period) | Not recorded during surveys | N/A |

## Diurnal birds (bird utilisation surveys)

Diurnal bird surveys have been undertaken by Nature Advisory as part of the BBUS work completed for the project. Detailed information is provided in the Nature Advisory reports, attached as Appendix 9. Incidental diurnal bird surveys, and hollow-bearing tree surveys, have also been completed by Biosis through 2022 and early 2023 and surveys were also undertaken by NGH Consulting in November 2021.

Methods, effort and results are summarised below.

### Survey method and effort

Nature Advisory completed 24 months of bird utilisation survey within the subject land in the following seasons and dates outlined in Table 23 below.

**Table 23 Nature Advisory diurnal bird survey effort**

| Year | Summer | Autumn | Winter | Spring |
|---|---|---|---|---|
| **2021** | 22 Feb – 28 Feb 2021 | 17 May – 21 May 2021 | 1 Aug – 9 Aug 2021 | 2 Nov – 6 Nov 2021 |
| **2022** | 15 Feb – 19 Feb 2022 | 26 Apr – 30 Apr 2022 | 11 Jul – 16 Jul 2022 | 6 Oct – 11 Oct 2022 |

A fixed-point method was completed, which comprised one observer stationed at each point for 15 minutes. A total of 10 fixed survey points were established, including eight impact points and two reference (control) points. Reference points were located at least 500 metres from proposed turbine locations in areas of similar habitat to that found within the impacted areas. All bird species within 200 metres of the observer were recorded including:

- Species.
- Count of individuals.
- Height of bird when first observed.
- Minimum and maximum height observed (for species of concern).

Each fixed point was surveyed eight times (eight replicates) per survey, twice each at four different times of day: early morning (8:00am to 10:30am), late morning (10:30am to 13:00 pm), early afternoon (13:30pm to 15:00pm) and late afternoon (15:00pm to 17:30pm). This equates to a total of 64 replicates and around 960 minutes per point over two years, or a total of 160 hours of targeted diurnal bird surveys (Nature Advisory 2023a).

### Justification of survey method and effort

Survey was undertaken in accordance with methodology outlined in the NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004) and in accordance with the requirements for a "Level One" bird risk assessment outlined in 'Wind Farms and Birds – Interim Standards for Risk Assessment' issued by the Australian Wind Energy Association (AusWEA 2005).

### Timing of survey

Two rounds of seasonal replicate surveys were completed meaning surveys were timed to provide the best opportunity to record all birds present within the subject land. This includes sedentary or resident birds, migratory or nomadic birds, and also provides an opportunity to determine the presence of certain species during BAM / BioNet specified breeding season survey periods.

### Survey personnel and relevant experience

Diurnal bird surveys were undertaken by the Nature Advisory ecologists outlined in Table 24.

**Table 24 Targeted diurnal bird survey personnel (Nature Advisory) and relevant experience**

| Staff member | Role | Relevant experience |
|---|---|---|
| **Gavin Thomas** | Senior Ecologist – Team Leader NSW | Over 20 years' experience in ecological consulting, bird surveys, research and ecological restoration. |
| **Clinton Schipper** | Zoologist | Over 20 years' experience in ecological consulting, and bird surveys. |

| Staff member | Role | Relevant experience |
|---|---|---|
| **Eamon O'Meara** | Zoologist | Over 5 years' experience in ecological consulting, and bird surveys for impact assessment projects. |
| **Phillip Allen** | Zoologist | Over 5 years' experience in ecological consulting, and bird surveys. |

### Results

Table 25 below provides a summary of the results of the diurnal bird surveys completed.

**Table 25 Summary of diurnal bird survey method and results**

| Species Name | Common name | Survey method | Survey results | Species Polygon (ha) |
|---|---|---|---|---|
| ***Ardeotis australis*** | Australian Bustard | • Diurnal ecological surveys undertaken by Biosis, Nature Advisory and NGH Consulting.<br>Species is large and non-cryptic, if present on site the species would have been recorded given the level of ecological survey undertaken within the subject land since 2021. | Not recorded during surveys | N/A |
| ***Haliaeetus leucogaster*** | White-bellied Sea-Eagle | • Diurnal surveys undertaken by Nature Advisory during breeding season: August, November 2021 and July, October 2022<br>• Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May 2021 and February, April 2022<br>• Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021<br>Large conspicuous raptor, whose presence on site would reliably have been detected. | Not recorded during surveys either during or outside breeding season.<br>The species is considered not to occur within the subject land in any more than a transient occasional basis. | N/A |
| ***Hamirostra melanosternon*** | Black-breasted Buzzard | • Diurnal surveys undertaken by Nature Advisory during breeding season: November 2021 and October 2022<br>• Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, August 2021 and February, April, July 2022<br>• Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021<br>Large raptor, whose presence on site would reliably have been detected (at a minimum) during targeted diurnal bird surveys. | Not recorded during surveys either during or outside breeding season.<br>The species is considered not to occur within the subject land in any more than a transient occasional basis. | N/A |
| ***Hieraaetus morphnoides*** | Little Eagle | • Diurnal surveys undertaken by Nature Advisory during breeding season: August 2021 and October 2022<br>• Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, November 2021 and February, April, July 2022<br>• Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021<br>Large conspicuous raptor, whose presence on site would reliably have been detected. | Not recorded during surveys either during or outside breeding season.<br>The species is considered not to occur within the subject land in any more than a transient occasional basis. | N/A |

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| Species Name | Common name | Survey method | Survey results | Species Polygon (ha) |
|---|---|---|---|---|
| ***Lophochroa leadbeateri*** | Major Mitchell's Cockatoo | • Diurnal surveys undertaken by Nature Advisory during breeding season: November 2021 and October 2022<br>• Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, August 2021 and February, April, July 2022<br>• Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021<br>Breeding activity has been recorded within the subject land (see below) and "species credit habitat" has been calculated based on the occurrence of suitable trees and potential habitat (further described in Section 4.3.3) below. | Species recorded on multiple occasions both during and outside breeding season.<br>Species considered resident within the subject land. | 37.4 ha |
| ***Lophoictinia isura*** | Square-tailed Kite | • Diurnal surveys undertaken by Nature Advisory during breeding season: November 2021 and October 2022<br>• Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, August 2021 and February, April, July 2022<br>• Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021<br>Large conspicuous raptor, whose presence on site would reliably have been detected. | Not recorded during surveys either during or outside breeding season.<br>The species is considered not to occur within the subject land in any more than a transient occasional basis. | N/A |

**Major Mitchell's Cockatoo**

Further to the information provided in Table 25 above, breeding activity was first recorded within the subject land by NGH Consulting in November 2021. The species was observed in both breeding pairs and foraging in flocks. The observed breeding pair was monitored for around 15 minutes, this pair was observed assessing Black Box hollows for suitability of breeding. The breeding pair was observed flying from hollow to hollow, entering hollows for 1 to 5 minutes before flying to the next hollow. Flocks were observed with between 4 to 10 individuals, foraging on grasses, saltbush and fruits or nuts of shrub and tree species (NGH 2022). Locations these records are illustrated on Figure 10.

Breeding activity was also observed by Nature Advisory during the spring 2021 bird utilisation survey (BUS) where three individuals were observed investigating and excavating suitable sized nesting hollows on the eastern side of the subject land. Nature Advisory note that the species is considered to be resident within the subject land, and was recorded over 200 times both during targeted BUS and incidentally (Nature Advisory 2023a).

The species was also detected on multiple occasions by Biosis during 2022, however no breeding activity was observed.

Due to the large areas of potential breeding habitat for the species, both within and surrounding (within the BAM prescribed 200 metre nest tree buffer) the subject land, and the lack of BAM guidance detailing acceptable survey effort and requirements, targeted nest tree surveys were not undertaken. Instead, hollow-bearing tree surveys were used to assess the presence of suitable nest trees within areas of highest potential habitat throughout the subject land, and this data was used to derive habitat polygons for the species. A total of seven hollow-bearing tree surveys areas were searched, across an area of over 500 hectares of wooded vegetation, representing the area of highest potential breeding habitat for the species. A total of 252 hollow-bearing trees were recorded, 86 of which were found to support the BAM prescribed breeding tree parameters for the species of "*Hollow bearing trees; Living or dead tree with hollows greater than 10 cm diameter*".

Further to this hollow-bearing tree survey undertaken by Biosis, an additional 27 trees, considered potentially suitable for breeding use by Major Mitchell's Cockatoo were recorded by NHG Consulting in November 2021.

Habitat polygons are further described in Section 4.3.3 below.

**Candidate raptor species**

It is acknowledged that no targeted nest tree surveys were undertaken during BAM prescribed breeding season for the four candidate raptor species listed in Table 25 above. However, had any of these species been present within the subject land during breeding season, their presence would have been recorded during the 80 hours of targeted diurnal birds surveys during breeding season for White-bellied Sea Eagle, or 40 hours of breeding surveys for Black-breasted Buzzard, Little Eagle and Square-tailed Kite.

Further to this none of the above species were recorded within the subject land during the 160 hours total BUS effort, or during incidental surveys undertaken by Nature Advisory, Biosis or NGH Consulting.

Absence from the study area (on anything more than a transient and occasional basis) can be concluded for each of the four candidate raptor species based on the results from the high level of survey undertaken for the project.

### Regent Parrot

Regent Parrot was recorded on multiple occasions within the subject land by Nature Advisory during BUS, incidental surveys and targeted site utilisation surveys for the species (described in further detail in Section 6 below).

It should be noted that whilst Regent Parrot has been recorded on site, it is not considered to occur in a "species credit – breeding" capacity, due to an absence of breeding habitat and the nomadic movements between the subject land and riparian habitats along the Wakool and Murrumbidgee Rivers.

BAM prescribed 'habitat constraints' for the species are not present within the subject land which require the presence of River Red Gums *Eucalyptus camaldulensis* which is absent from the subject land.

## Microchiropteran bats

Microchiropteran bat (microbat) surveys have been undertaken by Nature Advisory as part of the BBUS work completed for the project. Detailed information is provided in the Nature Advisory reports, attached as Appendix 9. Methods, effort and results are summarised below.

It should be noted that there are no microbat species considered candidate species credit species as part of the current assessment.

### Survey method, effort and timing

Nature Advisory completed two surveys in 2021 to characterise the microbat fauna using the subject land. The survey effort was a broad analysis undertaken to determine the presence or absence of all possible species predicted to occur in the area, with a particular focus on potential threatened species. Survey timeframes and data analysed for the assessment is summarised Table 26 below.

**Table 26 Nature Advisory diurnal bird survey effort**

| Season | Dates | No. nights | Detector nights | Recording hours |
|---|---|---|---|---|
| **Summer 2021** | 22 Feb – 27 Feb 2021 | 6 consecutive nights | 36 | 432 |
| **Spring 2021** | 2 Nov – 30 Nov 2021 | 24-29 consecutive nights (location dependent) | 130 | 1560 |

A total of six automated bat recorders (Song Meters ®) were deployed during each survey at ground level only. Survey locations were chosen that were representative of the broad habitat types within the subject land and were located near proposed wind turbines. Song Meters were secured to trees or fence posts approximately 1.5 – 2 metres above ground and programmed to commence operation approximately 30 minutes before dusk, ceasing approximately 30 minutes after dawn (Nature Advisory 2023b)

All echolocation data captured during the survey periods were analysed by Rob Gration of EcoAerial Environmental Services using Kaleidoscope Pro analysis software by Wildlife Acoustics USA. (Nature Advisory 2023b)

### Justification of survey method and effort

The survey effort employed by Nature Advisory is substantially greater than the minimum survey effort for acoustic recorded prescribed by the BAM guidelines *'Species credit' threatened bats and their habitats,*

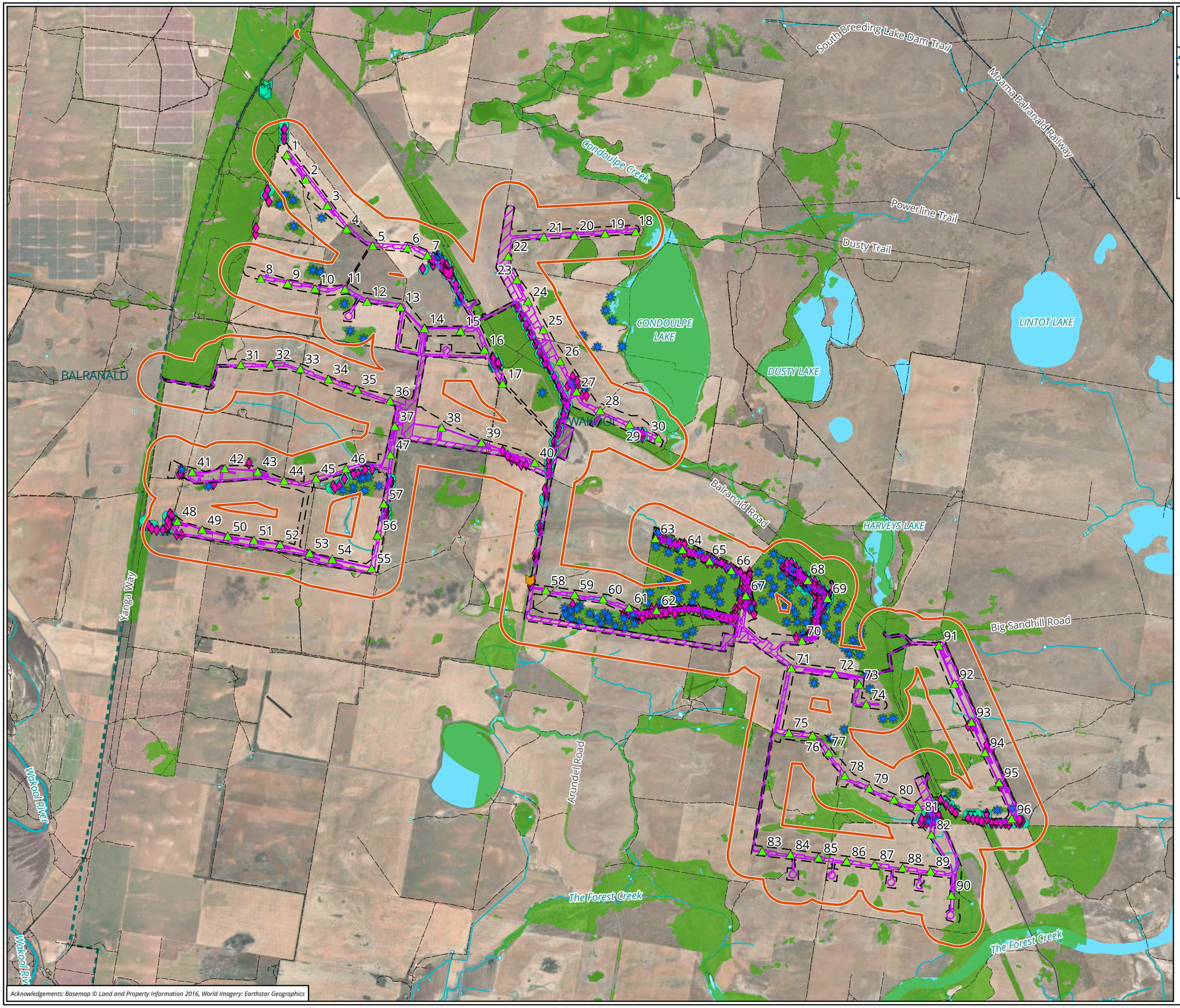
(OEH 2018b) and based on the lack of detection of species credit bats, no further survey effort in the form of harp trapping or mist netting is required.

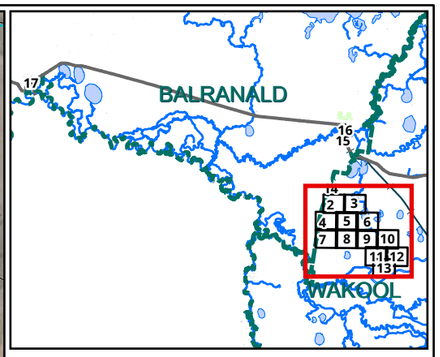
Nature Advisory also note their surveys were completed in accordance with the 'Onshore Wind Farms – Interim guidance on bird and bat management (DAWE 2022).

**Results**

A total of nine bat species were positively identified within the subject land. All nine bat species positively identified are noted as being considered common, secure and widespread species. No threatened species were positively identified, however, three species complexes were identified. One of the three species complexes has the potential of being Corben's Long-eared Bat *Nyctophilus corbeni*, a threatened species listed as Vulnerable under the EPBC Act and BC Act. Corben's Long-eared Bat is considered an ecosystem credit species under the BAM, so further survey and assessment under the BAM is not required.

Further detail on the species recorded is provided below in Section 6 in relation to detailed description of BBUS work completed for the project.




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Threatened flora**

- *Santalum murrayanum*
- *Austrostipa metatoris*

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.1 Targeted species mapping- Flora**

0 750 1,500 2,250 3,000

Meters

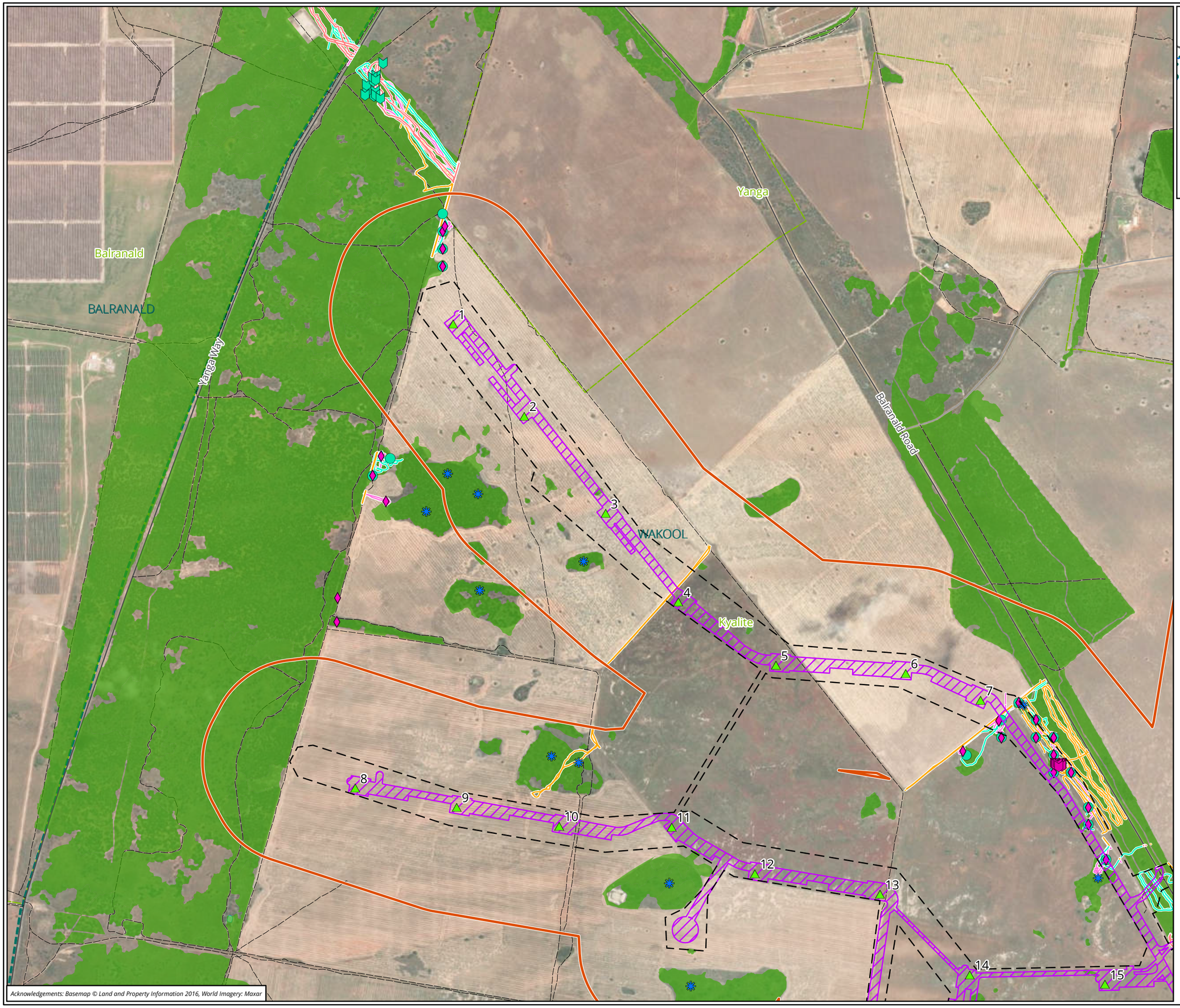
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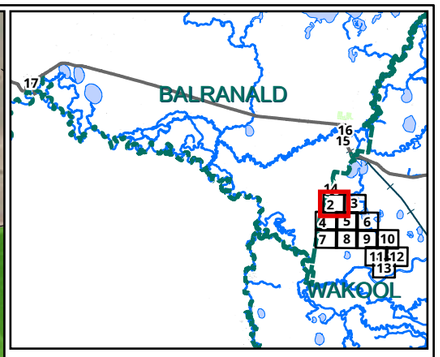
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Layout: 37502_F10a_TSM_Flora

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics*




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Threatened flora**

- *Santalum murrayanum*
- *Austrostipa metatoris*

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.2 Targeted species mapping- Flora**

0 200 400 600 800

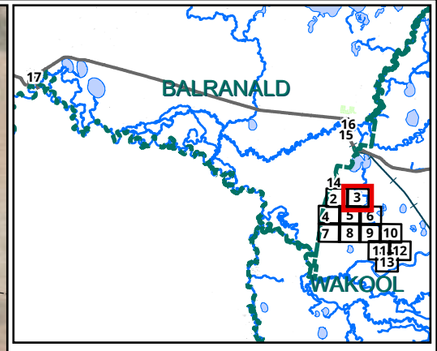
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Threatened flora**

- *Santalum murrayanum*

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.3 Targeted species mapping- Flora**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

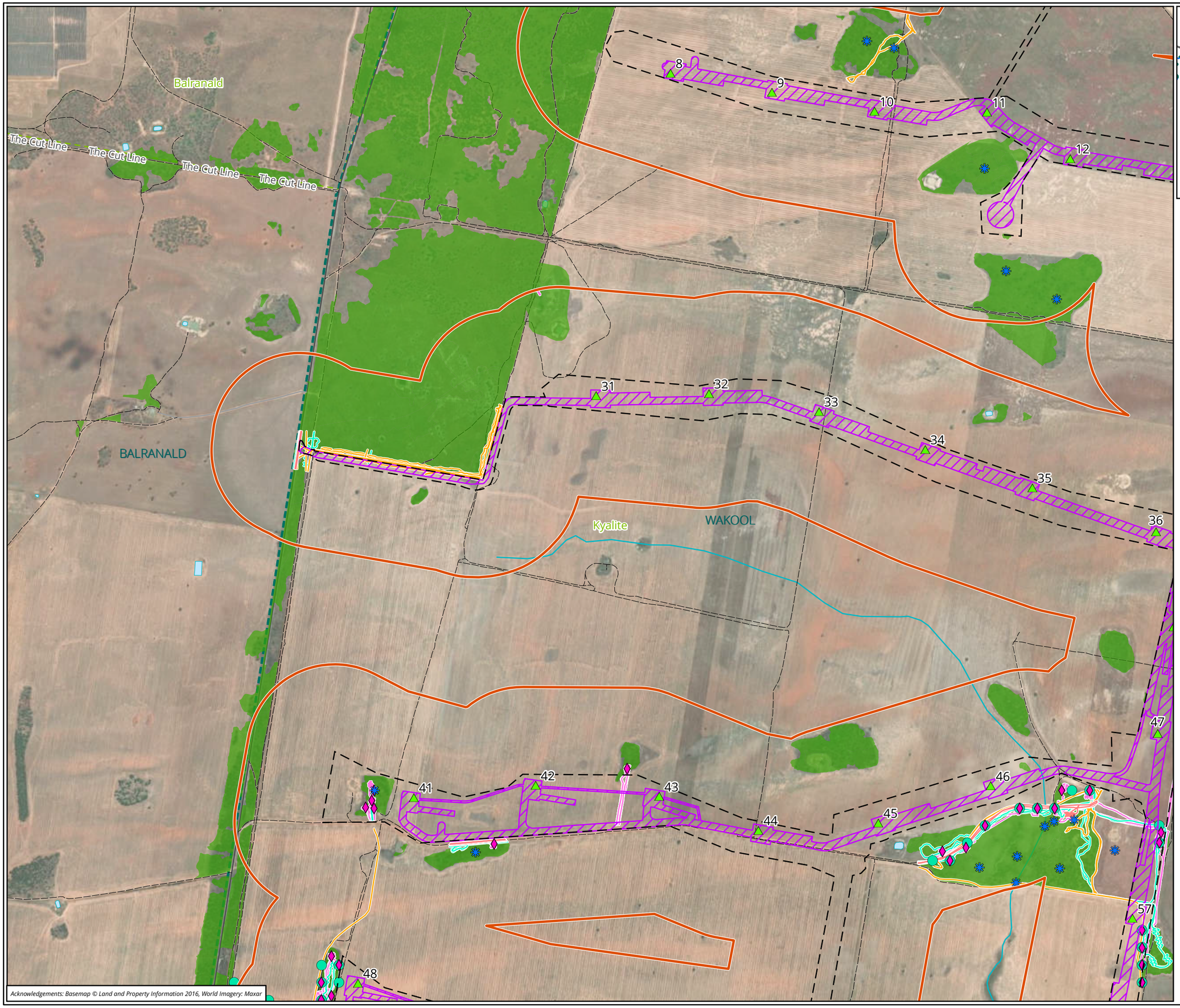
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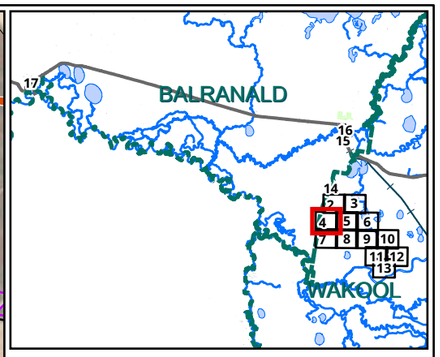
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.4 Targeted species mapping- Flora**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

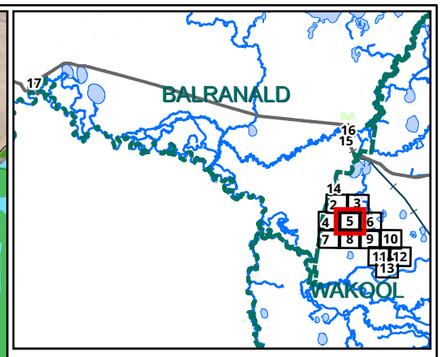
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Threatened flora**

- *Santalum murrayanum*

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.5 Targeted species mapping- Flora**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

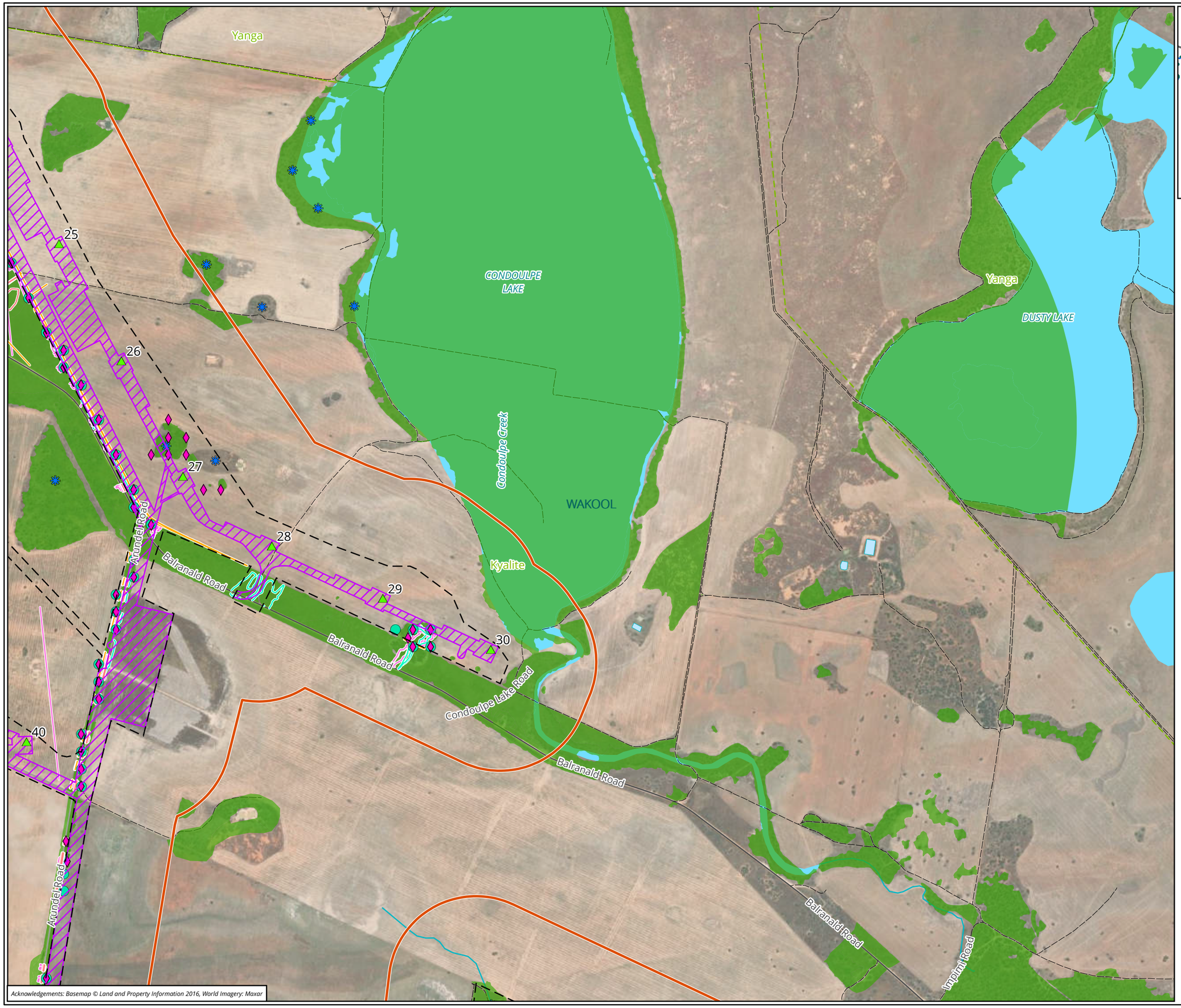
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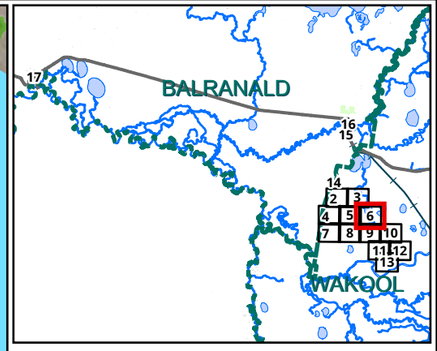
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## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

### Survey tracks

- December
- March
- October
- September

### Surveys

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.6 Targeted species mapping- Flora**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

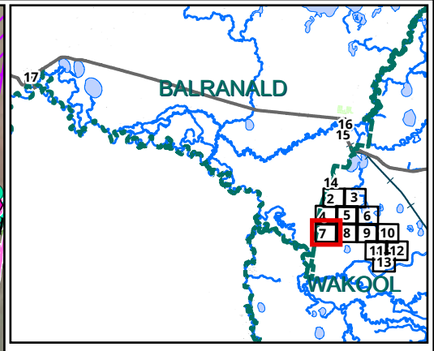
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.7 Targeted species mapping- Flora**

0 200 400 600 800

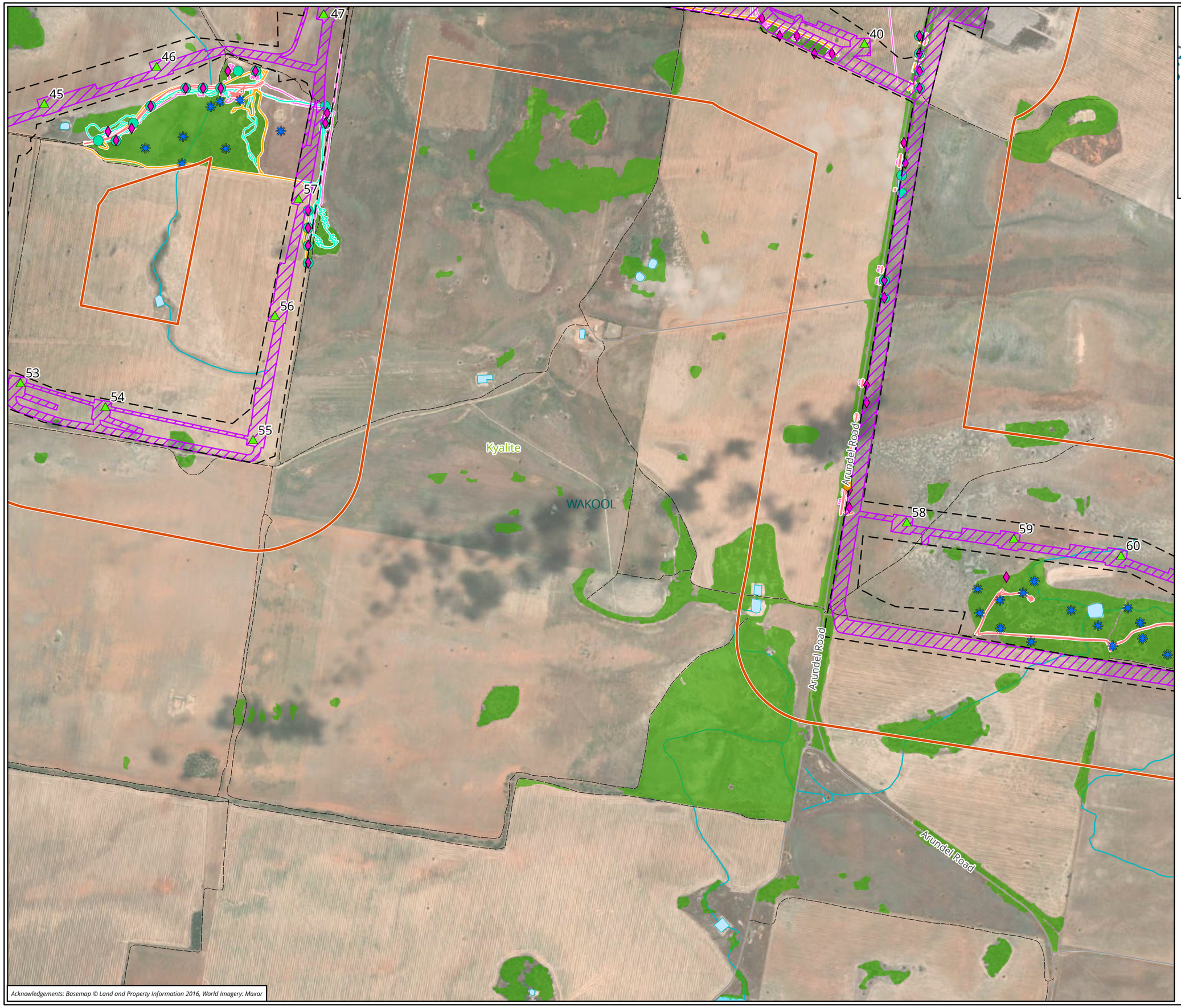
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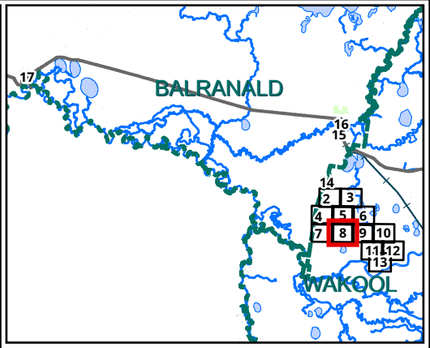
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.8 Targeted species mapping- Flora**

0 200 400 600 800

Meters

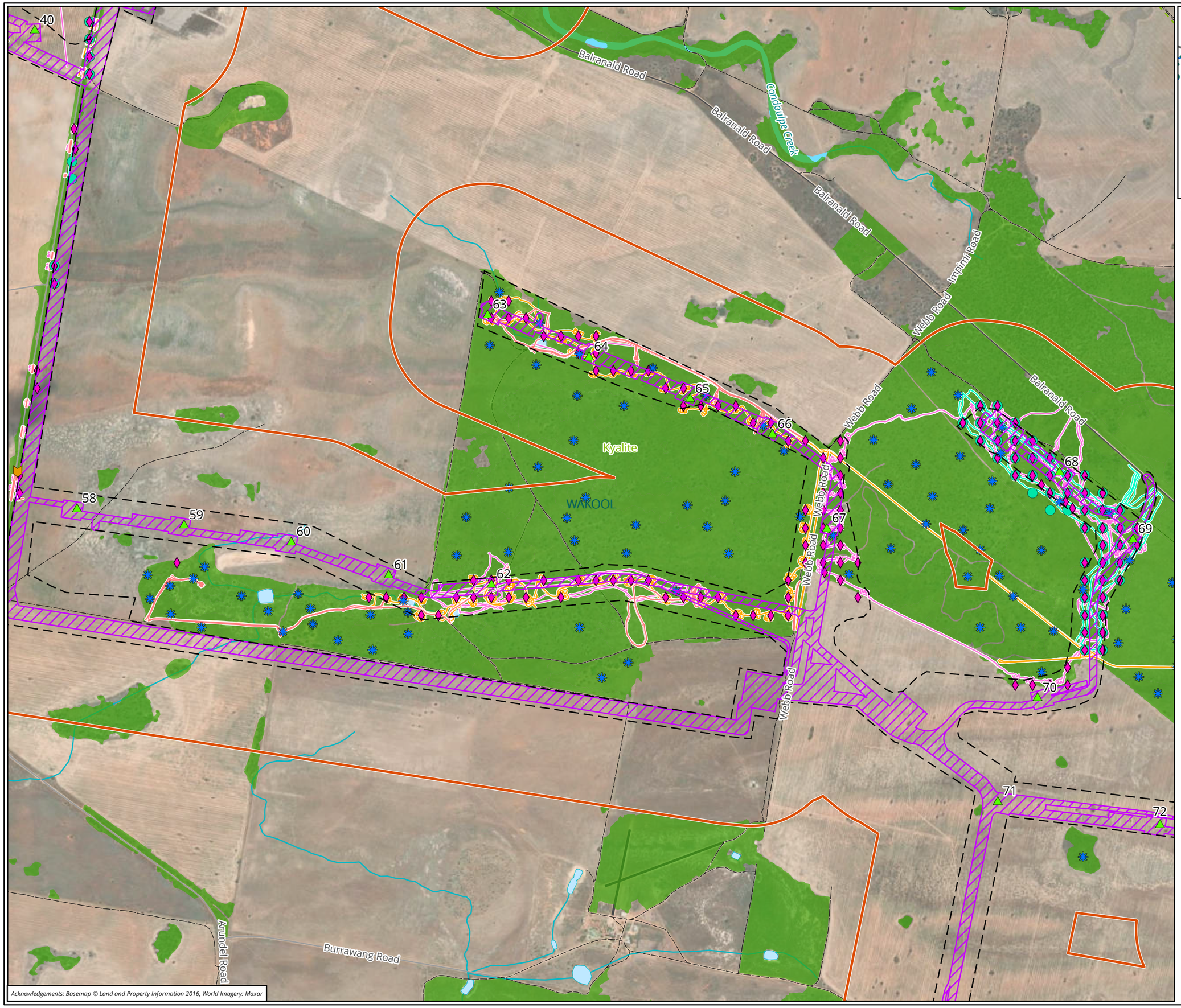
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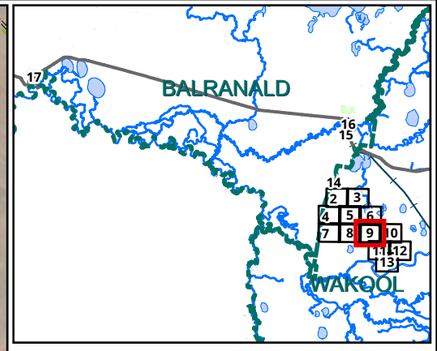
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.9 Targeted species mapping- Flora**

0 200 400 600 800

Meters

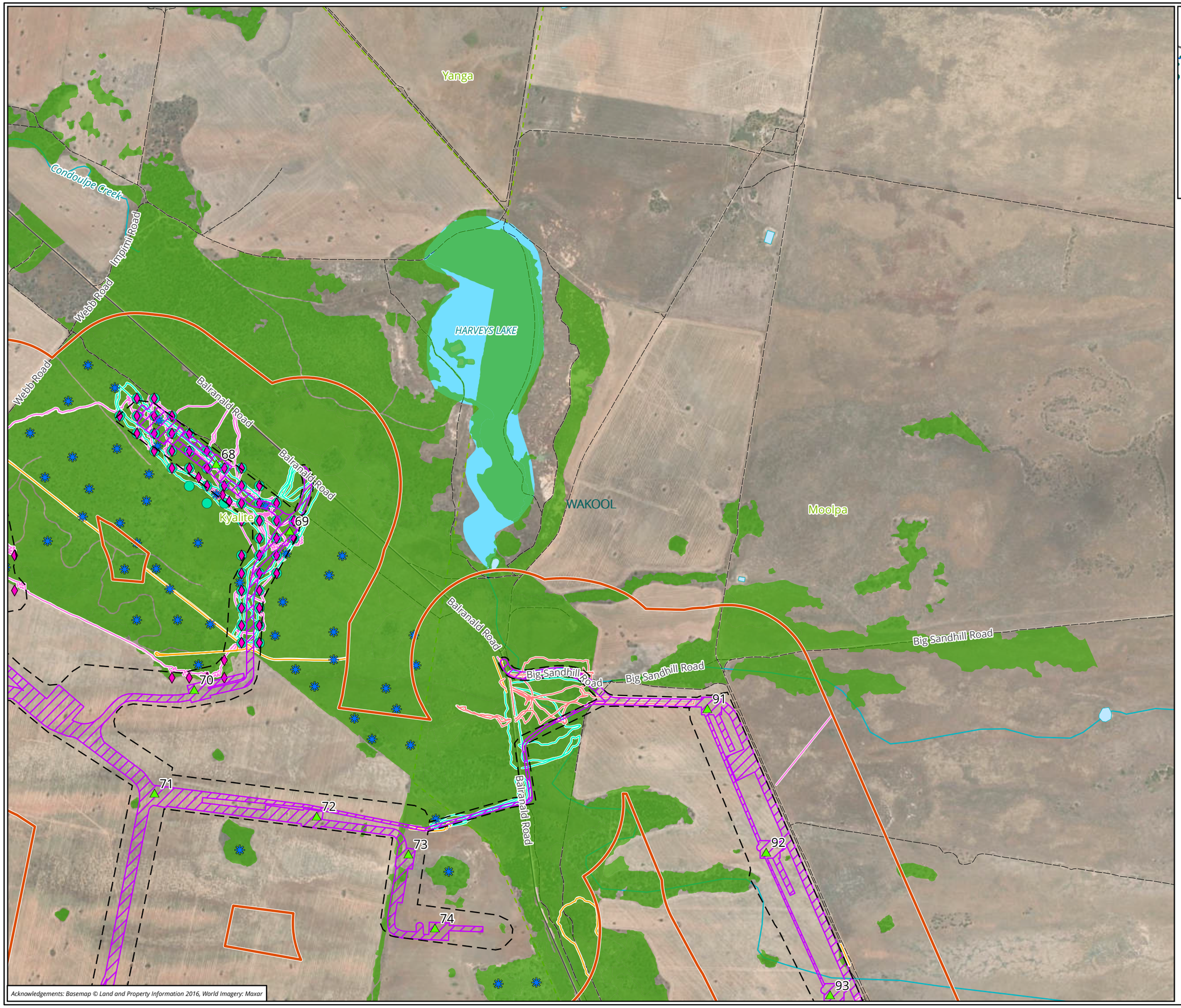
Scale: 1:20,000 @ A3

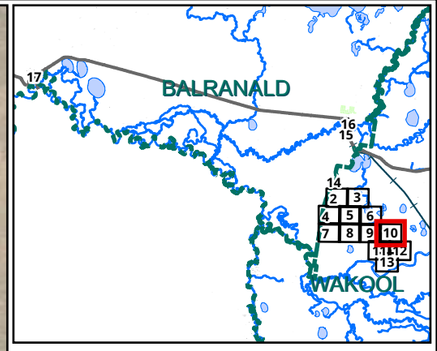
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

### Survey tracks

- December
- March
- October
- September

### Surveys

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.10 Targeted species mapping- Flora**

0 200 400 600 800

Meters

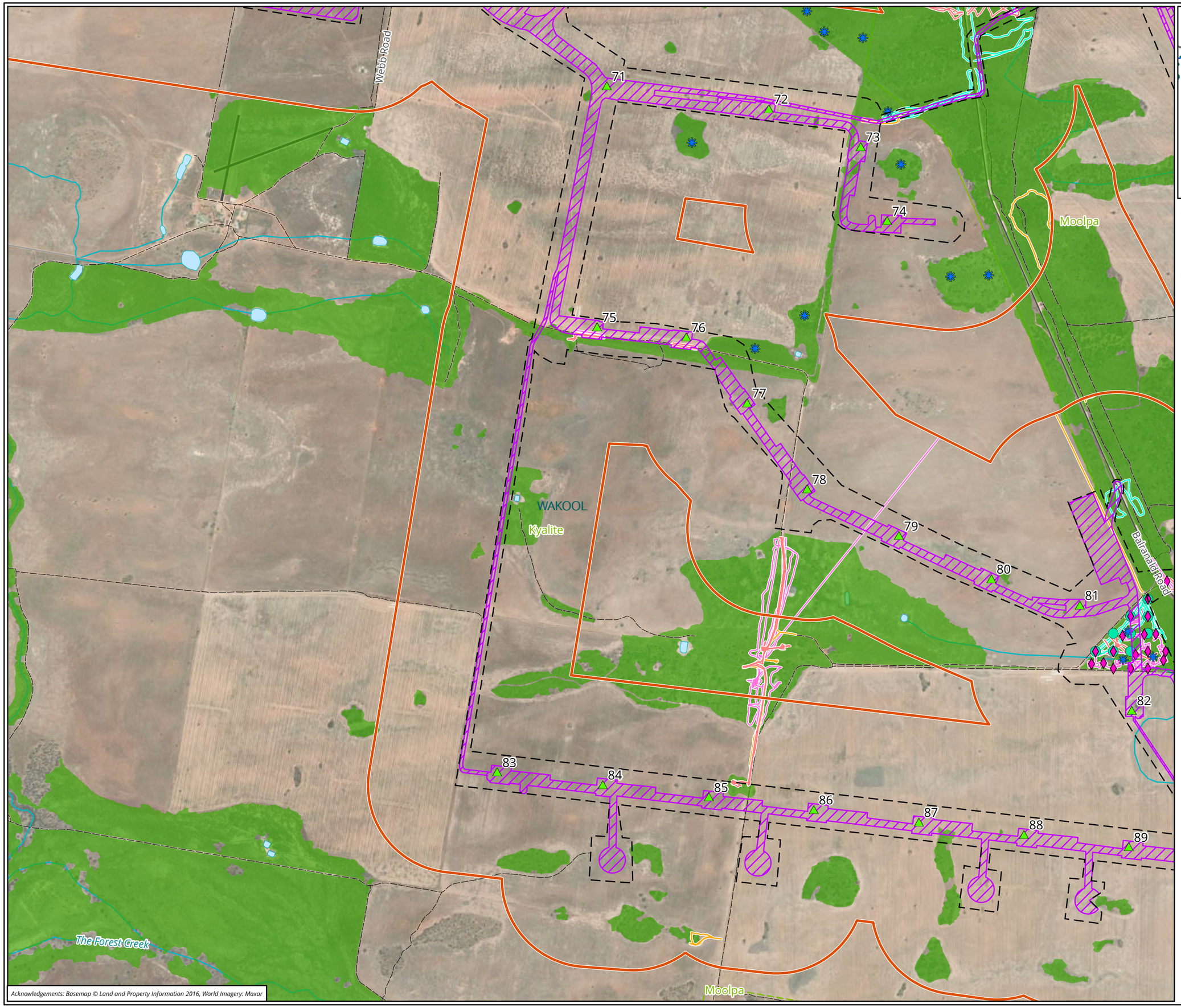
Scale: 1:20,000 @ A3

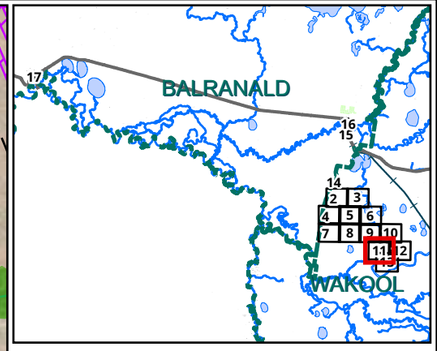
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.11 Targeted species mapping- Flora**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

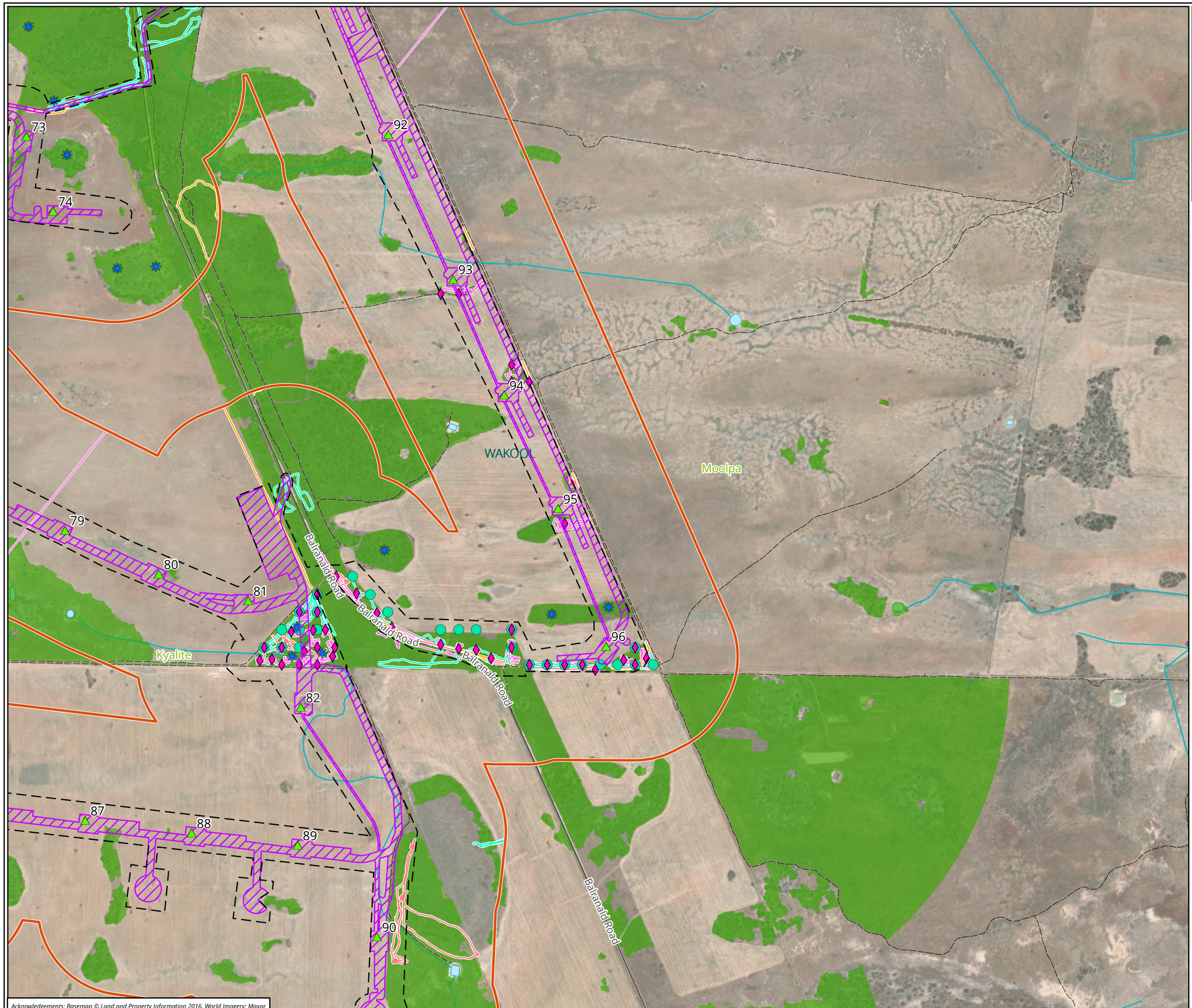
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

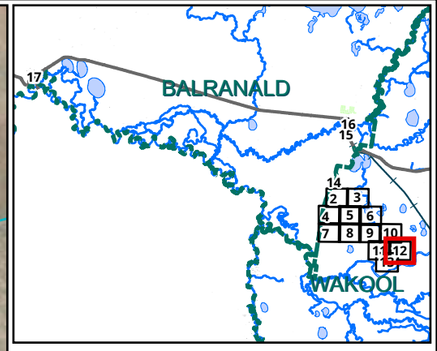
biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*




Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

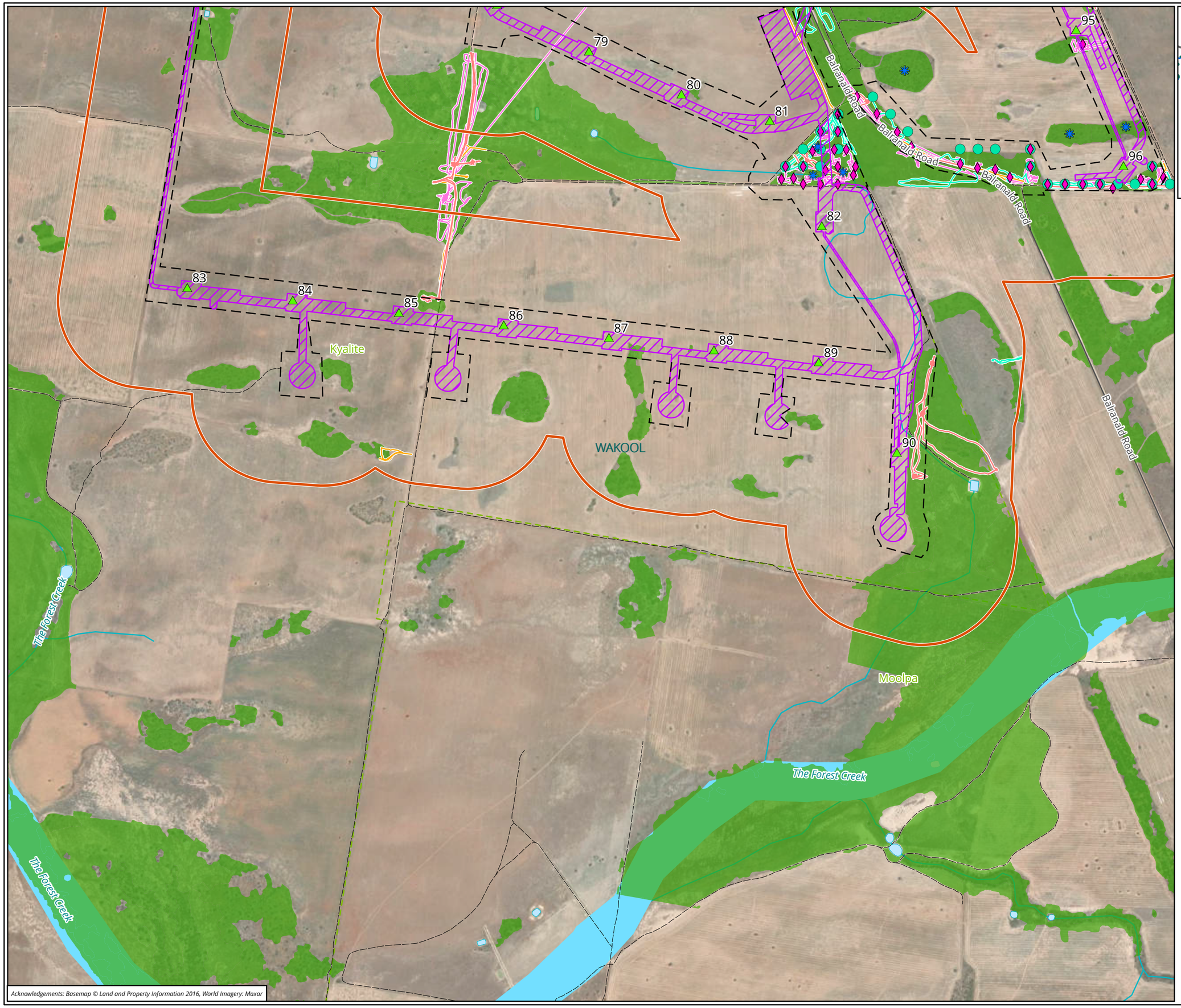
**Figure 10a.12 Targeted species mapping- Flora**

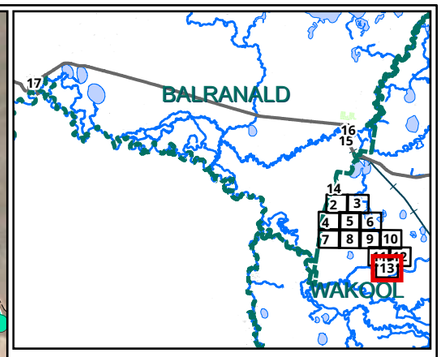
0 200 400 600 800

Meters
Scale: 1:20,000 @ A3
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation

**Survey tracks**

- December
- March
- October
- September

**Surveys**

- NGH - January 2022
- Biosis - September 2022
- Biosis - October 2022

**Figure 10a.13 Targeted species mapping- Flora**

0 200 400 600 800

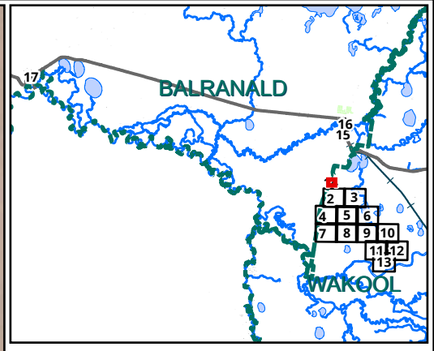
Meters

Scale: 1:20,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora




**Legend**

- Subject land
- Development footprint
- Native vegetation

Yanga Way

Balranald Road

Balranald Road

Balranald Road

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 10a.14 Targeted species mapping- Flora**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

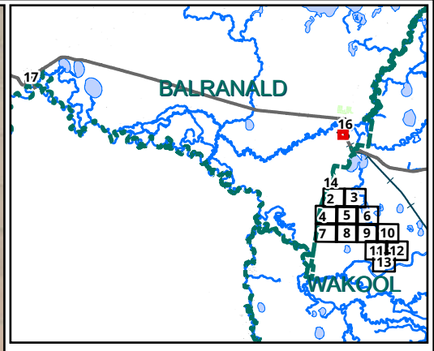
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora




**Legend**

- Subject land
- Development footprint
- Native vegetation

**Figure 10a.15 Targeted species mapping- Flora**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

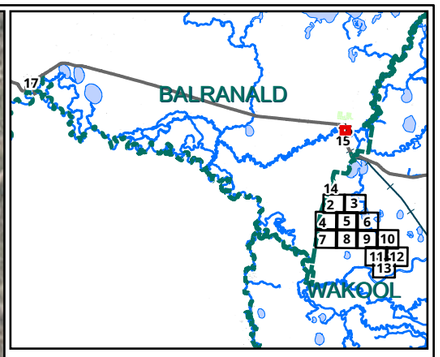
N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*




**Legend**

- Subject land
- Development footprint
- Native vegetation

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 10a.16 Targeted species mapping- Flora**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

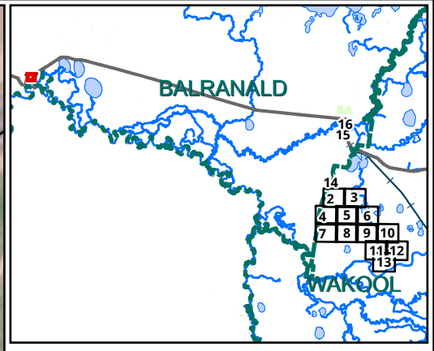
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora




**Legend**

- Subject land
- Development footprint
- Native vegetation

**Figure 10a.17 Targeted species mapping- Flora**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

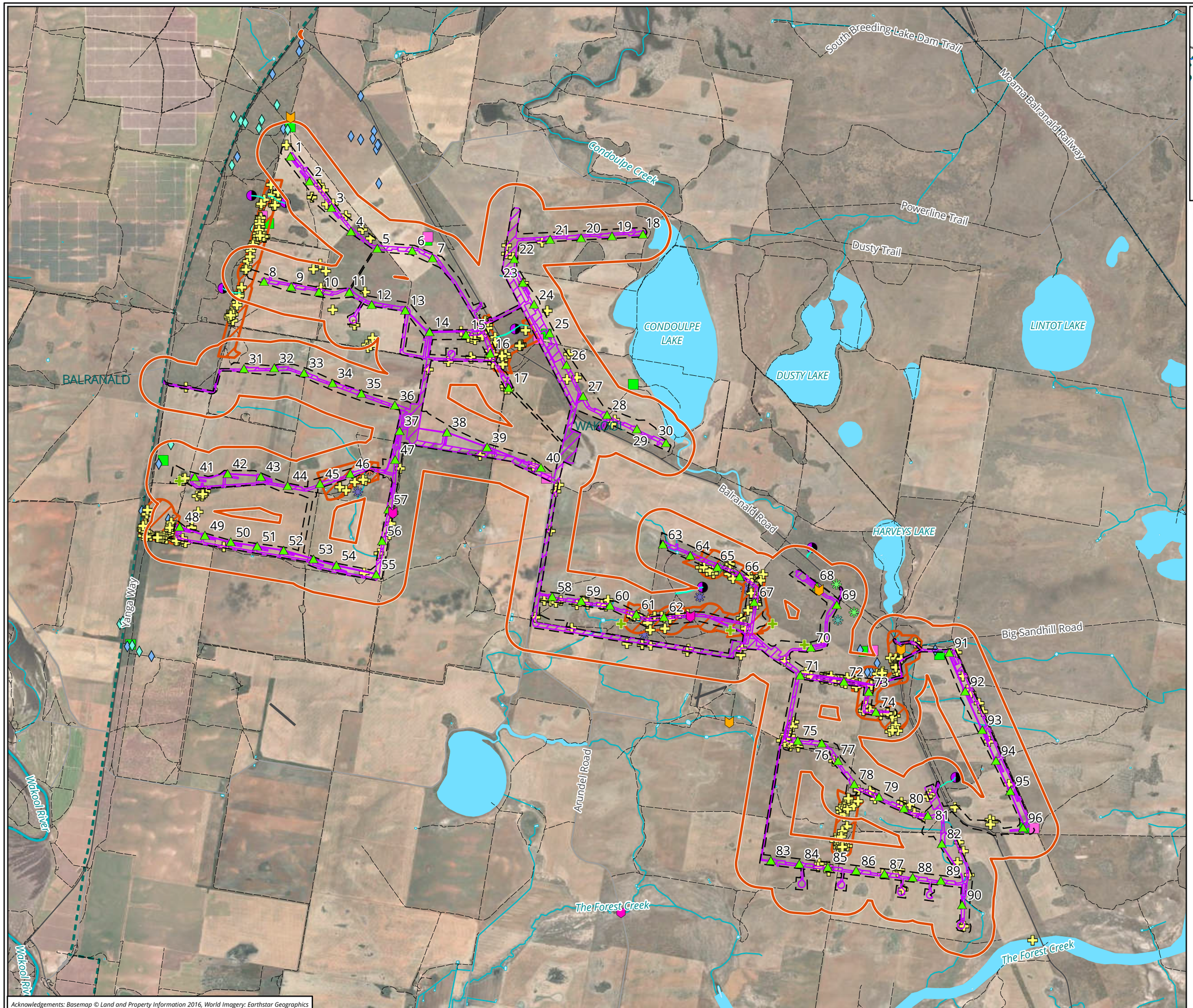
*Coordinate System: GDA2020 MGA Zone 54*

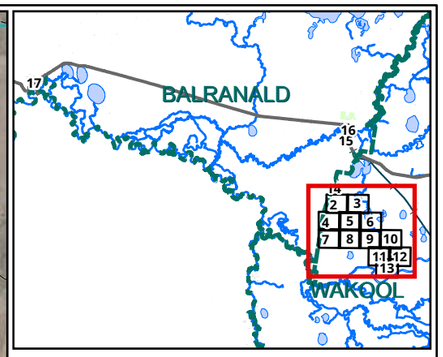
N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10a_TSM_Flora

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Stick nest (NGH)
- Call playback / Spotlighting
- Line survey

**Threatened fauna (Biosis)**

- Grey-crowned Babbler
- Major Mitchell's Cockatoo

**Threatened fauna (Nature advisory)**

- Regent parrot
- Major Mitchell's Cockatoo

**Threatened fauna (NGH)**

- Grey Crowned Babbler
- Major Mitchells Cockatoo
- Spotted Harrier
- White Fronted Chat

**Survey points (Nature Advisory)**

- BUS
- Bat

# Figure 10b.1 Targeted species mapping - Fauna

0 750 1,500 2,250 3,000

Meters

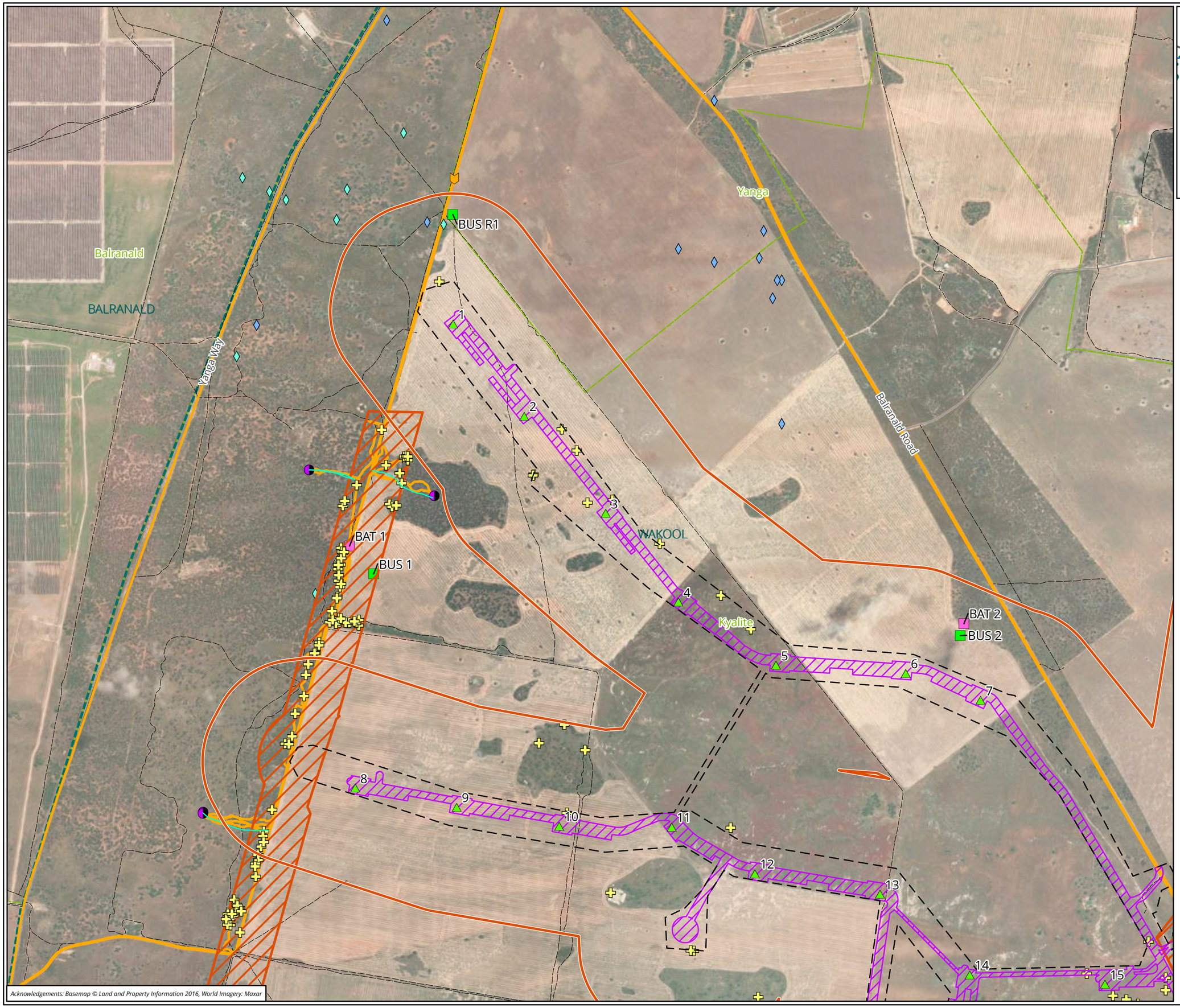
Scale: 1:75,000 @ A3

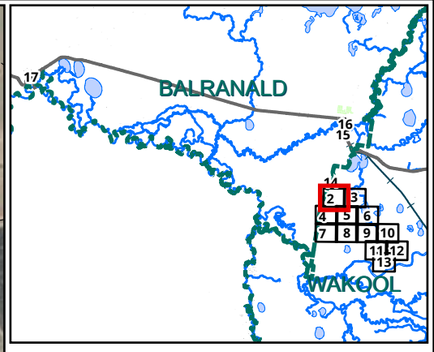
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Call playback / Spotlighting
- Line survey
- February 2022

**Threatened fauna (Biosis)**

- Major Mitchell's Cockatoo

**Threatened fauna (Nature advisory)**

- Regent parrot
- Major Mitchell's Cockatoo

**Survey points (Nature Advisory)**

- BUS
- Bat

## Figure 10b.2 Targeted species mapping - Fauna

0 200 400 600 800

Meters

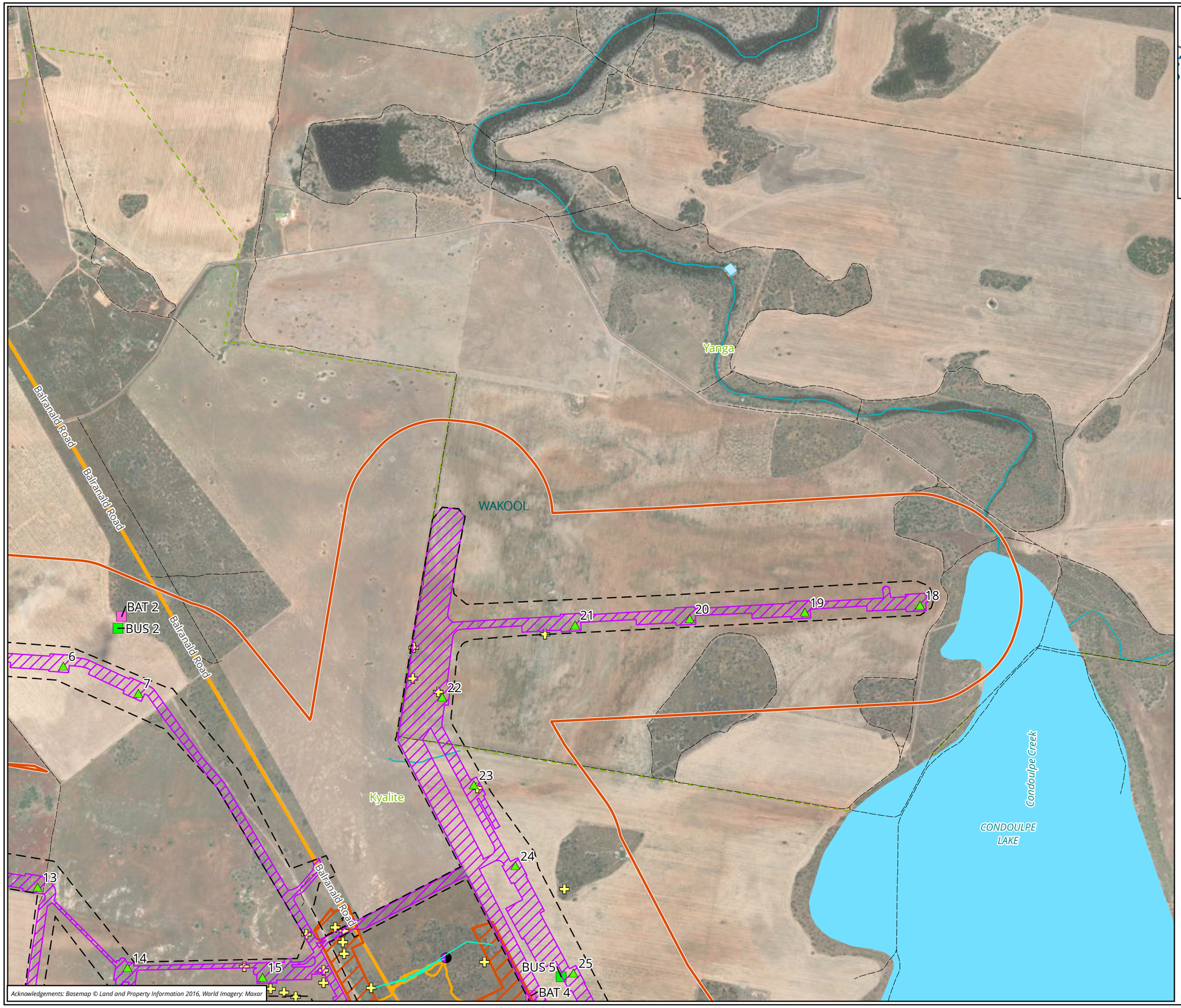
Scale: 1:20,000 @ A3

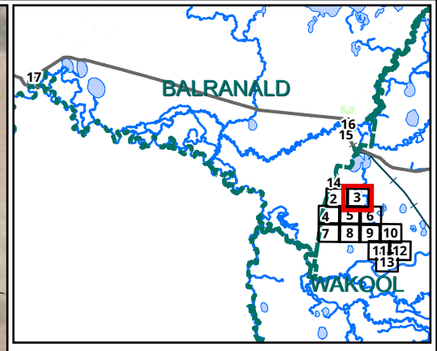
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Call playback / Spotlighting
- Line survey
- February 2022

**Survey points (Nature Advisory)**

- BUS
- Bat

**Figure 10b.3 Targeted species mapping - Fauna**

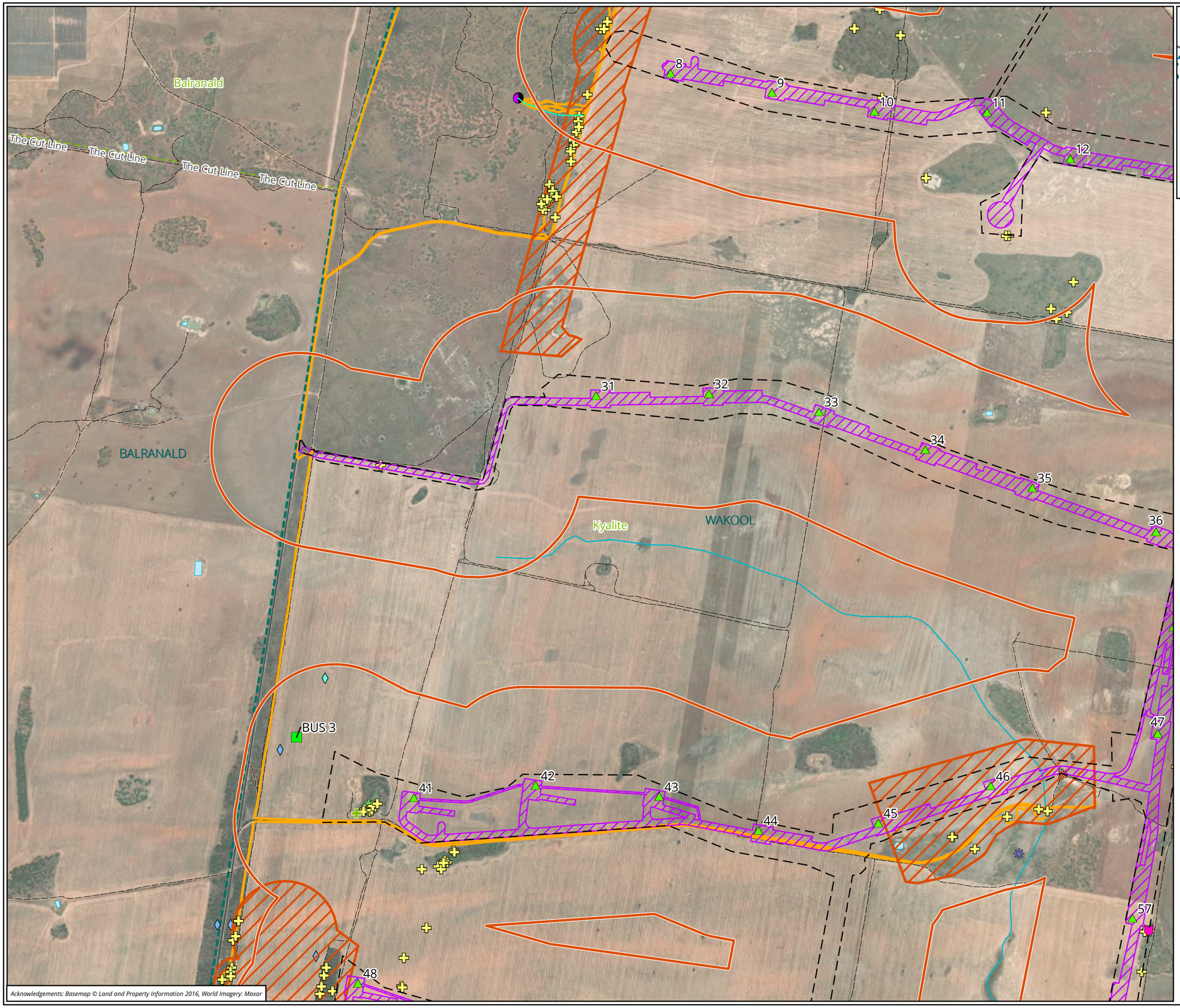
0 200 400 600 800

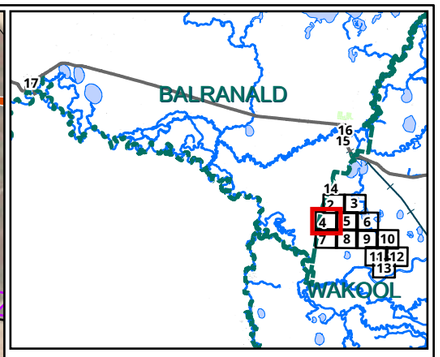
Meters
Scale: 1:20,000 @ A3
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Stick nest (NGH)
- Call playback / Spotlighting
- Line survey
- February 2022

**Threatened fauna (Biosis)**

- Grey-crowned Babbler

**Threatened fauna (Nature advisory)**

- Regent parrot
- Major Mitchell's Cockatoo

**Threatened fauna (NGH)**

- Grey Crowned Babbler
- Major Mitchells Cockatoo
- Spotted Harrier

**Survey points (Nature Advisory)**

- BUS

## Figure 10b.4 Targeted species mapping - Fauna

0 200 400 600 800

Meters

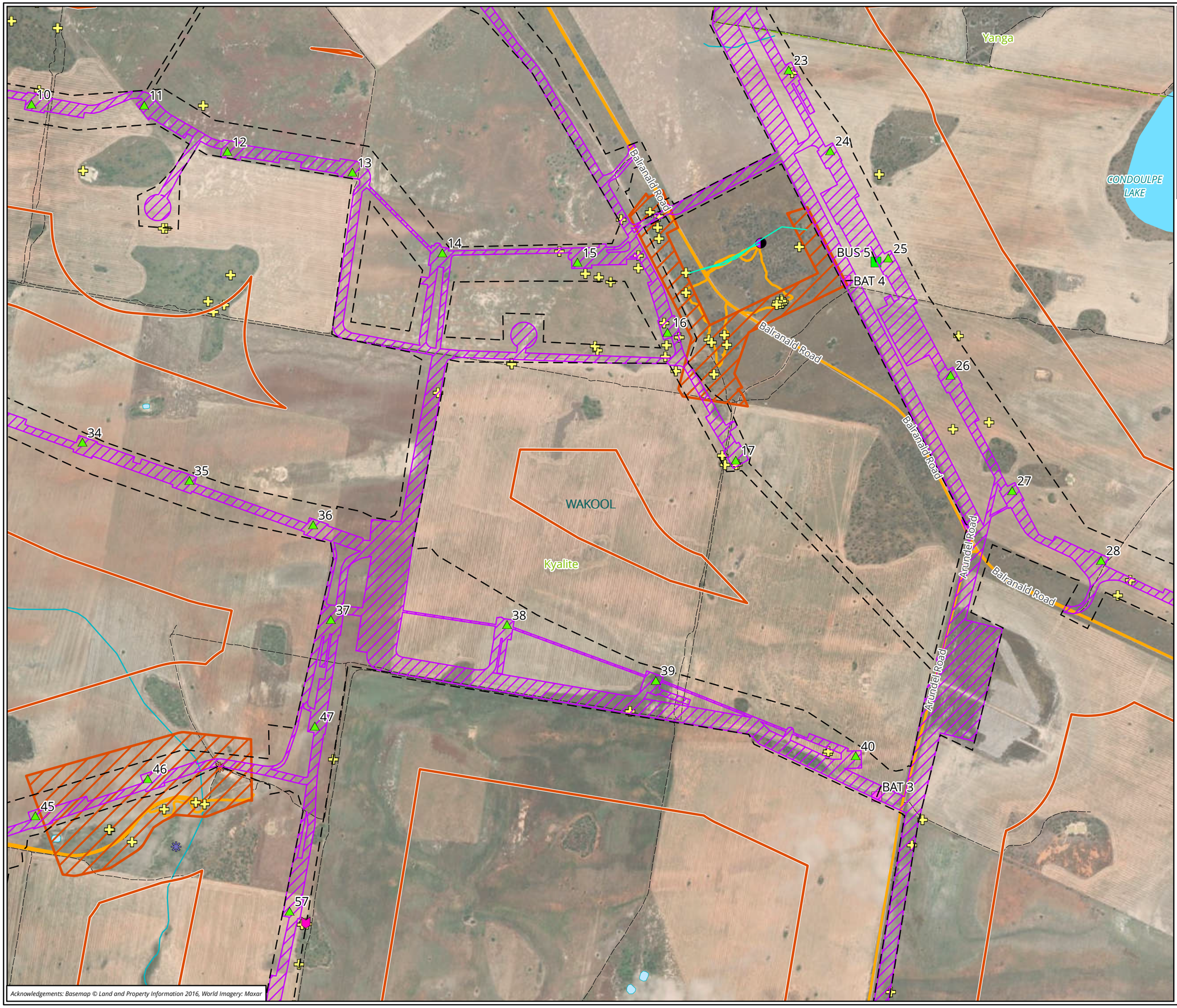
Scale: 1:20,000 @ A3

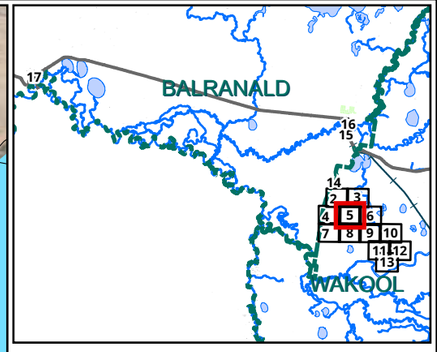
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Call playback / Spotlighting
- Line survey
- February 2022

**Threatened fauna (Biosis)**

- Grey-crowned Babbler

**Threatened fauna (NGH)**

- Grey Crowned Babbler
- Spotted Harrier

**Survey points (Nature Advisory)**

- BUS
- Bat

**Figure 10b.5 Targeted species mapping - Fauna**

0 200 400 600 800

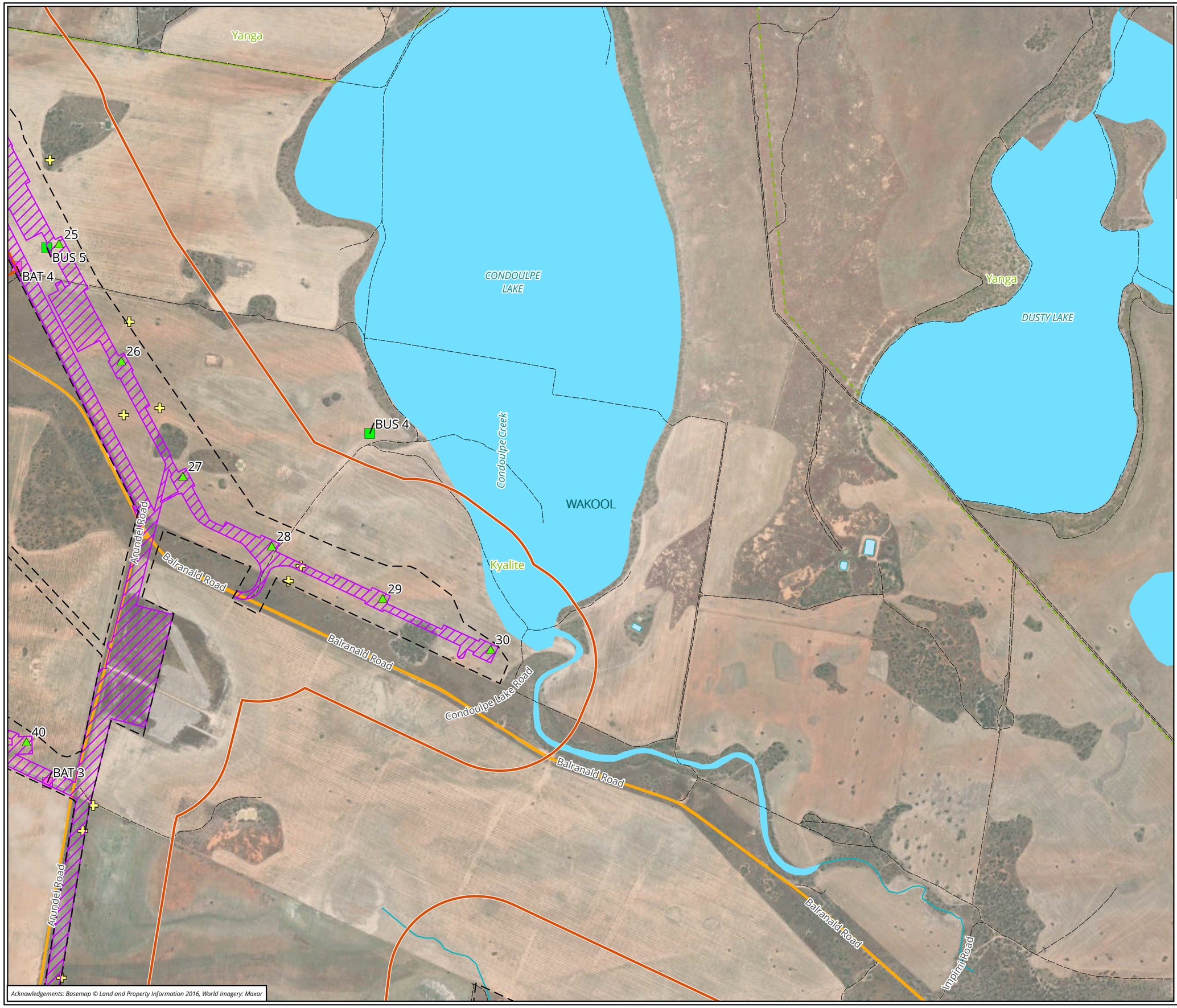
Meters

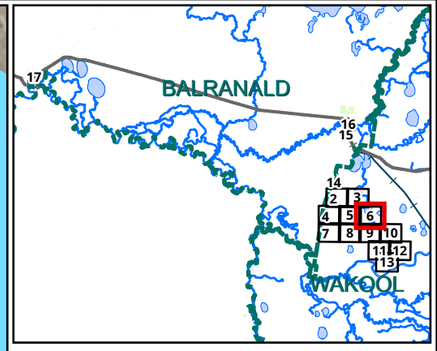
Scale: 1:20,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- February 2022

**Survey points (Nature Advisory)**

- BUS
- Bat

**Figure 10b.6 Targeted species mapping - Fauna**

0 200 400 600 800

Meters

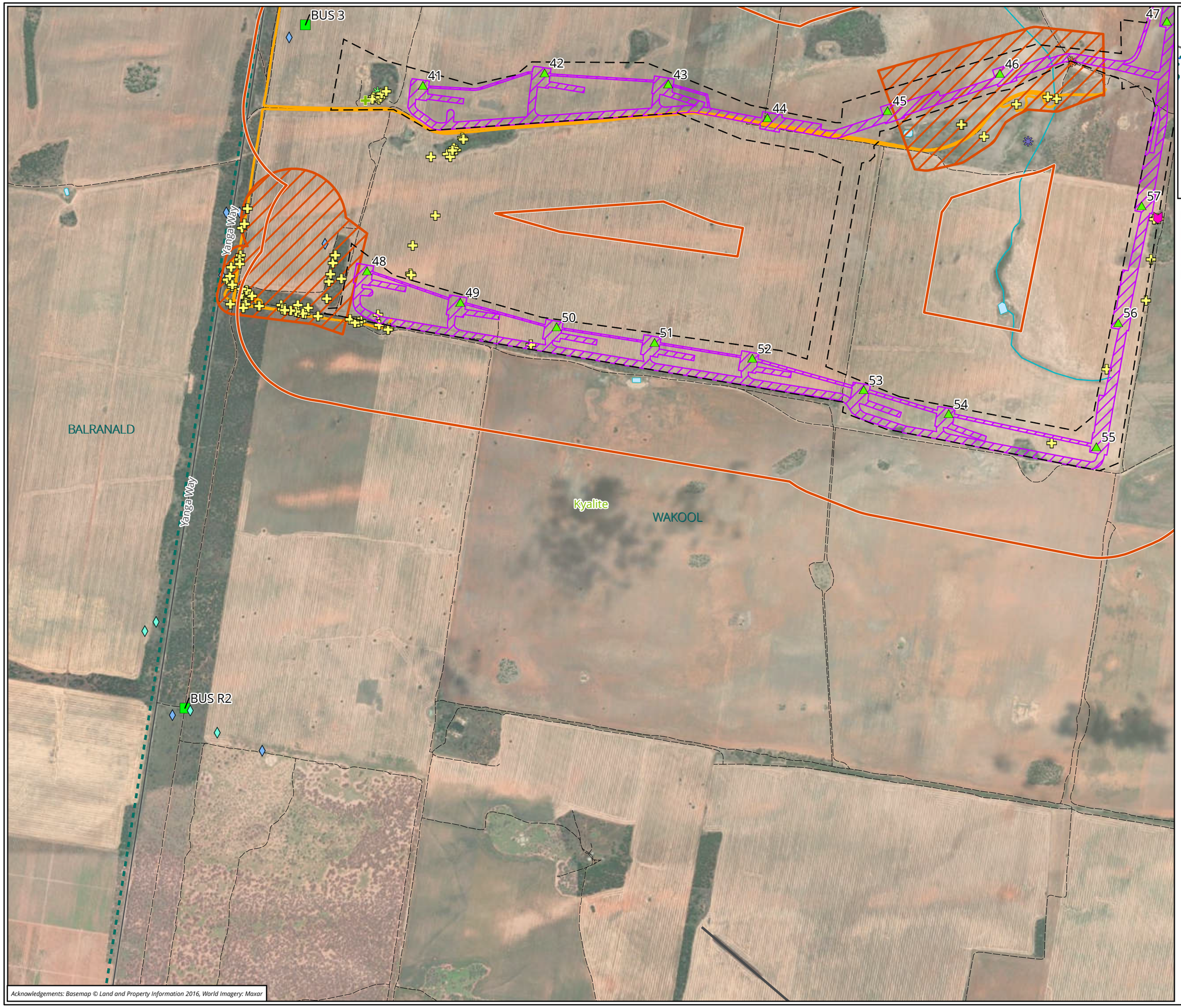
Scale: 1:20,000 @ A3

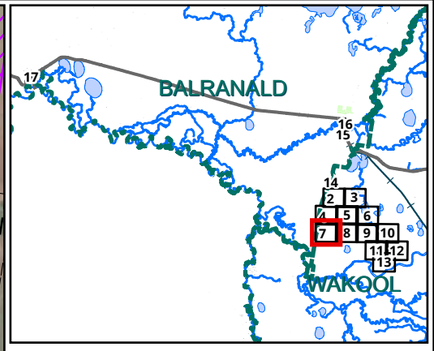
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Stick nest (NGH)
- February 2022

**Threatened fauna (Biosis)**

- Grey-crowned Babbler

**Threatened fauna (Nature advisory)**

- Regent parrot
- Major Mitchell's Cockatoo

**Threatened fauna (NGH)**

- Grey Crowned Babbler
- Major Mitchells Cockatoo
- Spotted Harrier

**Survey points (Nature Advisory)**

- BUS

## Figure 10b.7 Targeted species mapping - Fauna

0 200 400 600 800

Meters

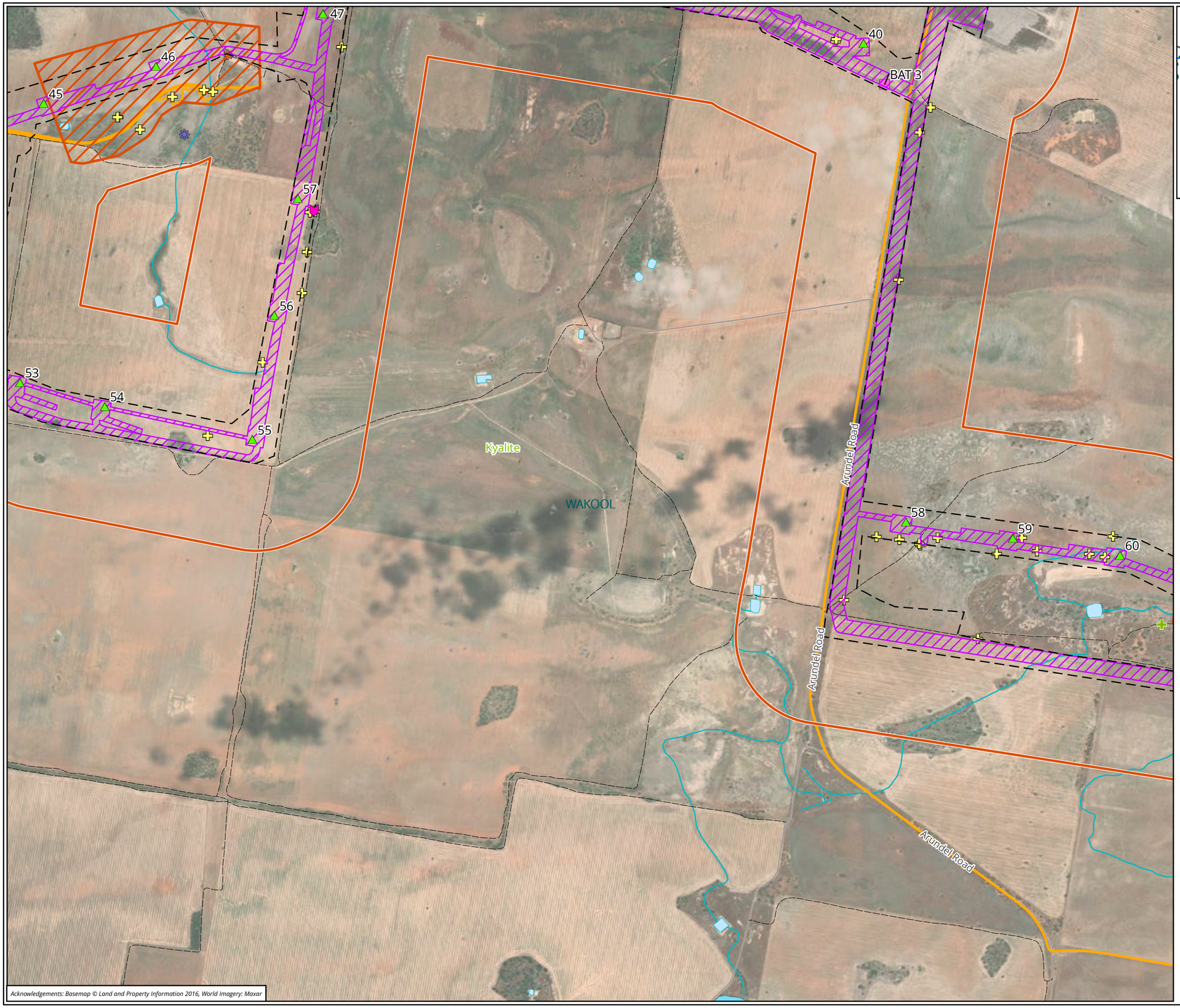
Scale: 1:20,000 @ A3

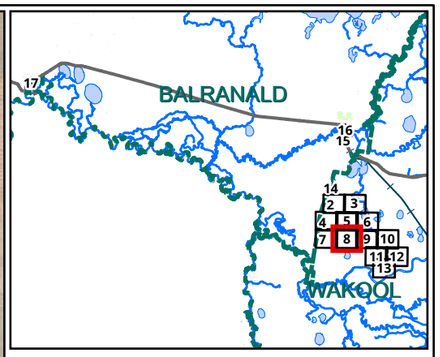
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Stick nest (NGH)
- February 2022

**Threatened fauna (Biosis)**

- Grey-crowned Babbler

**Threatened fauna (NGH)**

- Grey Crowned Babbler
- Spotted Harrier

**Survey points (Nature Advisory)**

- Bat

**Figure 10b.8 Targeted species mapping - Fauna**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

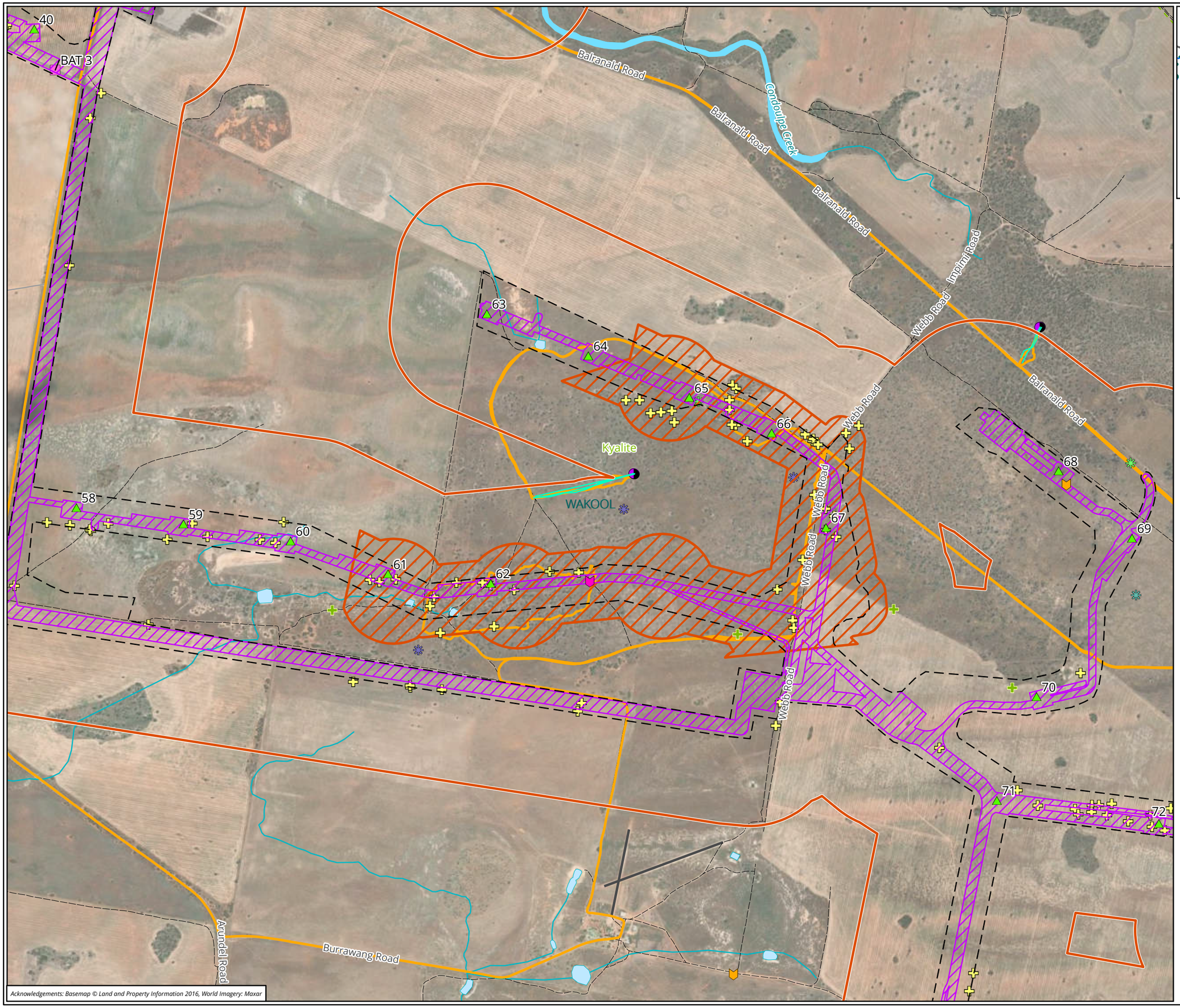
*Coordinate System: GDA2020 MGA Zone 54*

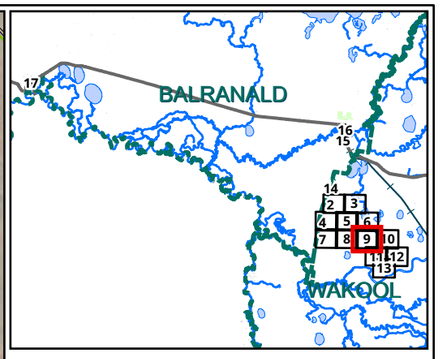
N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna

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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Stick nest (NGH)
- Call playback / Spotlighting
- Line survey
- February 2022

**Threatened fauna (Biosis)**

- Grey-crowned Babbler
- Major Mitchell's Cockatoo

**Threatened fauna (NGH)**

- Grey Crowned Babbler
- Major Mitchells Cockatoo
- White Fronted Chat

**Survey points (Nature Advisory)**

- Bat

## Figure 10b.9 Targeted species mapping - Fauna

0 200 400 600 800

Meters

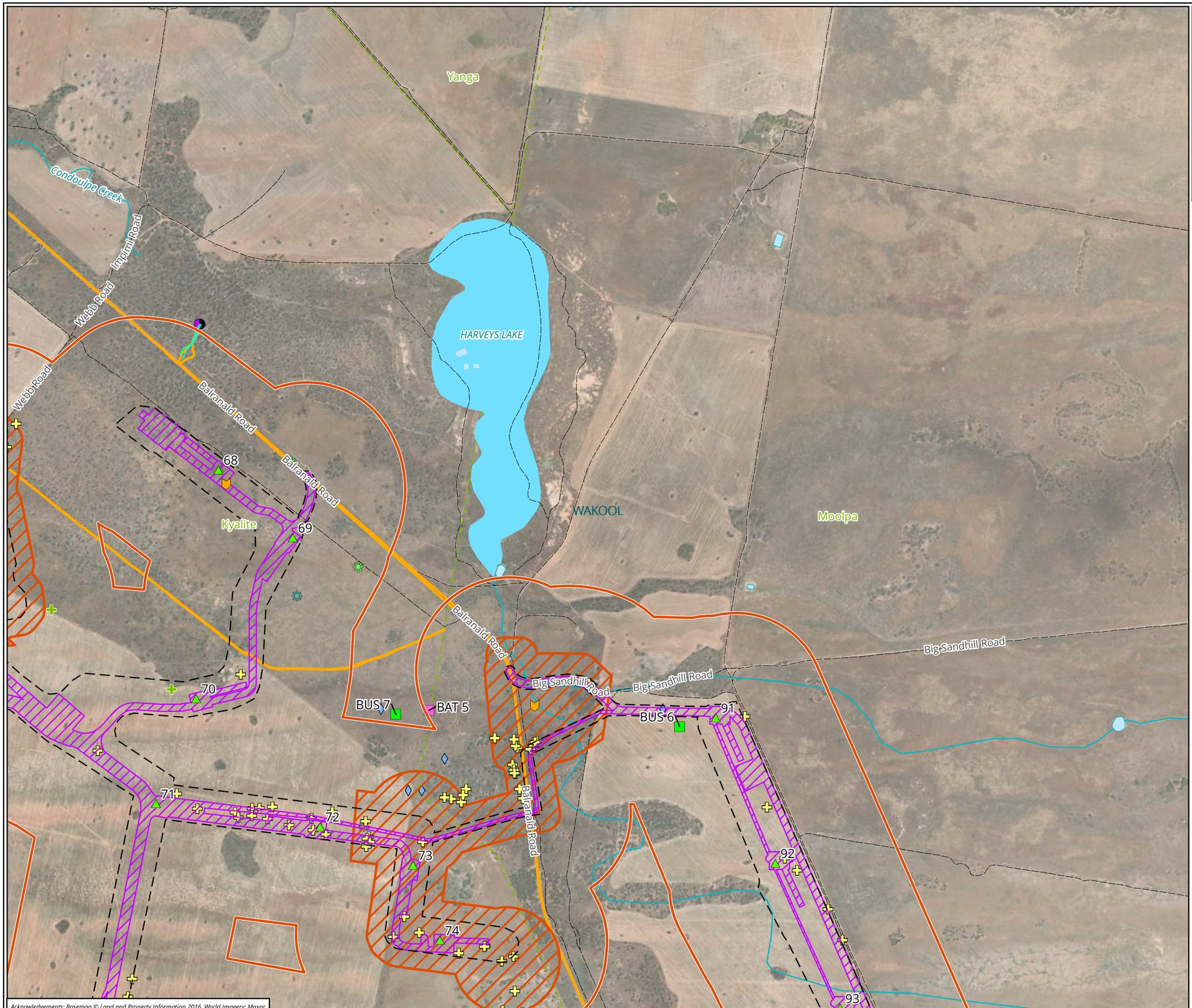
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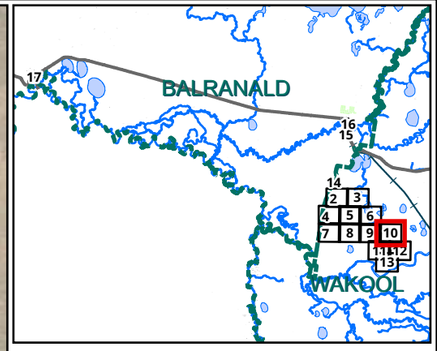
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Stick nest (NGH)
- Call playback / Spotlighting
- Line survey
- February 2022

**Threatened fauna (Biosis)**

- Major Mitchell's Cockatoo

**Threatened fauna (Nature advisory)**

- Major Mitchell's Cockatoo

**Threatened fauna (NGH)**

- Major Mitchells Cockatoo
- White Fronted Chat

**Survey points (Nature Advisory)**

- BUS
- Bat

**Figure 10b.10 Targeted species mapping - Fauna**

0 200 400 600 800

Meters

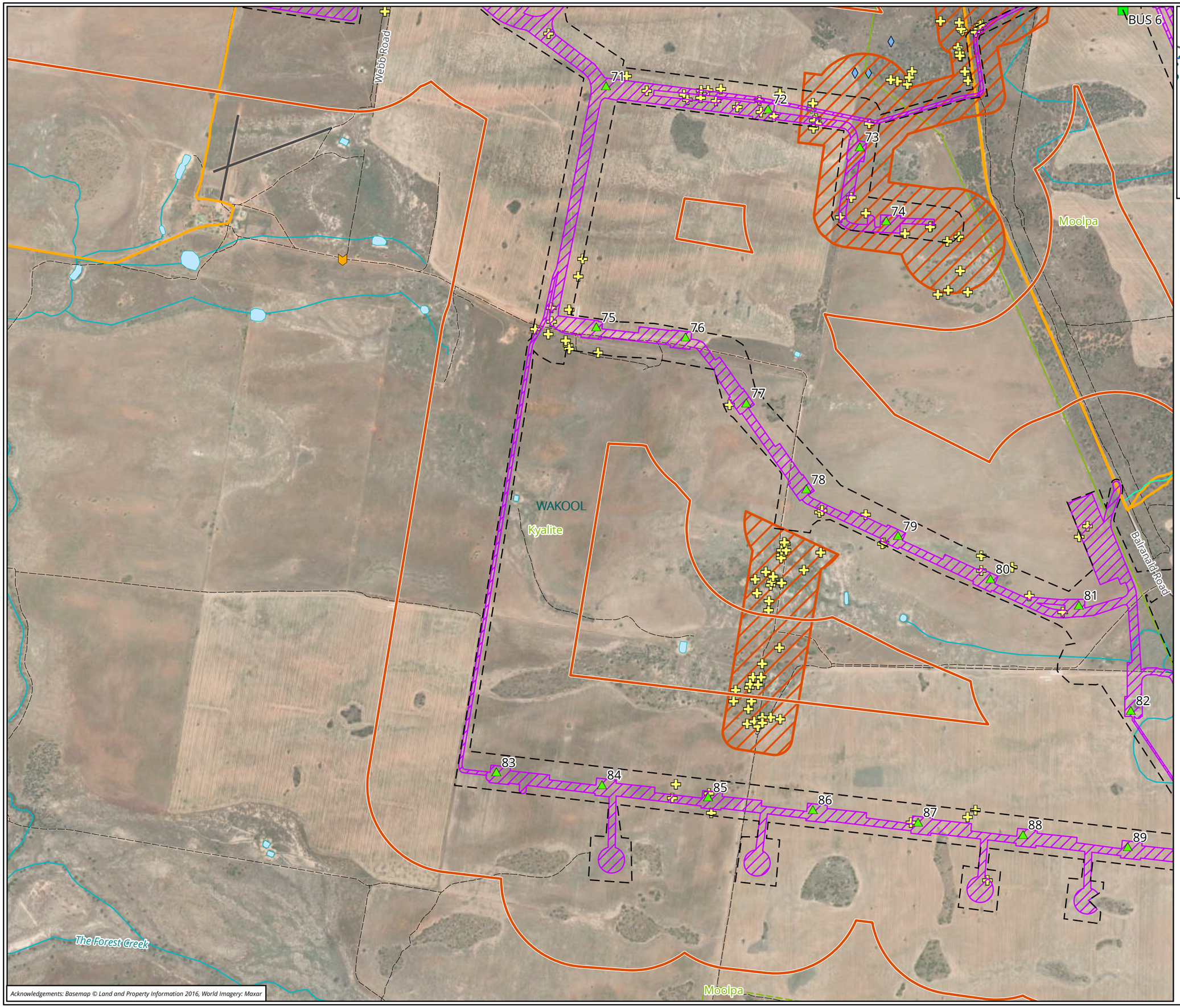
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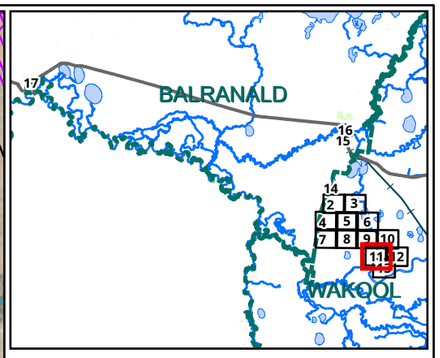
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Line survey
- February 2022

**Threatened fauna (Biosis)**

- Major Mitchell's Cockatoo

**Threatened fauna (Nature advisory)**

- Major Mitchell's Cockatoo

**Threatened fauna (NGH)**

- Major Mitchells Cockatoo

**Survey points (Nature Advisory)**

- BUS

## Figure 10b.11 Targeted species mapping - Fauna

0 200 400 600 800

Meters

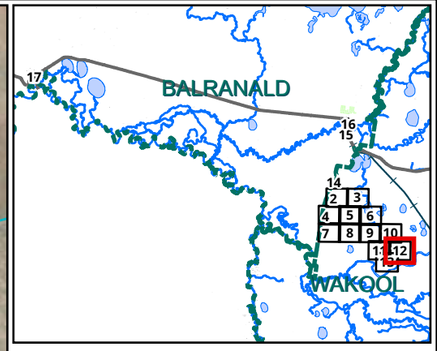
Scale: 1:20,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Call playback / Spotlighting
- Line survey
- February 2022

**Threatened fauna (Nature advisory)**

- Major Mitchell's Cockatoo

**Survey points (Nature Advisory)**

- BUS
- Bat

**Figure 10b.12 Targeted species mapping - Fauna**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

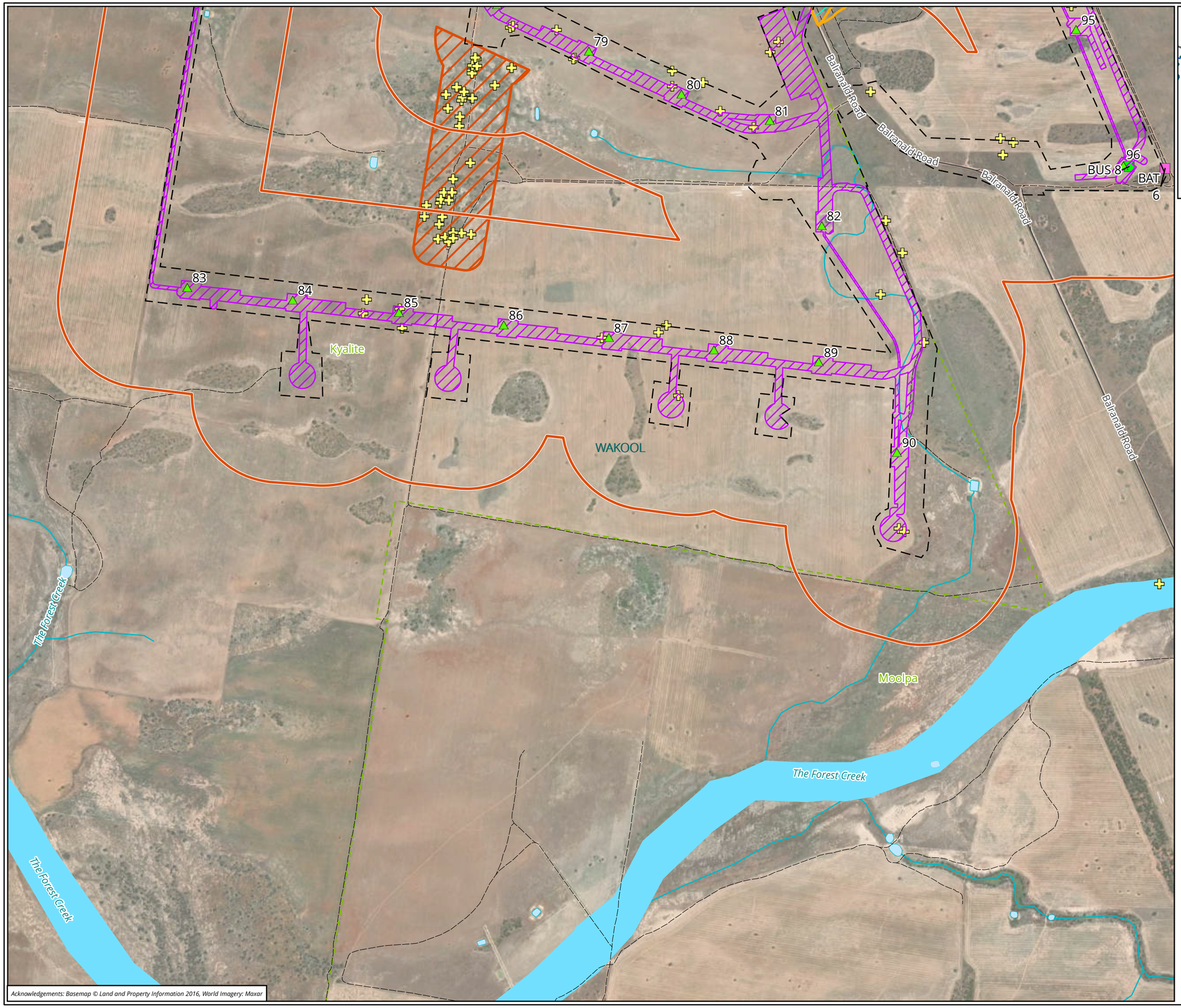
*Coordinate System: GDA2020 MGA Zone 54*

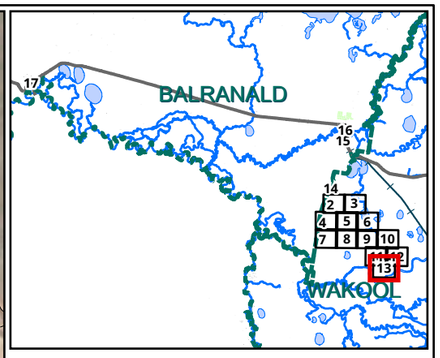
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biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna

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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Hollow-bearing tree survey areas
- Hollow-bearing trees
- Line survey
- February 2022

**Survey points (Nature Advisory)**

- BUS
- Bat

**Figure 10b.13 Targeted species mapping - Fauna**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

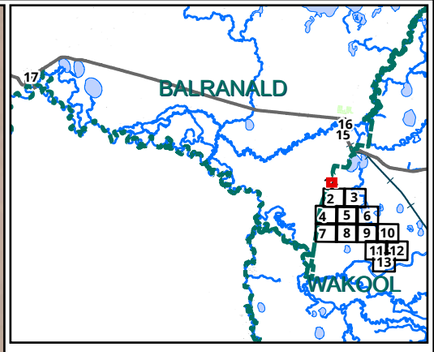
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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna

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**Legend**

- Subject land
- Development footprint
- February 2022

**Threatened fauna (Nature advisory)**

- Major Mitchell's Cockatoo

**Figure 10b.14 Targeted species mapping - Fauna**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

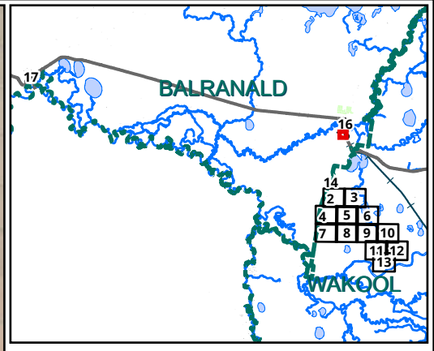
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biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna

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**Legend**

- Subject land
- Development footprint
- February 2022

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 10b.15 Targeted species mapping - Fauna**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

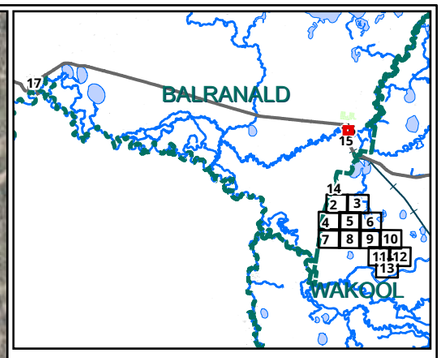
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna




**Legend**

- Subject land
- Development footprint

**Figure 10b.16 Targeted species mapping - Fauna**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

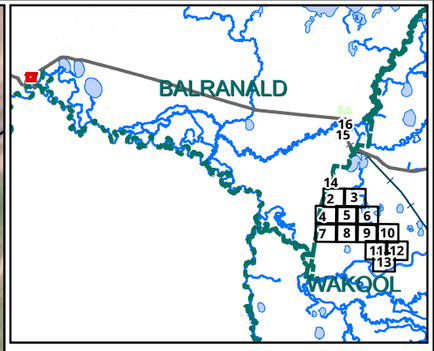
N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F10b_TSM_Fauna

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**Legend**

- Subject land
- Development footprint

**Figure 10b.17 Targeted species mapping - Fauna**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 19 April 2024
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### 4.3.2. Expert reports

Expert reports were not used in this assessment.

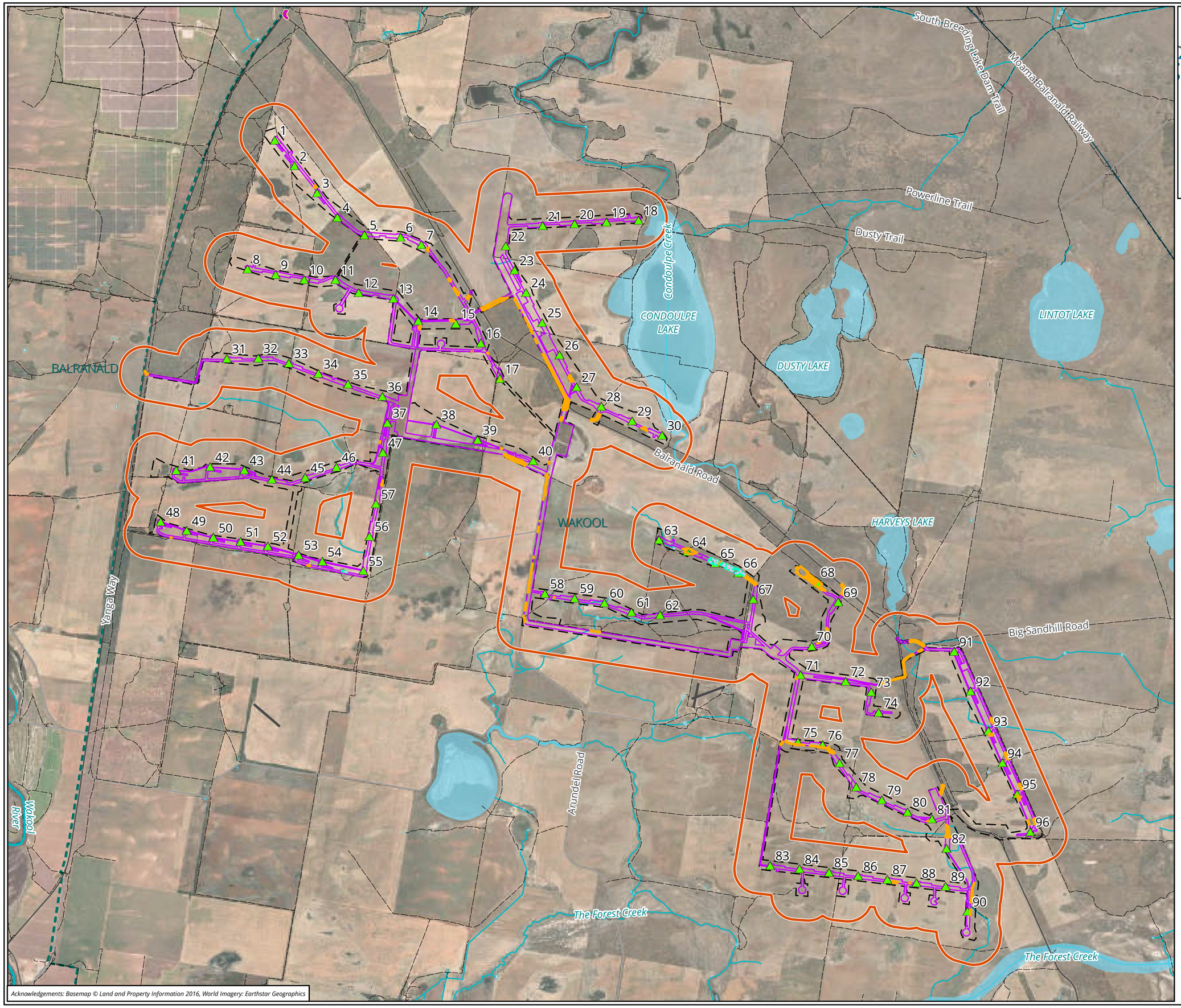
### 4.3.3. Threatened species summary and polygons

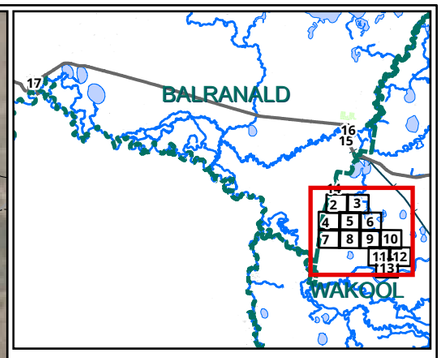
Table 27 provides details of threatened species impacted by the project and outlines the attributes that comprise the threatened species habitat polygons. The presence of threatened species impacted by the project is illustrated on Figure 11.

**Table 27 Threatened species polygons within the development footprint**

| Threatened species | Impact (ha) | Unit of measure | Biodiv. Risk weighting | Polygon attributes |
|---|---|---|---|---|
| **Flora** | | | | |
| **Menindee Nightshade** | • 2.34 ha PCT 16 moderate. | Area | 1.5 | • Assumed present in under-surveyed areas of PCT 16 in Moderate and DNG condition.<br>• All other areas of suitable potential habitat have been subject to survey or comprise degraded edges that would not support the species' presence.<br>• Potential habitat associated with vegetation zones PCT 16_Low and PCT 16_Paddock_Trees is considered degraded and not to support the species. |
| **Mossgiel Daisy** | • 2.34 ha PCT 16 moderate.<br>• 1.57 ha PCT 163 moderate. | Area | 2.0 | • Assumed present in under-surveyed areas of PCT 16 in Moderate and DNG condition, and PCT 163 in Moderate condition.<br>• All other areas of suitable potential habitat have been subject to survey or comprise degraded edges that would not support the species' presence.<br>• Potential habitat associated with vegetation zones PCT 16_Low and PCT 16_Paddock_Trees is considered degraded and not to support the species. |
| **Winged Peppercress** | • 2.16 ha PCT 16 moderate.<br>• 1.50 ha PCT 163 moderate. | Area | 2.0 | • Assumed present in under-surveyed areas of PCT 16 in Moderate and DNG condition, and PCT 163 in Moderate condition.<br>• All other areas of suitable potential habitat have been subject to survey or comprise degraded edges that would not support the species' presence.<br>• Potential habitat associated with vegetation zones PCT 16_Low and PCT 16_Paddock_Trees is considered degraded and not to support the species. |

| Threatened species | Impact (ha) | Unit of measure | Biodiv. Risk weighting | Polygon attributes |
|---|---|---|---|---|
| **Fauna** | | | | |
| **Major Mitchell's Cockatoo** | • 37.4 ha total. | Area | 2.0 | • Associated PCTs in all condition states where they occur within 200m of a confirmed nest tree OR within 200m of potential (unsurveyed) habitat.<br>– Non-treed condition states are considered appropriate for inclusion in the species polygon due to the species being known to frequently forage on-ground for roots, bulbs, insect larvae and seeds (Cth DCCEEW 2023b).<br>• Surveyed areas confirmed not to support potential nest trees, or greater than 200m of a potential nest tree, have been excluded.<br>• Unsurveyed areas greater than 200m from potential habitat (i.e., associated wooded PCTs that may support nest trees) have been excluded. |




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Mosgiel Daisy
- Winged Peppercress
- Menindee Nightshade
- Major Mitchell's Cockatoo

## Figure 11.1 Threatened species polygons

0 825 1,650 2,475 3,300

Meters

Scale: 1:72,000 @ A3

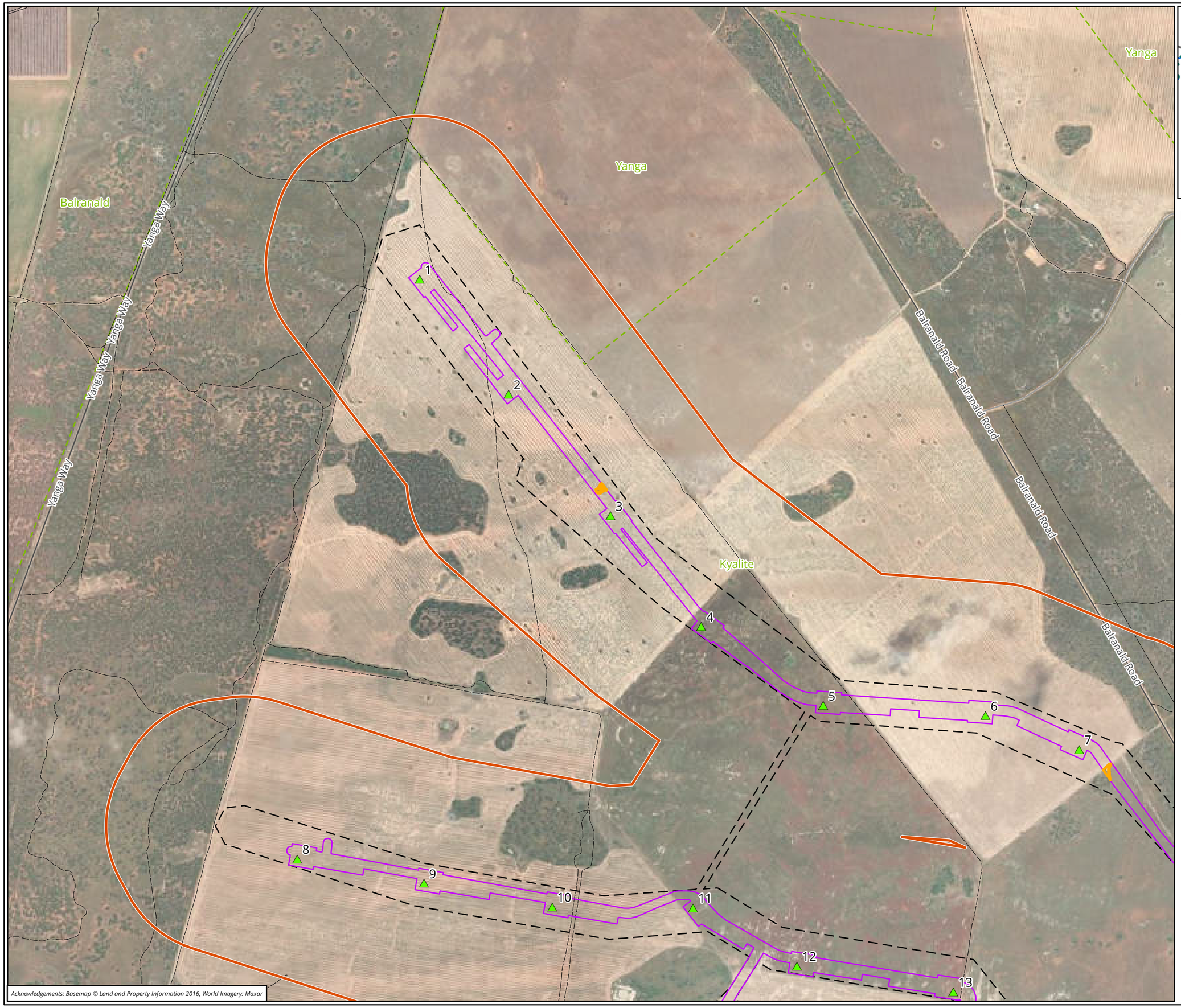
*Coordinate System:*
*GDA2020 MGA Zone 54*

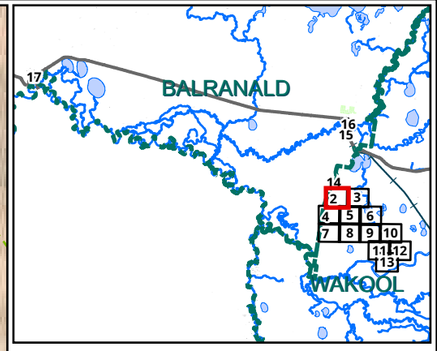
N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics*




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.2 Threatened species polygons**

0 180 360 540 720

Meters

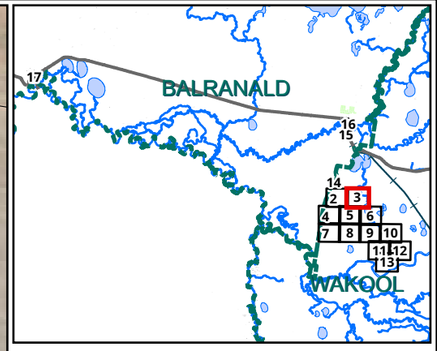
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*Coordinate System:*
*GDA2020 MGA Zone 54*

N

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

Yanga
Kyalite
Balranald Road
Balranald Road
Balranald Road
Condoulpe Creek
CONDOULPE LAKE
7
18
19
20
21
22
23
24

Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar

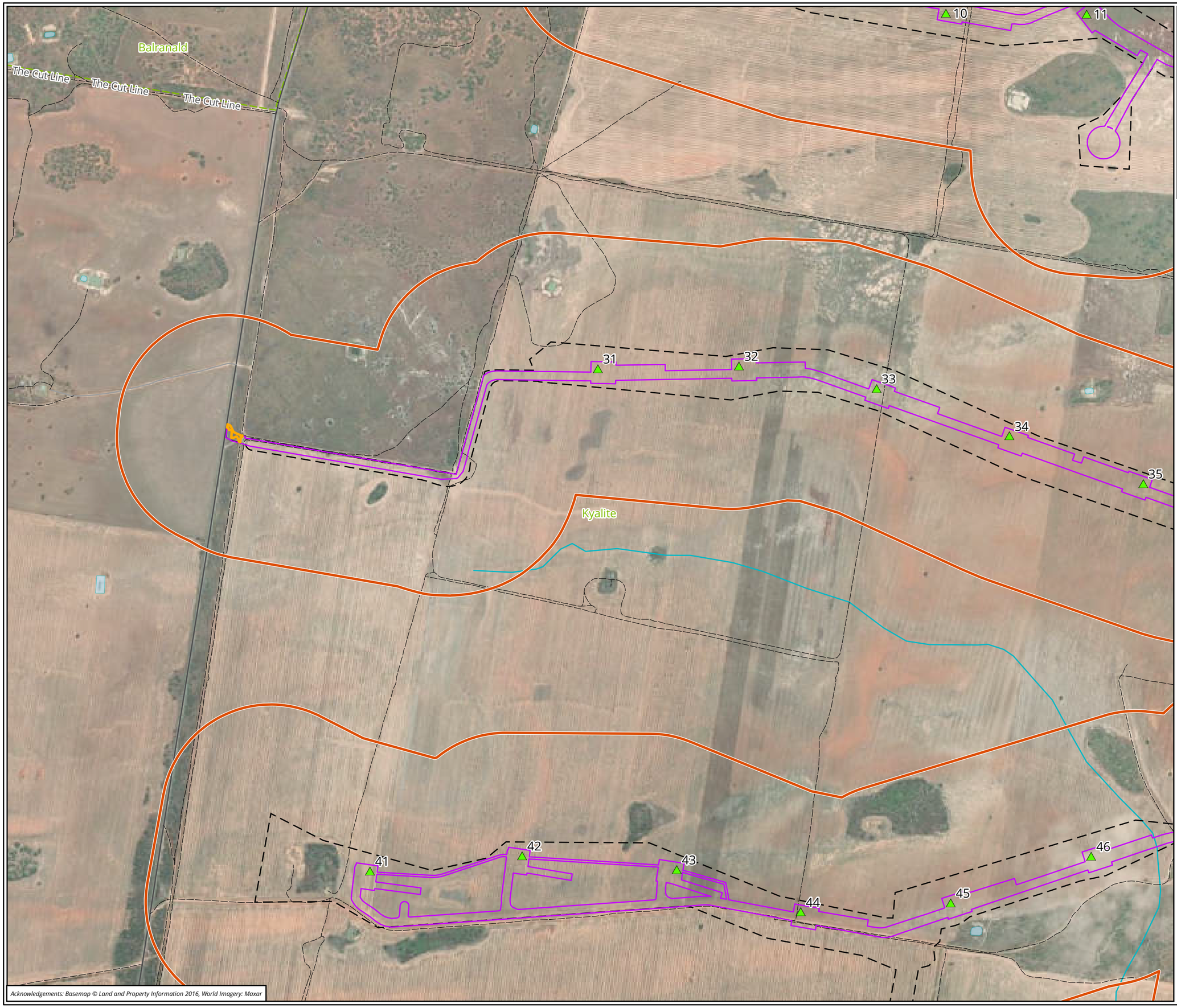
**Figure 11.3 Threatened species polygons**

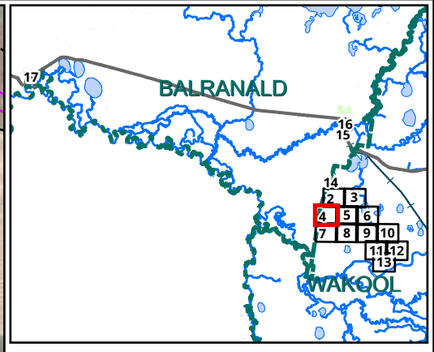
0 180 360 540 720
Meters
Scale: 1:16,000 @ A3
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.4 Threatened species polygons**

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

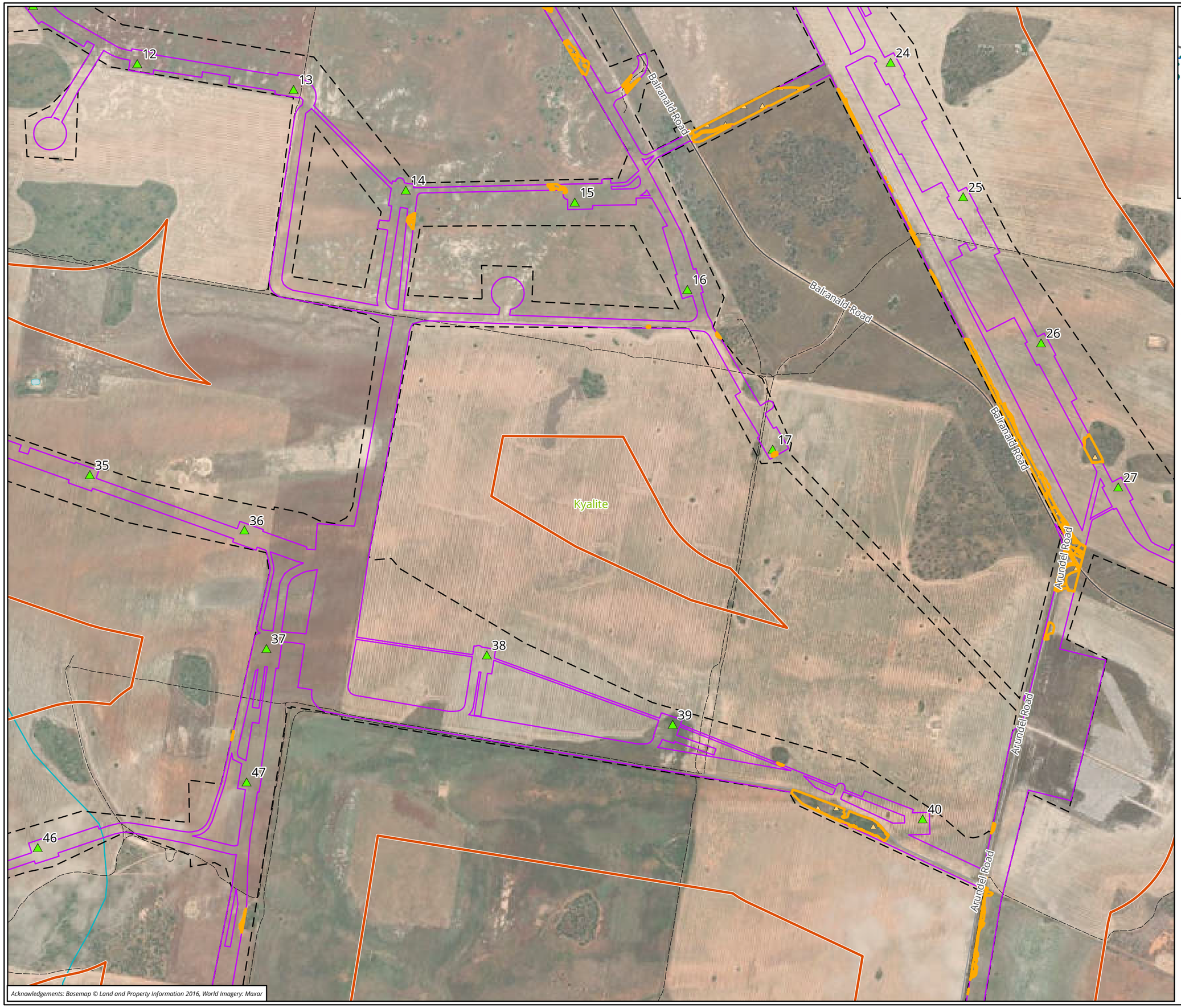
*Coordinate System: GDA2020 MGA Zone 54*

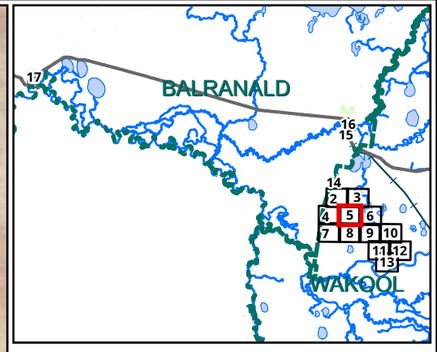
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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.5 Threatened species polygons**

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

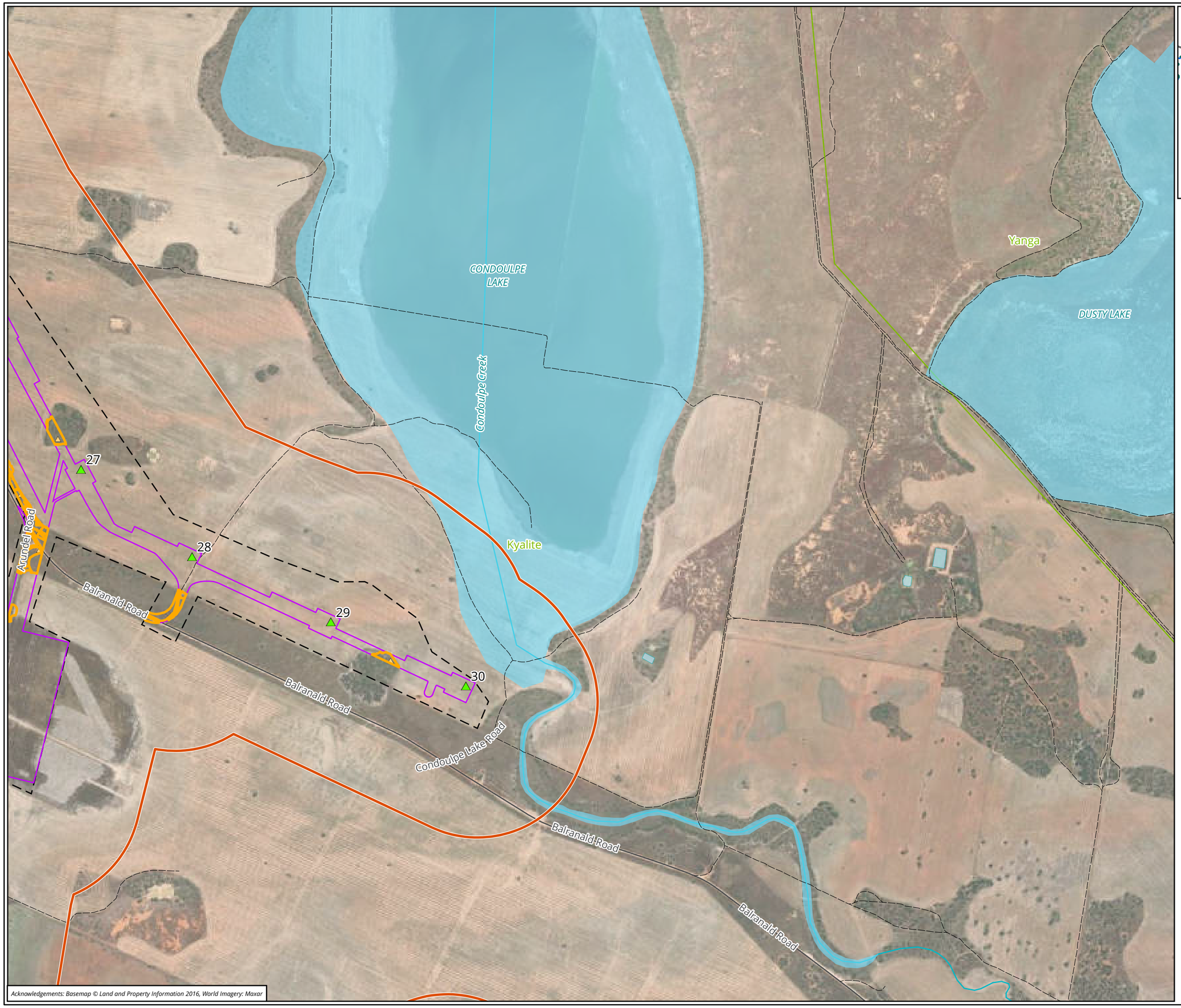
*Coordinate System: GDA2020 MGA Zone 54*

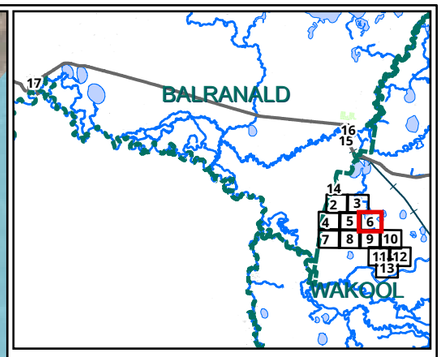
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biosis

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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.6 Threatened species polygons**

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

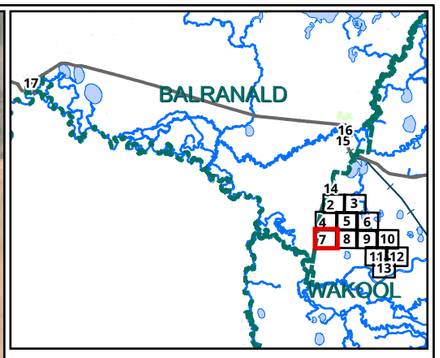
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Mosgiel Daisy
- Winged Peppercress
- Menindee Nightshade
- Major Mitchell's Cockatoo

**Figure 11.7 Threatened species polygons**

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

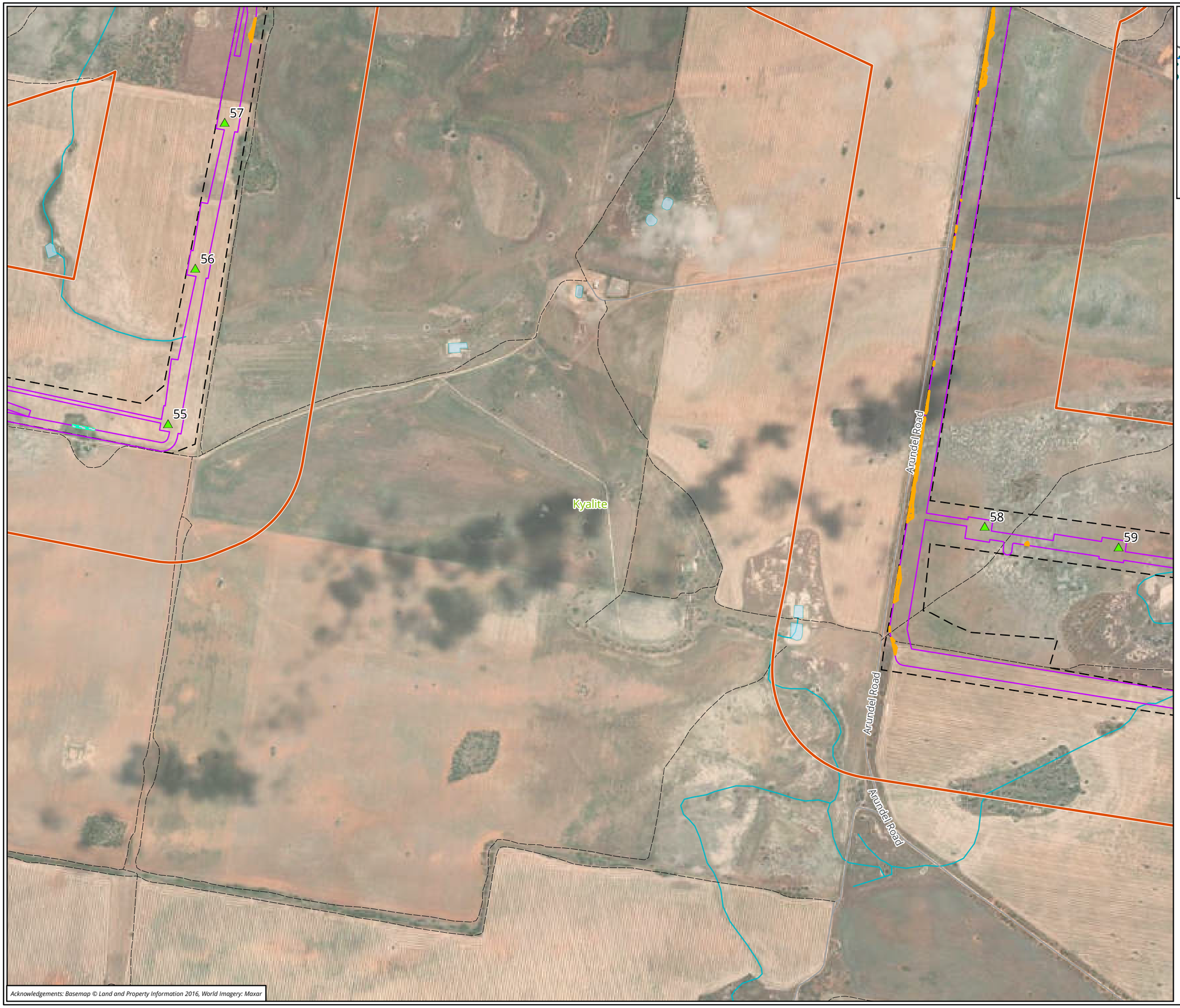
*Coordinate System: GDA2020 MGA Zone 54*

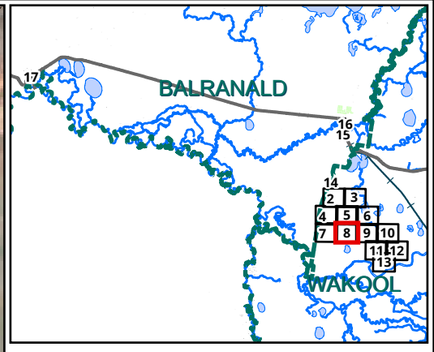
N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Mosgiel Daisy
- Winged Peppercress
- Menindee Nightshade
- Major Mitchell's Cockatoo

**Figure 11.8 Threatened species polygons**

0 180 360 540 720

Meters

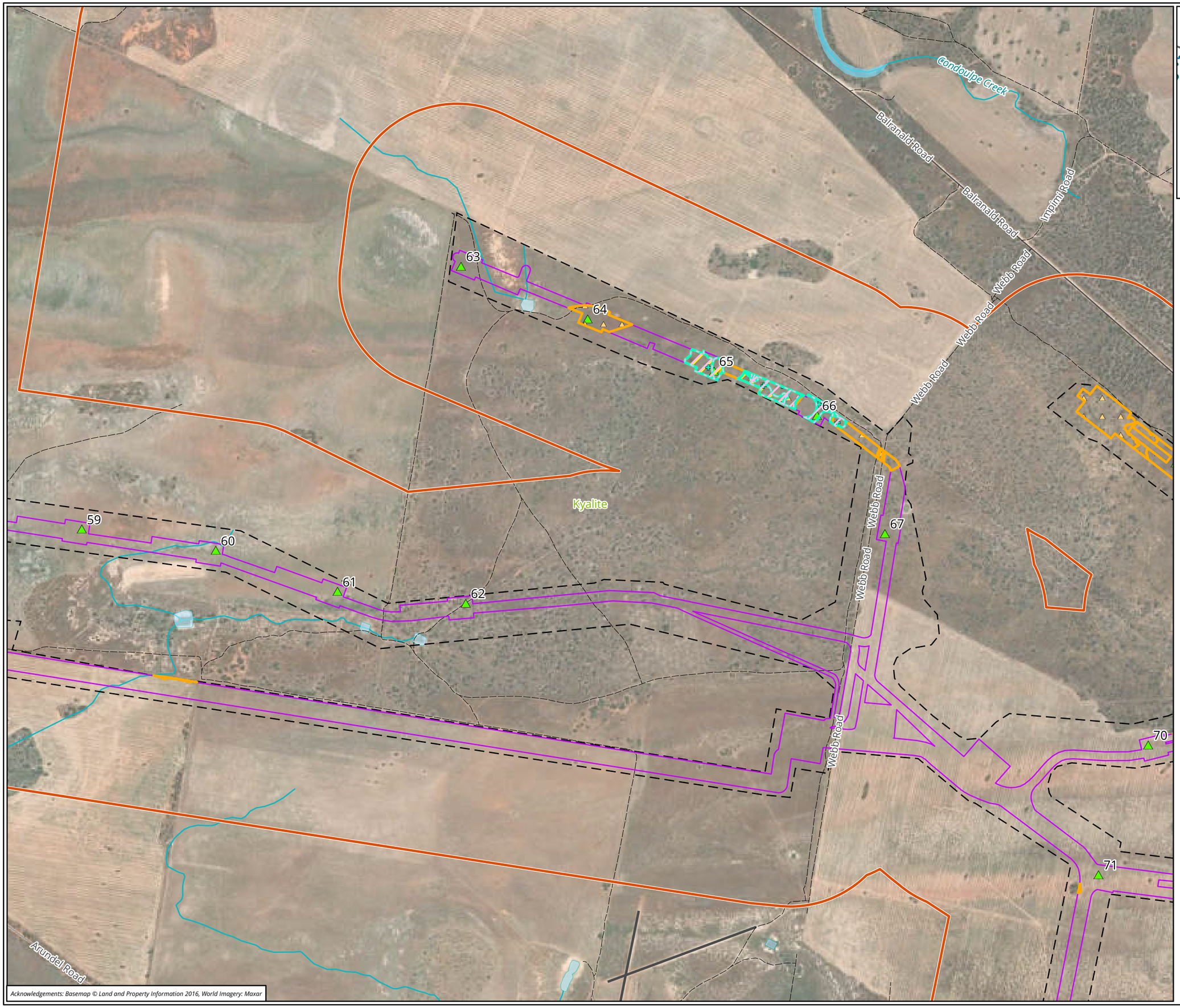
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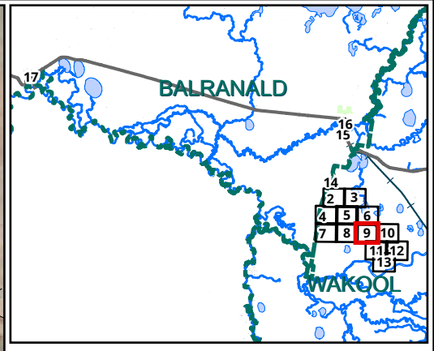
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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Mosgiel Daisy
- Winged Peppercress
- Menindee Nightshade
- Major Mitchell's Cockatoo

**Figure 11.9 Threatened species polygons**

0 180 360 540 720

Meters

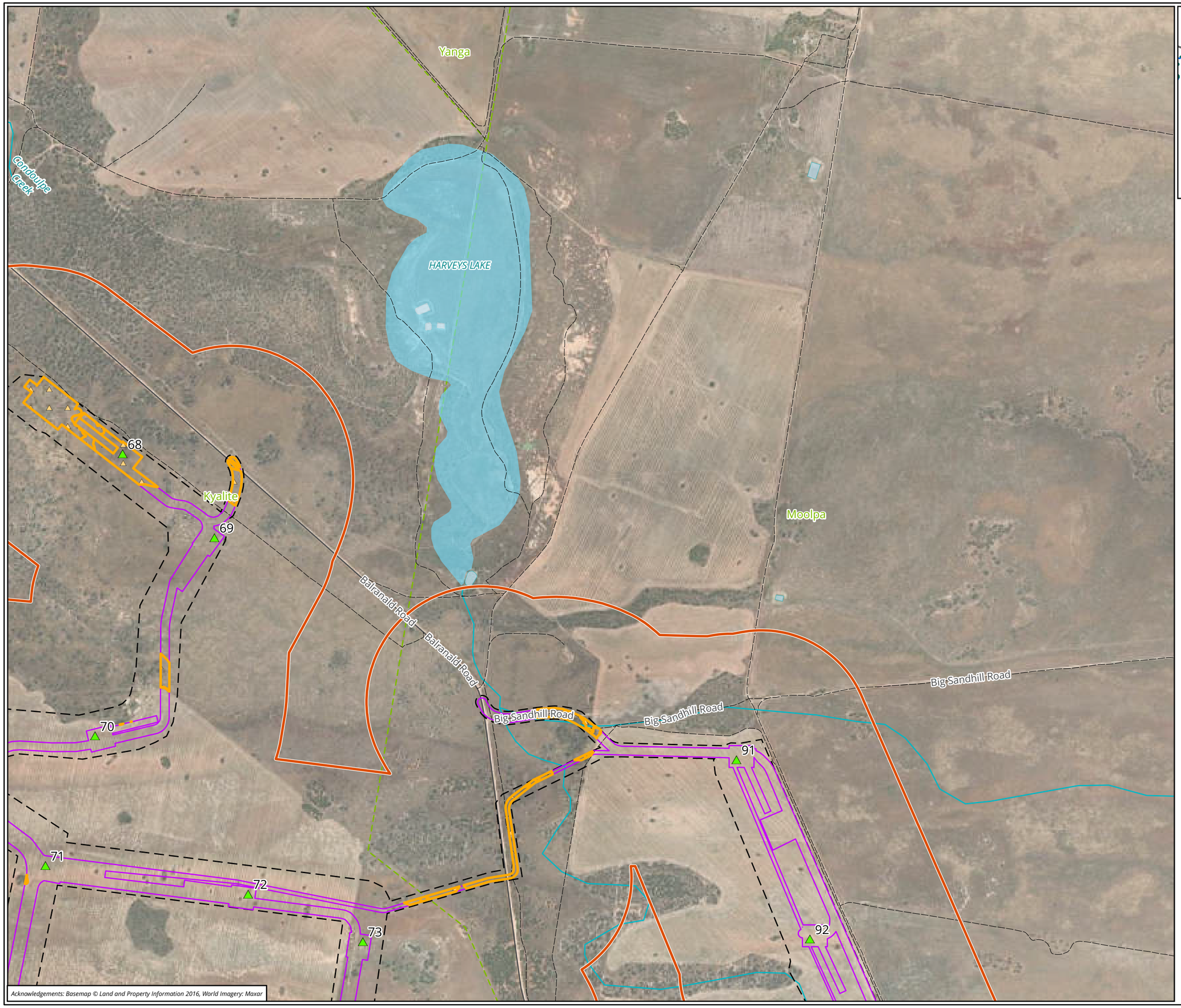
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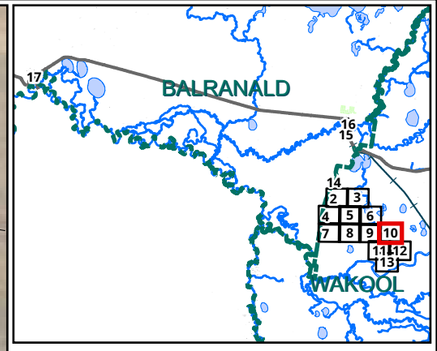
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Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.10 Threatened species polygons**

0 180 360 540 720

Meters

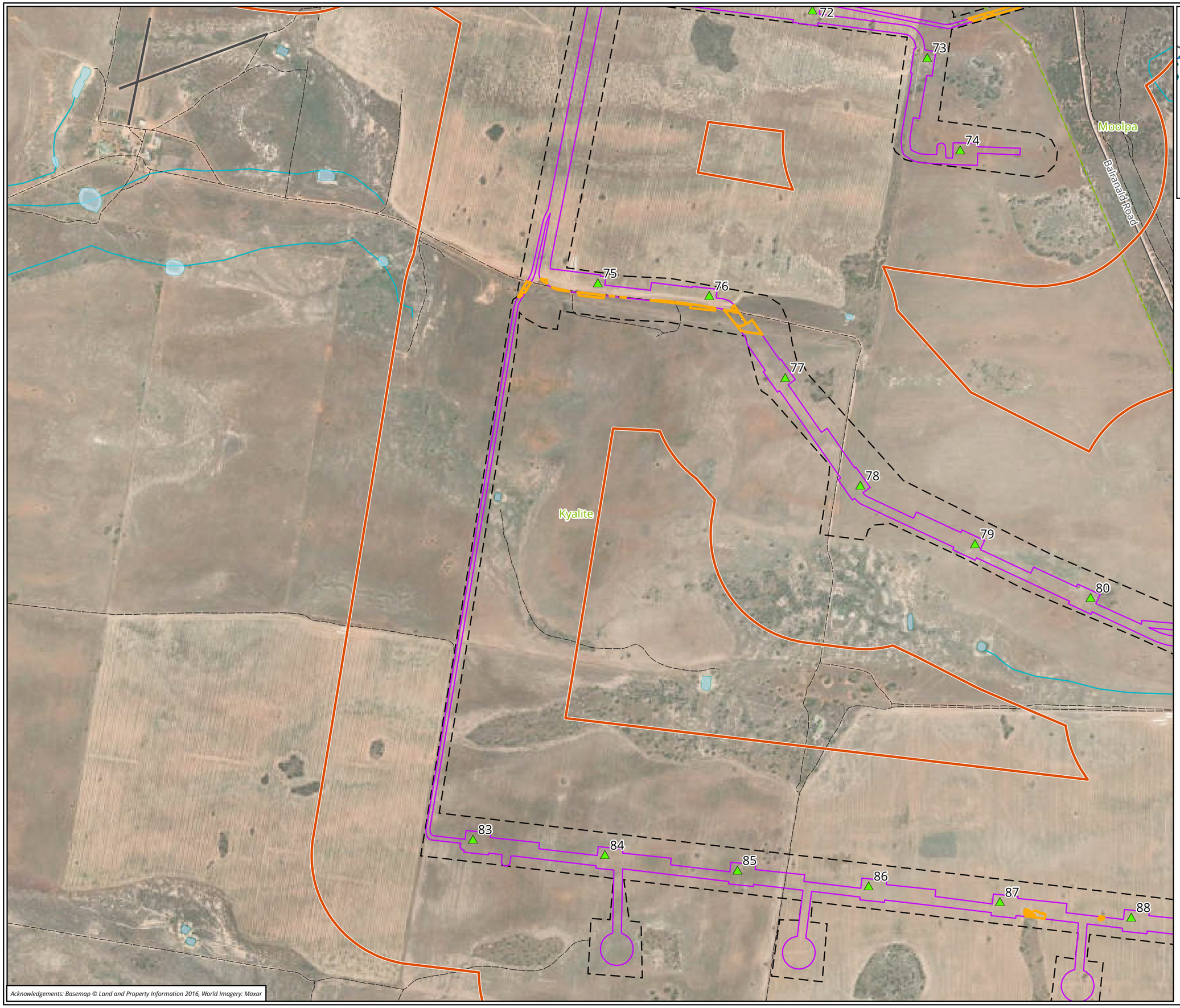
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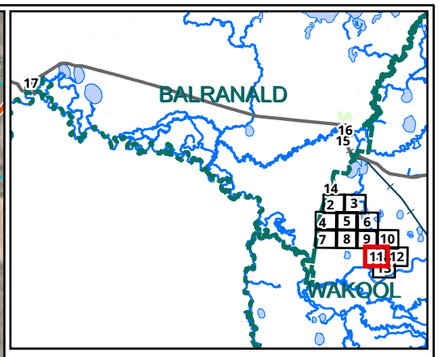
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 11.11 Threatened species polygons**

0 180 360 540 720

Meters

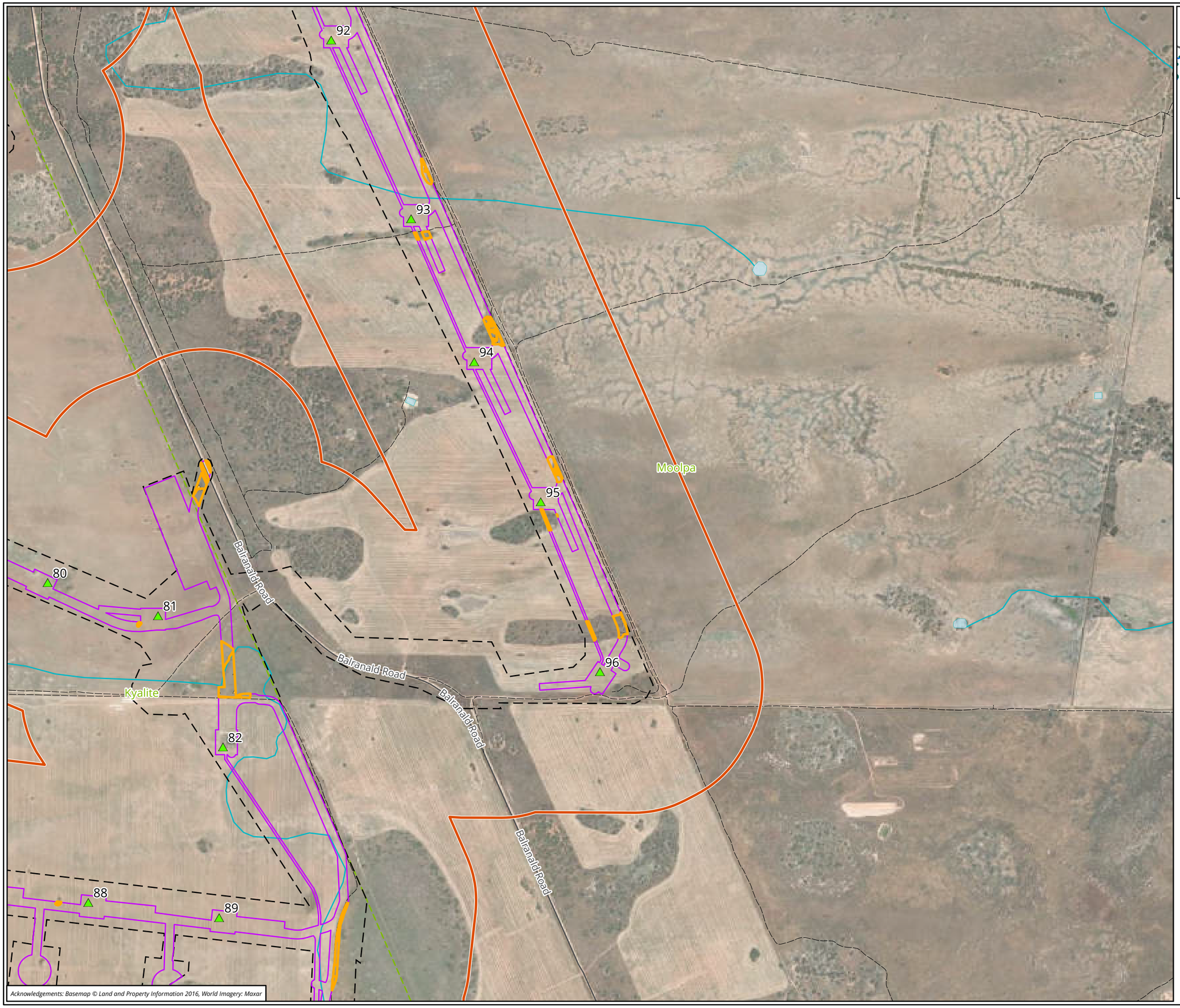
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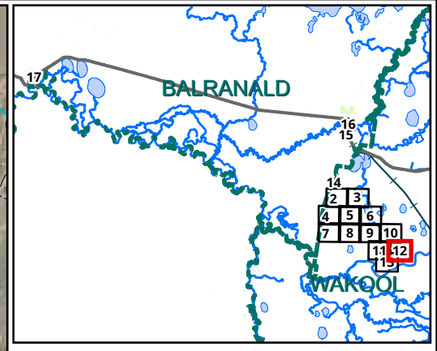
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Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.12 Threatened species polygons**

0 180 360 540 720

Meters

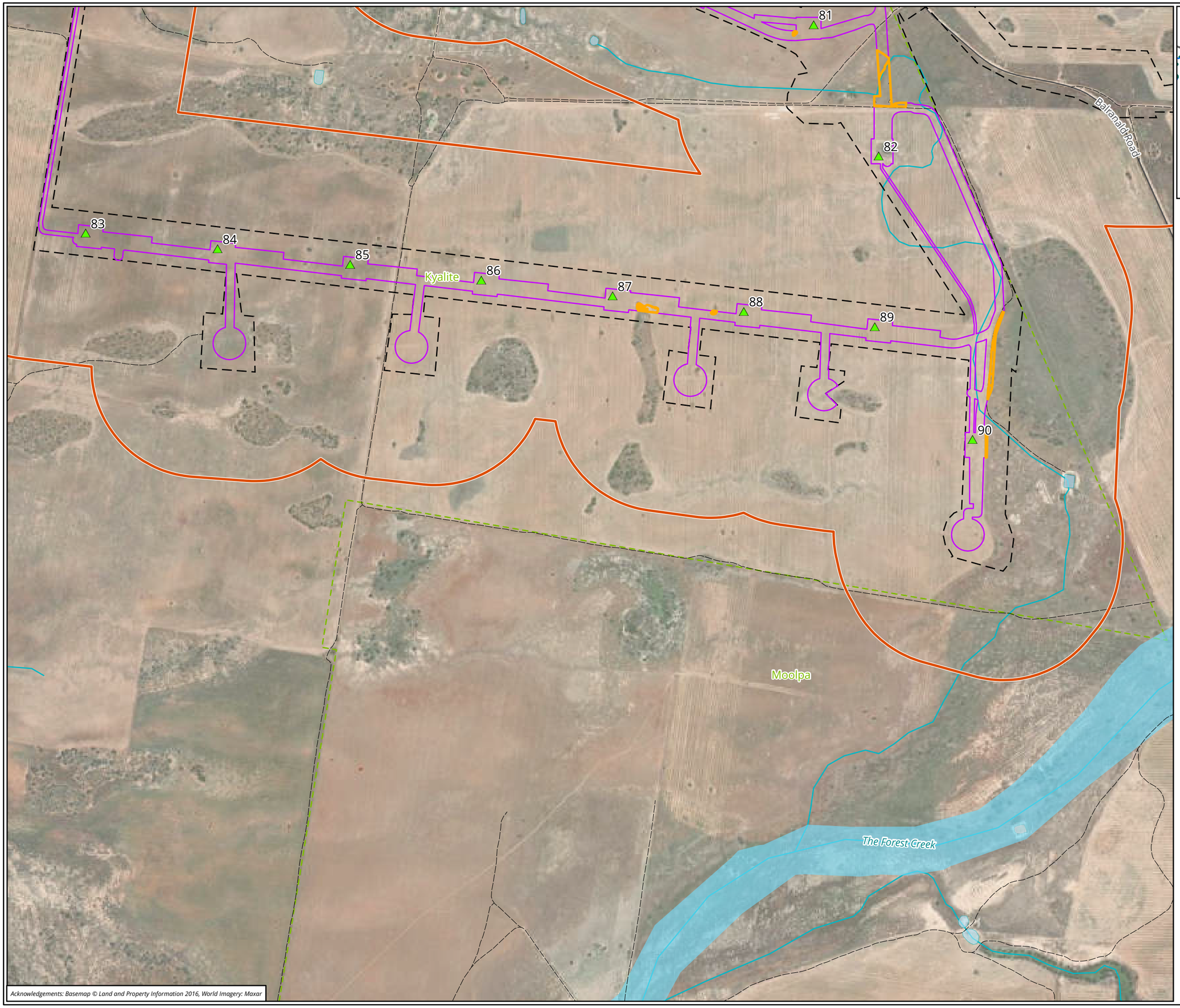
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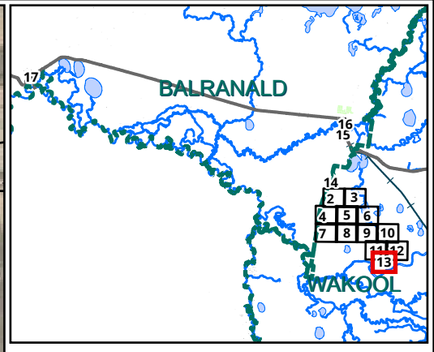
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened species polygons**

- Major Mitchell's Cockatoo

**Figure 11.13 Threatened species polygons**

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

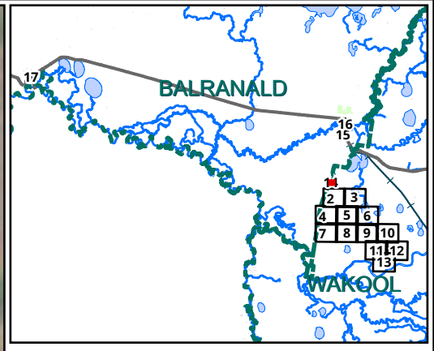
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Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development footprint

**Figure 11.14 Threatened species polygons**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

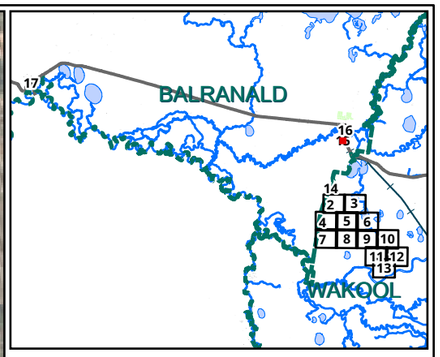
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Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development footprint

**Figure 11.15 Threatened species polygons**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

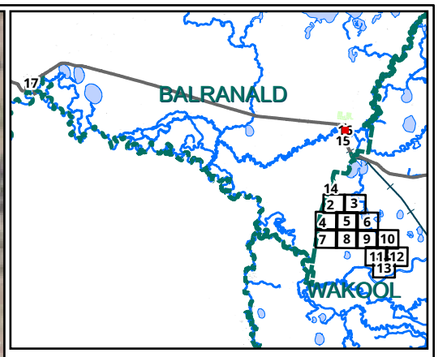
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Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development footprint

**Figure 11.16 Threatened species polygons**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

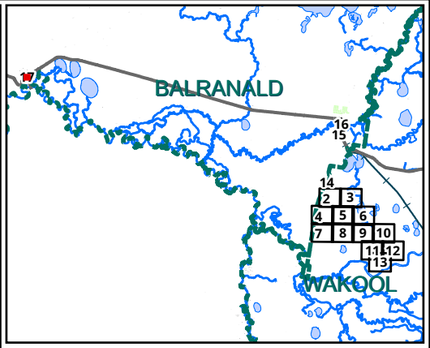
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Layout: 37502_F11_TSP

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**Legend**

- Subject land
- Development footprint

**Figure 11.17 Threatened species polygons**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
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Layout: 37502_F11_TSP

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# 5. Identifying prescribed impacts

## 5.1. Assessment of the occurrence of prescribed impacts

Prescribed impacts have been identified in accordance with Section 6 of the BAM and Clause 6.1 of the BC Regulation. Identification of prescribed impacts are outlined below in Table 28 and Sections 5 and 6.

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**Table 28 Prescribed impacts associated with the project**

| Feature | Present | Description of feature characteristics and location | Threatened entities that use, are likely to use, or are part of the habitat feature. |
|---|---|---|---|
| **Karst, caves, crevices, cliffs, rocks or other geological features of significance** | No | No karst, caves, crevices, cliffs, rocks or other geological features of significance occur within the subject land or assessment area. | N/A |
| **Human-made structures** | Yes | Human made structures are present within the subject land. Within the development site the following human made structure are present:<br>• Dams.<br>• Fences.<br>• Farm tracks.<br>• Formed public roads.<br>• Water troughs. | Avian fauna species are known to utilise artificial and human made structures for nesting due to historical clearing of native vegetation. Dams and water troughs are utilised by fauna species as permanent water resources throughout the year, some dams are created in areas that likely originally supported natural ephemeral billabongs.<br>Refer to Section 8.3.1. |
| **Non-native vegetation** | Yes | Non-native vegetation occurs, predominately in the form of cropped land, and exotic components of retained native vegetation. | Exotic vegetation, including cropped land is known to be utilised by raptor species for foraging.<br>Refer to Section 8.3.2 |
| **Habitat connectivity** | Yes | Natural corridors in the form of native vegetation and riparian watercourses in both a project level scale and broader landscape scale occur.<br>Landscape scale habitat connectivity also exists for aerial species over the wind farm between water bodies present in the surrounding landscape. This includes both vegetation and non-vegetation (or farmed/cropped) areas. | All threatened fauna, flora and TECs within the landscape. Aerial species are particularly at risk from habitat connectivity loss arising from the potential barrier effect of operating wind turbines.<br>Refer to Section 8.3.3. |
| **Waterbodies, water quality and hydrological processes** | Yes | Condoulpe Lake is a large wetland feature within the subject land. It is mapped as a 'natural waterbody' and is described as mainly dry, however an assessment of historical imagery shows the lake bed has been subject to grazing and cropping since at least 1961.<br>A number of watercourses occurs within the subject land. The project design as avoided the majority of riparian areas. | When containing water, migratory species, and fauna species have the potential to use Condoulpe Lake, The Forest Creek and floodplain depressions/watercourses outside the subject land. Refer to Section 8.3.4<br>Riparian areas are utilised by fauna species as connectivity corridors. Refer to Section 8.3.4 |
| **Wind turbine strikes** | Yes | See Section 6 below. | See Sections 6 and 8.3.5 below. |

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| Feature | Present | Description of feature characteristics and location | Threatened entities that use, are likely to use, or are part of the habitat feature. |
|---|---|---|---|
| **Vehicle strikes** | Yes | Vehicle movement will increase during construction, and to a lesser extent during operation, of the project. this increase in vehicle movements has the potential to impact upon threatened fauna species.<br>Refer to section 8.3.6. | • Major Mitchell's Cockatoo<br>• Regent Parrot |

## 5.2. Identification of potential impacts associated with wind farm developments

### 5.2.1. Background review and bird and bat utilisation surveys

A review of key guidelines and assessments completed by Nature Advisory on behalf of WindLab Pty Ltd with regard to impacts associated with bird and bat utilisation of the subject land, and associated impacts such as wind turbine strikes and barrier effect has been undertaken. The following sources of information were reviewed, and have been relied on in the completion of this portion of the BDAR:

- Relevant guidelines
  - Wind Farms and Birds – Interim Standards for Risk Assessment' issued by the Australian Wind Energy Association (AusWEA 2005).
  - Onshore Wind Farms – Interim guidance on bird and bat management (DAWE 2022).
  - Commonwealth Offshore Wind Farm Guidance (Cth DCCEEW 2023c) .
  - Best Practice Guidelines for Wind Energy Developments in Australia (Clean Energy Council 2018).
  - Draft Wind Energy Guideline: Guidance for state significant wind energy development (DPE 2023d).
  - Unpublished South West Biodiversity and Conservation Division Draft Turbine Risk Assessment Guidance (BCS 2023a).
  - Unpublished South West Biodiversity and Conservation Division Suggested BBUS Method (BCS 2023b).
- Baseline reports:
  - Burrawong Wind Farm Bird and Bat Baseline Report (Year 1). Prepared for Windlab Pty Ltd. Report No. 20195.05 (1.0) (Nature Advisory 2023b).
  - Burrawong Wind Farm. Bird and Bat Baseline Report (Year 2). Prepared for Windlab Pty Ltd. Report No. 20195.05 (1.1) (Nature Advisory 2023a).
- Utilisation survey reports:
  - Burrawong Wind Farm. Bat Utilisation Survey. Prepared for NGH Consulting on behalf of Windlab Pty Ltd. Report No. 20195.3 (1.0) (Nature Advisory 2022a).
  - Burrawong Wind Farm. Bird Utilisation Survey – Year One. Prepared for NGH Consulting on behalf of Windlab Pty Ltd. Report No. 20195.04 (1.0) (Nature Advisory 2022b).
- Species (groups) specific assessments:
  - Burrawong Wind Farm. Preliminary Literature Review on Habitat Use of the Australasian Bittern in the Riverina. Prepared for Windlab Pty Ltd. Report No. 20195.07 (1.0) (Nature Advisory 2023c).
  - Burrawong Wind Farm Regent Parrot Targeted Assessment Report. Prepared for Windlab Pty Ltd. Report No. 20195.06 (1.1) (Nature Advisory 2023d).
  - Burrawong Wind Farm Regional Review of Waterbirds in the Riverina. Prepared for Windlab Pty Ltd. Report No. 20195.07 (1.0) (Nature Advisory 2023e).

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- Risk assessments:
  - Burrawong Wind Farm Initial Bird and Bat Risk Assessment. Prepared for Windlab Pty Ltd. Report No. 20195.04 (2.1) (Nature Advisory 2023f).

The findings of the above listed reports are summarised in the following sections with the reports attached in full in Appendix 9. These methods, data and results of these assessments have been replied upon for the completion of the prescribed impact assessments related to wind farm developments in this BDAR.

### Bird and bat utilisation survey methods

Nature Advisory was engaged by Windlab Pty Ltd and/or NGH Consulting on behalf of Windlab Pty Ltd between 2021 and 2023 to complete bird and bat utilisation surveys (BBUS) for the proposed Junction Rivers Wind Project. The survey methods and results of these assessments are summarised below, refer to Appendix 9 for further details.

**Bird utilisation survey Year 1 & 2 (Nature Advisory 2023b) (Nature Advisory 2023a)**

Completed in accordance with the requirements for a "Level One" bird risk assessment outlined in 'Wind Farms and Birds – Interim Standards for Risk Assessment' issued by the Australian Wind Energy Association (AusWEA 2005) which was adopted by the Best Practice Guidelines for Wind Energy Developments in Australia issued by the Clean Energy Council (2018) to provide baseline data on the pre-construction utilisation by avian species. In addition to this, surveys were completed in accordance with the Onshore Wind Farms – Interim guidance on bird and bat management (DAWE 2022) (Nature Advisory 2023b) (Nature Advisory 2023a).

Nature Advisory completed 24 months of bird surveys within the subject land in the following seasons and dates:

- Summer: 22 February 2021 – 28 February 2021.
- Autumn: 17 May 2021 – 21 May 2021.
- Winter: 1 August 2021 – 9 August 2021.
- Spring: 2 November 2021 – 6 November 2021.
- Summer: 15 February 2022 – 19 February 2022.
- Autumn: 26 April 2022 – 30 April 2022.
- Winter: 11 July 2022 – 16 July 2022.
- Spring: 6 October 2022 – 11 October 2022.

A fixed-point method was completed, which comprised one observer stationed at each point for 15 minutes. A total of 10 fixed survey points were established, including eight impact points and two reference points. Reference points were located at least 500 metres from proposed turbine locations in areas of similar habitat to that found within the impacted areas.

Each fixed point was surveyed eight times (eight replicates) per survey, twice each at four different times of day: early morning (8:00am to 10:30am), late morning (10:30am to 13:00 pm), early afternoon (13:30pm to 15:00pm) and late afternoon (15:00pm to 17:30pm). This equates to a total of 64 replicates and around 960 minutes per point over two years (Nature Advisory 2023a).

All bird species within 200 meters of the observer were recorded including:

- Species.
- Count of individuals.
- Height of bird when first observed.
- Minimum and maximum height observed (for species of concern).

Draft bird and bat utilisation guidance has been provided by NSW Biodiversity, Conservation and Science (BCS) of NSW DCCEEW for projects within the SW REZ (NSW DCCEEW 2023a), this guidance recommends a minimum of 48 replicates at 30 minutes per point over two years. The Nature Advisory survey effort calculates to be the equivalent of 48 replicates at 20 minutes per point, this is adequate and within a reasonable survey tolerance. Bird height was classified and recorded as ≤50 metres (below RSA), 51-300 metres (at RSA), ≥ 301 metres (above RSA) (Nature Advisory 2023b) (Nature Advisory 2023a).

**Bat Utilisation Survey Year 1 (Nature Advisory 2022a)**

Completed in accordance with the Onshore Wind Farms – Interim guidance on bird and bat management (DAWE 2022).

Nature Advisory completed two surveys in 2021 to provide baseline data on the pre-construction utilisation of the subject land by microbat species. The survey effort was a broad analysis undertaken to determine the presence or absence of all possible species predicted to occur in the area, with a particular focus on potential threatened species. The calls of free-flying bats that were representative of habitat types of the wind farm site and located near proposed turbines was analysed. Survey timeframes and data analysed for the assessment is summarised below:

- Summer: 22 February 2021 – 27 February 2021:
  - 36 bat recorder-nights/432 bat recording hours.
- Spring: 2 November 2021 - 30 November 2021:
  - 24-29 consecutive nights of data (location dependent), 130 bat-recorder-nights/1560 bat recording hours.

Surveys were only completed in summer and spring (February and November) of 2021, no continuation of survey was completed.

A total of six automated bat recorders (Song Meters ®) were deployed at ground level during each survey. Song meters record the echolocation calls of free-flying bat species. Survey locations were chosen that were representative of the broad habitat types within the subject land and were located near proposed wind turbines. Song Meters were secured to trees or fence posts approximately 1.5 – 2 metres above ground and programmed to commence operation approximately 30 minutes before dusk, ceasing approximately 30 minutes after dawn. Each Song Meter unit recorded the date and time of each echolocation detected.

Draft bird and bat utilisation guidance has been provided by BCS for projects within the SW REZ. This guidance recommends bat utilisation surveys are completed over summer, autumn, winter and spring for a two-year period as a minimum. Additional surveys and data collection will be completed during the finalisation of the project's BBAMP.

## Bird and bat utilisation survey results

**Bird utilisation survey Year 1 & 2 (Nature Advisory 2023b) (Nature Advisory 2023a)**

A total of 81 bird species were recorded across the 24 months of survey. This included a total of:

- 63 bird species recorded during the February 2021 – November 2021 survey, and
- 43 bird species recorded during the February 2022 – October 2022 survey period:
  - This included an additional 18 species previous unrecorded during the 2021 survey period.

A total of 52 bird species were recorded at the eight impact survey points in 2021 and 63 in 2022. A total of 42 bird species were recorded at the two reference points in 2021 and 50 in 2022.

The following height matrix was defined:

- Below Rotor Swept Area (RSA): <50 metres.
- RSA: 50 – 300 metres.
- Above RSA: > 300 metres.

Majority of the birds recorded were observed below RSA height at both the impact and reference survey points. No birds were observed flying above RSA and only around 1.44 % of birds were observed flying within the RSA.

From the 81 bird species recorded a total of eight raptor species, four waterbirds and four threatened species were observed. Threatened species consisted of:

- Regent Parrot*:*
  - BC Act – Endangered.
  - EPBC Act – Vulnerable.
- Major Mitchell's Cockatoo:
  - BC Act – Vulnerable.
  - EPBC Act – Endangered
- Spotted Harrier:
  - BC Act – Vulnerable.
- White-fronted Chat:
  - BC Act Vulnerable.

The results of the bird utilisation surveys were compiled into a Bird and Bat Baseline Report (Nature Advisory 2023a).

**Bat utilisation survey Year 1 (Nature Advisory 2022a)**

A total of nine bat species were positively identified within the subject land. Seven species were identified during the summer survey period in February 2021 with an additional two species identified during the spring November 2021 survey period. These were:

- Gould's Wattled Bat *Chalinolobus gouldi.*

- Chocolate Wattled Bat *Chalinolobus morio.*
- Inland Free-tailed Bat *Ozimops petersi.*
- Southern Free-tailed bat *Ozimops planiceps.*
- Inland Broad nosed Bat *Scoterepens balstoni.*
- White-striped Freetail Bat *Austronomus australis.*
- Large Forest bat *Vespadelus darlingtoni.*
- Little Forest Bat *Vespadelus vulturnus.*
- Southern Forest Bat *Vespadelus regulus.*

All echolocation data captured during the survey periods were analysed by Rob Gration of EcoAerial Environmental Services using Kaleidoscope Pro analysis software by Wildlife Acoustics USA.

All nine bat species positively identified are noted as being considered common, secure and widespread species (Nature Advisory 2022a). No threatened species were positively identified; however, three species complexes were identified. One of the three species complexes has the potential of being Corben's Long-eared Bat *Nyctophilus corbeni*, a threatened species listed as Vulnerable under the EPBC Act and BC Act, refer to Section 6.1.3. Species complexes occur, as not all microbat species are able to be consistently or reliably identified using echolocation detection alone. Where this occurs, groupings are compiled of possible species and labelled as a species complex (Nature Advisory 2022a).

The species complexes identified were (Nature Advisory 2022a):

- Free-tailed Bat *Ozimops planiceps* and *Ozimops petersi.*
- Long-eared Bat *Nyctophilus* sp.
- Forest Bat *Vespadelus regulus* and/or *Vespadelus vulturnus* and/or *Vespadelus regulus*.

The draft guidance published by BCS recommends a minimum of two years microbat survey effort covering spring, summer, autumn and winter. The survey effort completed by Nature Advisory does not meet this recommended standard. The conclusion of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) concluded no threatened bat species were positively identified, or considered likely to occur, therefore no further survey was recommended. The Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) notes the interim guideline recommendation of a minimum two year survey effort across each season.

### 5.2.2. Regent Parrot, Australasian Bittern and waterbirds

Further species or species group specific assessments were undertaken by Nature Advisory to understand how the subject land may be used by Regent Parrot (Nature Advisory 2023d), Australasian Bittern (Nature Advisory 2023c) and waterbirds more generally (Nature Advisory 2023e). These assessments have provided useful insight into the population dynamics and potential utilisation of the subject land by these species, and the results have been considered in risk assessments undertaken by Nature Advisory and within this BDAR (refer to Section 6.1).

### 5.2.3. Identification of resident, nomadic and migratory species and flight paths

Section 6.1.5 of the BAM dictates that wind farm developments must identify resident threatened aerial species, resident raptor species and nomadic/migratory species likely to fly over the proposed development

site as a flyway or migration route. The Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) identified species that that fell into these categories. These species are summarised below in their respective categories.

### Resident raptor species

The following resident raptor species were identified in Appendix 2 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a):

- Black-shouldered Kite *Elanus axillaris.*
- Brown Falcon *Falco berigora.*
- Nankeen Kestrel *Falco cenchroides.*
- Peregrine Falcon *Falco peregrinus.*

Additional to the species listed in Appendix 2 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a), chapter 2.3.5 identified Spotted Harrier *Circus assimilis*, a threatened raptor species as likely to be resident. Chapter 4.1 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) also identified Wedge-tailed Eagle *Aquila audax* as likely to have resident pairs within or close to the subject land.

Additional to the above, Table 7 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) identified Black-shouldered Kite *Elanus axillaris* and Whistling Kite *Haliastur sphenurus* within the subject land. These species are common/widespread and likely to occur as resident raptor species.

### Threatened aerial species

Appendix 2 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) defined this category as 'Resident threatened aerial', listing the following species:

- Major Mitchell's Cockatoo.
- Regent Parrot.

Although Black Falcon, a threatened aerial species, was identified within the subject land it was not included in the category 'threatened aerial resident' within the Bird and Bat Baseline Report (Year 2) due to insufficient data regarding species utilisation of the study area and surrounds (Nature Advisory 2023a).

Additional to the species listed in Appendix 2 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a), Chapter 2.3.5 and 2.3.6 identified Spotted Harrier and White-fronted Chat, both listed threatened species, as likely to be resident (Nature Advisory 2023a).

One threatened microbat species has the potential to occur within the subject land, Corben's Long-eared Bat was identified as potentially occurring, where call complexes of the genus *Nyctophilus* were recorded. Refer to Section 5.2.1 below for further information this species likely presence within the subject land. Chapter 3.1.3 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) states further investigation is warranted on this species as it is considered likely to occur. Further assessment in accordance with the EPBC Act is provided in Section 12 and Appendix 5.

### Nomadic/Migratory species

The following species were identified in Appendix 2 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) as nomadic/migratory, or listed in Nature Advisory's Regional Waterfowl review (Nature Advisory 2023e):

- Australian Pelican *Pelecanus conspicillatus.*
- Australasian Darter *Anhinga novaehollandiae*
- Australasian Bittern *Botaurus poiciloptilus*
- Australasian Shoveler *Spatula rhynchotis*
- Banded Lapwing *Vanellus tricolor.*
- Black Falcon *Falco berigora.*
- Black Swan *Cygnus atratus.*
- Brown Songlark *Cincloramphus cruralis.*
- Caspian Tern *Hydropogne caspia*
- Cockatiel *Nymphicus hollandicus.*
- Fairy Martin *Petrochelidon ariel.*
- Fork-tailed Swift *Apus pacificus*
- Freckled Duck *Stictonetta nervosa*
- Great Cormorant *Phalacrocorax carbo*
- Grey Teal *Anas gracilis*
- Gull-billed Tern *Gelochelidon nilotica*
- Little Black Cormorant *Phalacrocorax sulcirostris*
- Magpie Goose *Anseranas semipalmata*
- Masked Woodswallow *Artamus personatus.*
- Mistletoebird *Dicaeum hirundinaceum.*
- Musk Lorikeet *Glossopsitta concinna.*
- Pacific Black Duck *Anas superciliosa*
- Pink-eared Duck *Malacorhynchus membranaceus*
- Rainbow-Bee-eater *Merops ornatus.*
- Restless Flycatcher *Myiagra inquieta.*
- Rufous Songlark *Cincloramphus mathewsi.*
- Silvereye *Zosterops lateralis.*
- Spotted Harrier *Circus assimilis.*
- Straw-Necked Ibis *Threskiornis spinicollis.*
- Whiskered Tern *Chlidonias hybrida*
- White-browed Woodswallow *Artamus superciliosus*
- White-necked Heron *Ardea pacifica.*

Spotted Harrier and Black Falcon are listed threatened species as noted above. No species listed as Migratory under the EPBC Act were identified (Nature Advisory 2023a).

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An assessment of habitat, movements and flight paths of nomadic and migratory species identified by Nature Advisory was completed. The nomadic/migratory movements within Australia of the non-threatened and threatened species are summarised below in Table 29. The migratory movement of non-threatened species outside Australia are summarised below in Table 30.

**Table 29 Nomadic/migratory avian species movements within Australia**

| Species | Nomadic/Migratory movement description | Movement trigger | Habitat in subject land |
|---|---|---|---|
| **Threatened species** | | | |
| **Spotted Harrier** | Partial migrant (Operation Migration 2023). | Some individuals move to warmer regions during cold seasons. | Forage over farmland. Nests and roosts in woodland. |
| **Black Falcon** | Highly dispersive and irruptive species, seasonal migrant (DoE 2010). | Winters in northern Australia, dispersal to the coast during droughts. | Forage over farmland. Nests and roosts in woodland. |
| **Non-threatened species** | | | |
| **Australian Pelican** | Highly mobile species, seasonal migrant (Australian Museum 2020) | Movement to areas of suitable breeding habitat. | Dams and/or areas of large waterbodies such as Condoulpe Lake when water is present. |
| **Banded Lapwing** | Seasonally nomadic (Australian Museum 2022a). | Fly considerable distances at night to find suitable conditions of food and water. | Woodland, grassland, shrubland. |
| **Black Swan** | Seasonal migrant (Murray 2023). | Non-nomadic during breeding season, staying in breeding habitat. Outside breeding season species flies large distances at night between areas of suitable habitat. | Dams and/or areas of large waterbodies such as Condoulpe Lake when water is present. |
| **Brown Songlark** | Locally nomadic (Australian Museum 2022). | Population numbers fluctuate locally with rainfall. | Woodland, farmland, grassland, shrubland. |
| **Cockatiel** | Highly nomadic (Birdlife Australia 2023a). | Moves in response to availability of food and water. | Woodland, farmland, grassland, shrubland. May congregate at dams in large flocks. |
| **Fairy Martin** | Generally resident. Locally nomadic in arid/semi-arid regions (Smith, J & Smith, P 2023). | Moves in response to availability of food and water. | Primarily uses woodland, with some foraging over shrubland, grassland and agricultural lands. |
| **Masked Woodswallow** | Seasonal migrant (Birdlife Australia 2023b). | Leave southern areas in autumn or late summer, returning south to breed in spring. Some individuals remain resident. | Primarily uses woodland, with some foraging over shrubland, grassland and agricultural lands. |

| Species | Nomadic/Migratory movement description | Movement trigger | Habitat in subject land |
|---|---|---|---|
| **Mistletoebird** | Locally nomadic (Birdlife Australia 2023c). | Moves in response to mistletoe fruiting. | Woodland where mistletoe is present. |
| **Musk Lorikeet** | Locally nomadic (Birdlife Australia 2023d). | Moves in response to flowering and fruiting feed tree species. | Woodland. |
| **Restless Flycatcher** | Seasonal migrant (Birdlife Australia 2023e). | Moves north during winter months, returning south as temperature warms. | Primarily uses woodland, with some foraging over shrubland, grassland and agricultural lands. |
| **Rufous Songlark** | Seasonal migrant (Birdlife Australia 2023f). | Moves south during summer to breed, returning north during cold months. | Primarily uses woodland, with some foraging over shrubland, grassland and agricultural lands. |
| **Silvereye** | Seasonal migrant (Birdlife Australia 2023g). | In south and east of range species moved north in autumn returning south in winter to breed. | Primarily uses woodland, with some foraging over shrubland, grassland and agricultural lands. |
| **Straw-Necked Ibis** | Highly nomadic (Birdlife Australia 2023h). | Moves in search of suitable habitat. | Dams and/or areas of large waterbodies such as Condoulpe Lake when water is present. Known to forage in agricultural crops and pastures. |
| **White-browed Woodswallow** | Seasonally nomadic. Partial migrant (Australian Museum 2023a). | Moves north in autumn, returning south in spring. | Primarily uses woodland, with some foraging over shrubland, grassland and agricultural lands. |
| **White-necked Heron** | Seasonal migrant (Australian Museum 2023b). | Movements occur in winter or spring. Movement patterns under researched. | Dams and/or areas of large waterbodies such as Condoulpe Lake when water is present. |

**Table 30 Migratory avian species movements within and outside of Australia**

| Species | Countries in migratory route | Season (months) in Australia | Breeding presence in Australia? | Habitat in subject land |
|---|---|---|---|---|
| **Rainbow Bee-eater** | Throughout Australia, eastern Indonesia, eastern Papua New Guinea. Rarely Solomon Islands. Vagrant to Japan and south-western Micronesia (Cth DCCEEW 2023d). | Seasonally common and locally abundant across most of its range. Unknown portion migrates to Papua New Guinea and eastern Indonesia during non-breeding periods. In Australia breeding season occurs August – January. | Majority of global population breeds in Australia. Breeding has also been recorded in Papua New Guinea and may occur in the Lesser Sundas Island, Indonesia. | Woodland. Forages over grassland, shrubland and agricultural lands. |

## Flyways and nomadic movements

Flyways and movements of aerial taxa likely to occur, or recorded within the subject land are described below in the following guilds: Microbats, raptors, waterbirds, woodland and shrubland birds.

### Microbats

Nine microbat species were positively identified within the subject land. Additional to this, three species complexes were identified. Calls could not be attributed to identified species complexes, refer to Section 5.2.1. Flight activities of microbat species vary in response to weather such as air temperature, relative humidity, barometric pressure, wind and moonlight. Microbat movements were common across the study area during the summer and spring 2021 period. No movement patterns were detectable. No microbat species were identified as nomadic or migratory in the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a).

Table 31 below provides a review of behaviour and flight characteristics of microbat species recorded within the subject land by Nature Advisory.

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**Table 31 Review of microbat behaviour**

| Species | Foraging space | Flight characteristics | Canopy | Overview |
|---|---|---|---|---|
| **White-striped free-tailed bat** *Austronomus australis* | Open | Fast, not designed for manoeuvrability | Above canopy | Fast-flying species intercepting their prey 50 m or more above the ground. (Churchill 2008). |
| **Gould's Wattled Bat** *Chalinolobus gouldi* | Edge | Fast, agile | Just below, within the lower level of the tree canopy and along forest edges, creek lines and isolated paddock trees. | Feeds on a wide variety of prey, regularly foraging 5 - 10 km from their roost site. They fly just below or within the lower level of the tree canopy and along the forest edges, creek lines and around isolated paddock tree with fast, agile flight (Churchill 2008). |
| **Chocolate Wattled Bat** *Chalinolobus morio* | Edge | Fast, agile, direct | Below canopy | In inland areas their distribution is associated with water courses that provide large trees for roosts. They prefer forests to small forest patches (Churchill 2008). They forage up to 5 km from their roost site, their flight is usually fast and direct with considerable agility (Churchill 2008). They mostly forage in the zone between the top of the understorey and the canopy, although sometimes fly low along forest trails. |
| **Long-eared Bat** *Nyctophilus* spp. | Closed | Slower, more manoeuvrable. | Below canopy, in and around vegetation. | Highly manoeuvrable and able to change direction often and quickly (Churchill 2008). Fly very close to vegetation, usually at canopy height, where they weave between gaps in the canopy (Churchill 2008). |
| **Inland Free-tailed Bat** *Ozimops petersi* | Open/ Edge | Fast, direct | Above canopy | Forage in open unobstructed areas. They fly fast above the canopy. They are not very manoeuvrable in flight. |
| **South-Eastern Free-Tailed Bat** *Ozimops planiceps* | Open/Edge | Fast, agile | Below canopy on ground, edge of canopy and above canopy. | Forage up to 12 km from their roost site. Roost in tree hollows wit narrow entrances and cavities. Forage in spaces between trees, at edge of canopy of remnant vegetation and above canopy. Can also forage on the ground due to their agility (Australian Museum 2020b). |
| **Inland Broad nosed Bat** *Scotorepens balstoni* | Edge | Moderately fast, agile | Below canopy | Flight is continuous with sudden rapid diversions. Forage mostly between trees but also at the edges of forests, and out in open areas. (Churchill 2008). They stay within 15 m of the ground and do not forage above the canopy. |

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| Species | Foraging space | Flight characteristics | Canopy | Overview |
|---|---|---|---|---|
| **Large Forest Bat** *Vespadelus darlingtoni* | Edge | Fast, less manoeuvrable. | Below canopy | Fast-flying bat that is less manoeuvrable than most *Vespadelus*. Avoid cluttered regrowth and rainforest by foraging mainly within the spaces among trees and between the canopy and the understorey. |
| **Southern Forest Bat** *Vespadelus regulus* | Edge | Fast, agile, manoeuvrable | Below canopy | Highly manoeuvrable, moderately fast insectivores. Fly with great agility very close to vegetation and readily enter gaps in the understorey, usually foraging at less than half the canopy height. Small foraging range of less than 10 ha. |
| **Little Forest Bat** *Vespadelus vulturnus* | Edge | | | |
| **In general:** | | | | |
| Open space / aerial = typically free-tail and sheath-tail bats. Fly fast. Long, narrow wings, not manoeuvrable. | | | | |
| Edge space = most bats (Vespertilionids and Myotis). Fly fast to moderately slow. Moderately long and broad wings. | | | | |
| Closed = gleaning bats (*Phoniscus, Nyctophilus, Rhinolophus*) = slow, but able to manoeuvre and hover in cluttered places. Broad, shorter wings, rounded tip, large tail membrane. | | | | |

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### Raptors

A total of 10 raptor species were identified by Nature Advisory within the subject land. Raptor presence varied between seasons. Raptor species utilise woodland and scattered trees for roosting and nesting within the subject land. Woodland, shrubland, grassland and agricultural lands were observed to be used for foraging by raptor species within the subject land (Nature Advisory 2023a). Movements of raptor species occur as a mixture of resident day to day movement, nomadic movements subject to climatic conditions and for some species, seasonal migration movements during warm and cold months, refer to Table 29. Figure 12 and Figure 13 depict indicative nomadic and local movements of aerial avian species.

### Waterbirds

Seven waterbirds were recorded within the subject land (Nature Advisory 2023a). Waterbird species within the subject land are likely to primarily use farm dams throughout the year as foraging or stop over habitat during local or seasonal movements. During wetter seasons, drainage lines with water present may also be utilised. In periods of high rainfall leading to flood events areas such as Condoulpe Lake would be utilised by large numbers of both resident and nomadic/migratory waterbirds (Nature Advisory 2023e). Outside of high rainfall and flood events, areas such as Condoulpe Lake are unlikely to hold water such that large numbers of waterbirds are present (Nature Advisory 2023e). When dry, this lake is subject to cropping. Movements of waterbird species are likely to occur as a mixture of resident day or night movement, nomadic movements subject to climatic conditions and for some species, seasonal migration movements during warm and cold months, refer to Table 29. Figure 12 and Figure 13 depict indicative nomadic and local movements of aerial avian species, including an indication, based on assessment of aerial imagery and broad scale habitat, likely flight paths of water bird species moving between large watercourses and permanent water sources such as Yanga Lake.

### Woodland and shrubland birds

Over 60 woodland bird species, including raptors, honeyeaters, parrots and insectivores were recorded within the subject land by Nature Advisory. These species utilise a broad range of habitats with woodland, shrubland and grassland specialists present, alongside generalist species likely to use all habitat types. Many woodland and shrubland birds utilise both native and agricultural environments. The majority of woodland and shrubland bird species are likely to use native habitat within the subject land (Nature Advisory 2023a). Many of these species would be considered resident, with general day to day movements in search of food, returning to suitable roosting or breeding habitat throughout the day/night. Species subject to nomadic movements are likely to use broad riparian and terrestrial habitat corridors to move within the landscape. These corridors are also likely to be used by migratory species refer to Table 29. Figure 12 and Figure 13 depict indicative nomadic and local movements of aerial avian species.

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**Legend**

Proposed Junction Rivers Wind Farm

**Migratory bird flight paths**

Indicative international migratory flight path

Indicative mainland migratory movements

Indicative nomadic movements

**Figure 12 Indicative nomadic and migratory flight paths**

0 100 200 300 400 500 600

Kilometers

Scale: 1:14,000,000 @ A3

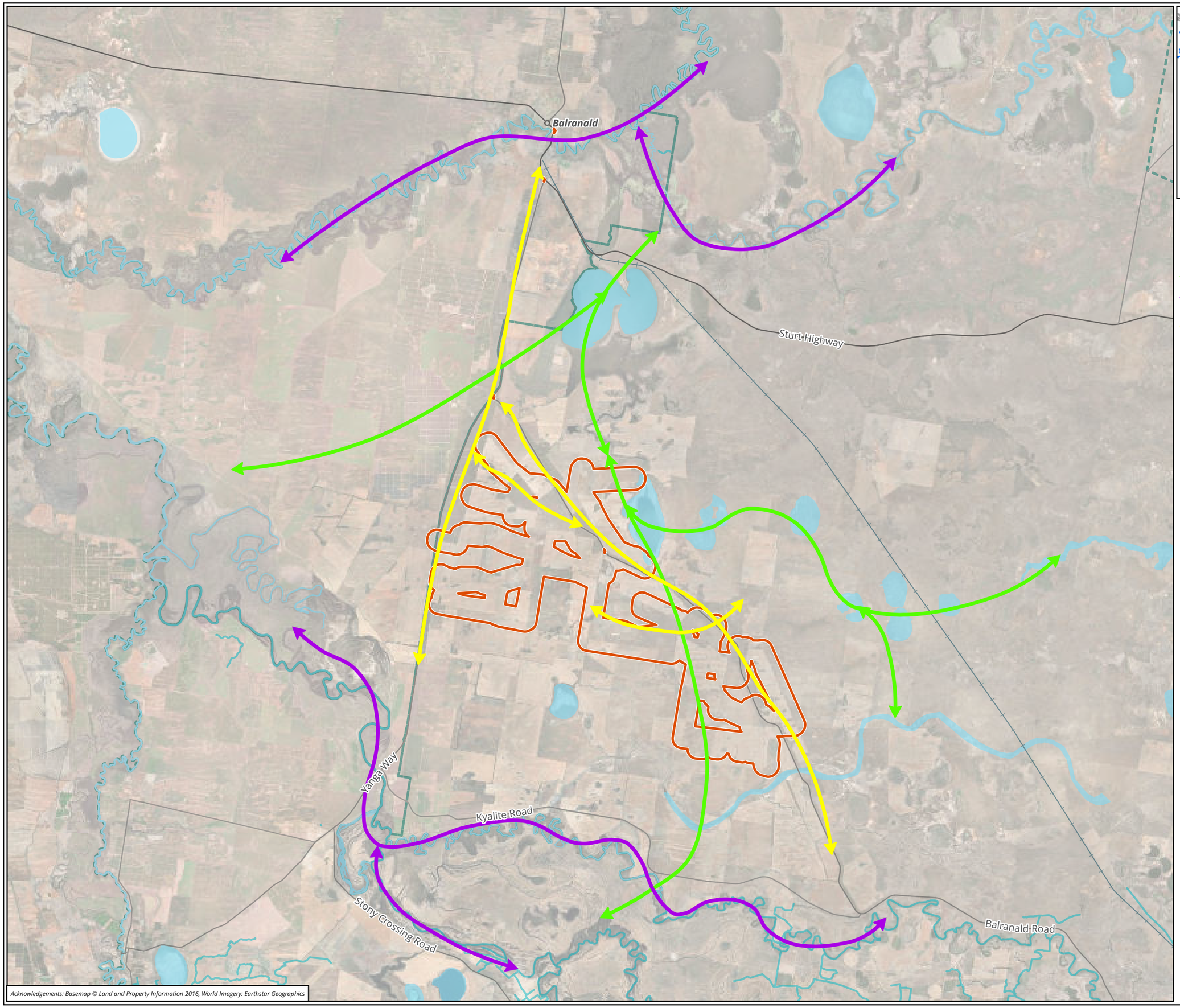
*Coordinate System: GDA2020*

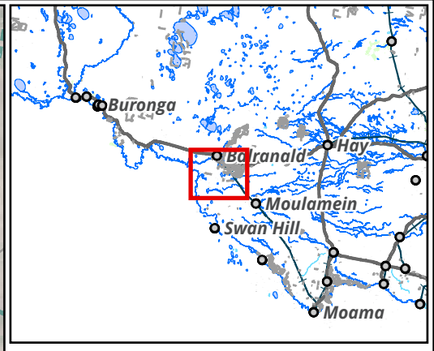
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Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F12_Nomadicflight

*Acknowledgements: Basemap © Land and Property Information 2016,*




**Legend**

Subject land

**Local flight paths**

Indicative waterbird movements

Riparian corridor movements

Woodland shrubland movement corridors

**Figure 13 Indicative local flight movements**

0 2 4 6 8

Kilometers

Scale: 1:180,155 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 15 March 2024
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Layout: 37502_F13_LocalFlight

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics*

# 6. Collision and barrier effect risk assessments

As outline above, Nature Advisory was commissioned to complete a Bird and Bat Risk Assessment (Nature Advisory 2023f) to inform the overall biodiversity impact assessment for the proposed Junction Rivers Wind Project. This assessment identified species or groups of birds and bats considered at potential risk of collision with turbines, and the potential impact on bird and bats subject to disturbance and/or barrier effects posed by constructed wind turbines. The outcome of these assessments enables the targeted assessment of key species to be considered in the preparation of the impact assessment for the Junction Rivers Wind Project.

In addition to the threat of direct loss of habitat from wind farm construction, wind farm impacts on birds and bats can arise from three potential pathways listed below:

- Direct collision of birds and bats with towers and/or operating wind turbine blades at RSA heights.
- Disturbance effects that exclude birds and bats from habitat within the wind farm.
- Barrier effects that limit bird and bat movements between essential resources, such as foraging and roosting areas (Nature Advisory 2023f).

The risk assessments completed by Nature Advisory have followed the procedure for risk assessment of AS ISO 31000 2018. The assessment was undertaken as follows:

- Species or groups of concern have been short-listed based on their likelihood of occurrence at the site.
- Two impact pathways have been assessed:
  - Collision with turbines.
  - Indirect effects (including both disturbance and barrier effects).
- Impact likelihood criteria have been developed and applied to each impact pathway for each species or group of concern.
- Impact consequence criteria have been developed and applied to each impact pathway for each species or group of concern.
- The risk level for each species or group of concern from the two impact pathways has been determined consistent with a risk matrix (Nature Advisory 2023f).

## 6.1. Qualitative risk assessment

### 6.1.1. Risk matrix methodology

A risk matrix was developed by Nature Advisory (Nature Advisory 2023f) and applied for individual species of birds and bats that incorporates probability that the wind farm might alienate birds or bats from habitats at the wind farm, or between habitats as a result of the wind farm, and the likelihood that particular species might collide with turbines. Likelihood of risks are ranked as Rare, Unlikely, Likely, Certain and Almost Certain. Consequence of risk are ranked and Negligible, Low, Moderate, High and Severe on the basis of a set of defined likelihood and consequence factors.

The species that have been the subject of this risk assessment (Nature Advisory 2023f) include the following:

- Species listed as threatened under Commonwealth or state legislation.

- Species known to be vulnerable to collision with turbines based on collision data (Nature Advisory data) from other wind farms in eastern Australia.
- Species for which a population concentration, or a population of significance, occurs on the site and that species may exhibit risk behaviour and potentially interact with the operation of wind turbines.

The risk assessment has also been applied to additional species of raptors and some bats that are not threatened. Risk assessment for these additional species was undertaken in particular because it is considered that their flight behaviours may put them at a greater risk of collisions than most other taxa.

The risk assessment completed by Nature Advisory is based on an initial project design of 107 turbines with:

- A rotor radius of 100 metres.
- Maximum upper RSA (blade tip) of 300 metres.
- Maximum hub height of 200 metres.
- Absolute lower minimum RSA of 50 metres.
- Total RSA/turbine area of 31,416 metres squared.

It should be noted that these parameters are an overestimate of the likely actual turbine specifications, and are based on a combination of two separate turbine models. This ensures the risk assessment was completed based on an overly conservative scenario, from which the reality of the potential impacts from the operational wind farm would be less severe. Furthermore, the project will only operate up to 96 turbines, rather than the 107 assessed. Further detail on turbine parameters is provided in Section 6.3.

The risk matrix implemented by Nature Advisory (Nature Advisory 2023f) is shown in Table 32 below. Descriptions of likelihood and consequence factors for birds and bats are set out in Table 33. This risk assessment is summarised in Section 6.1.2 and 6.2. The full assessment is outlined as 'Burrawong Wind Farm Initial Bird and Bat Risk Assessment Report No. 20195.04 (2.1)' (Nature Advisory 2023f) in Appendix 9 of this BDAR.

**Table 32 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike and barrier effect for birds and microbats (Nature Advisory 2023f)**

| Likelihood | Criteria | Consequence | Criteria |
|---|---|---|---|
| **Rare** | An event may occur only in unusual circumstances (less than 5 %). The risk event is only theoretically possible, or would require exceptional circumstances to occur. | **Negligible** | Occasional individuals lost but no reduction in population viability. |
| **Unlikely** | It is less probable than not that the risk event could occur in any year (< 50%). | **Low** | Repeated loss of small number of individuals but no reduction in population viability. |
| **Likely** | It is equally probable that the risk event could or could not occur in any year (50%). | **Moderate** | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. |
| **Almost Certain** | It is more probable than not that the risk event could occur in any year (>50%) | **High** | Major loss in number of individuals, leading to reduction in population viability for between five to 10 years. |

| Likelihood | Criteria | Consequence | Criteria |
|---|---|---|---|
| **Certain** | It is very probable that the risk even could occur in any year (>95%). | **Severe** | Extreme loss in number of individuals, leading to reduction in population viability for a period of at least 10 years. |

**Table 33 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for birds and microbats (Nature Advisory 2023f)**

| Likelihood | Consequence | | | | |
|---|---|---|---|---|---|
| | Negligible | Low | Moderate | High | Severe |
| Rare | Negligible | Negligible | Negligible | Low | Low |
| Unlikely | Negligible | Negligible | Low | Moderate | High |
| Likely | Negligible | Low | Moderate | High | High |
| Almost certain | Negligible | Low | Moderate | High | Severe |
| Certain | Negligible | Low | High | Severe | Severe |

### 6.1.2. Nature Advisory risk matrices

The results of the qualitative risk assessment completed by Nature Advisory (Nature Advisory 2023f) has identified the likely species at risk of collision with operational wind turbines. The qualitative risk assessment found 17 species (birds and bats) to be at more than a 'Negligible' risk of collision with an operating turbine, refer to Table 34.

The qualitative risk assessment did not identify any species with a likelihood of collision greater than '*Low - Repeated loss of small number of individuals but no reduction in population viability*.' This assessment was completed in 2022 by Nature Advisory.

The risk assessment did not find any birds to be at more than a 'Negligible' risk of indirect disturbance including barrier effects (Nature Advisory 2023f).

Chapter 2.3 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) completed in 2023 listed and discussed the following threated species as 'at risk birds':

- Black Falcon – Some collision risk with operating turbines and has been recorded at RSA height.
- Major Mitchell's Cockatoo – Not recorded at or expected to fly at RSA height when transitioning between foraging areas, no observation data on how birds may be dispersing away from the subject land.
- Regent Parrot – Not recorded at RSA height.
- Spotted Harrier – Species likely to be resident. Species not observed at RSA height.
- White-fronted Chat – Species likely to be resident/frequent visitor to subject land. Species not observed at RSA height.

Chapter 2.3.7 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) completed in 2023 identified the following raptor species as 'at risk of collision with turbines':

- Nankeen Kestrel
- Wedge-tailed Eagle

The 2022 qualitative risk assessment (Nature Advisory 2023f) determined the above species all had a 'Negligible' to 'Low' consequence and risk rating associated with the potential collisions that may occur. Results of the risk assessment for species deemed 'At-risk' by (Nature Advisory 2023f) are outlined within Table 34, with the full assessments presented in Appendix 9 of this BDAR.

**Table 34 Bird and bat collision risk likelihood consequence (Nature Advisory 2023f)**

| Species | Threat listing | | Collision with operating turbine | | | Indirect disturbance including barrier effects | | |
|---|---|---|---|---|---|---|---|---|
| | EPBC Act | BC Act | Likelihood | Consequence | Risk rating | Likelihood | Consequence | Risk rating |
| **Birds** | | | | | | | | |
| **Black Falcon *Falco subniger*** | - | VU | Unlikely | Moderate | **Low** | Rare | Moderate | **Negligible** |
| **Black-shouldered Kite *Elanus axillaris*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **Brown Falcon *Falco berigora*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **Black Kite *Milvus migrans*** | | | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **Brown Goshawk *Accipiter fasciatus*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **Fork-tailed Swift *Apus pacificus*** | - | - | Likely | Low | **Low** | Rare | Negligible | **Negligible** |
| **Little Eagle *Hieraaetus morphnoides*** | - | V | Unlikely | Moderate | **Low** | Rare | Low | **Negligible** |
| **Major Mitchell's Cockatoo *Lophochroa leadbeateri*** | En | V | Unlikely | Moderate | **Low** | Rare | Low | **Negligible** |
| **Nankeen Kestrel *Falco cenchroides*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **Peregrine Falcon *Falco peregrinus*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **Regent Parrot (eastern subspecies) *Polytelis anthopeplus monarchoides*** | Vu | EN | Unlikely | Moderate | **Low** | Rare | Moderate | **Negligible** |

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| Species | Threat listing | | Collision with operating turbine | | | Indirect disturbance including barrier effects | | |
|---|---|---|---|---|---|---|---|---|
| | EPBC Act | BC Act | Likelihood | Consequence | Risk rating | Likelihood | Consequence | Risk rating |
| **Wedge-tailed Eagle *Aquila audax*** | - | - | Almost certain | Moderate | **Low** | Unlikely | Negligible | **Negligible** |
| **Whistling Kite *Haliastur sphenurus*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **White-bellied Sea-Eagle *Haliaeetus leucogaster*** | - | V | Unlikely | Moderate | **Low** | Unlikely | Negligible | **Negligible** |
| **Bats** | | | | | | | | |
| **Gould's Wattled Bat *Chalinolobus gouldii*** | - | - | Almost certain | Low | **Low** | Unlikely | Negligible | **Negligible** |
| **White-striped Freetail-bat *Austronomus australis*** | - | - | Almost certain | Low | **Low** | Unlikely | Low | **Negligible** |
| **Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*** | - | V | Likely | Low | **Low** | Unlikely | Low | **Negligible** |

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### 6.1.3. Regional Review of Waterbirds in the Riverina (Nature Advisory 2023e)

#### Assessment approach

Nature Advisory was commissioned to complete a review of the ecological literature and previous records concerning waterbirds in the Riverina region, surrounding the proposed Junction Rivers Wind Project. This assessment considered the risk of collision to a large number of waterbird and water associated species with wind turbines and drew conclusions on the likelihood of collision risk (Nature Advisory 2023e). The full assessment is presented in Appendix 9 of this BDAR.

Records of all bird species belonging to relevant bird orders within 20 kilometres of the approximate location of Junction Rivers Wind Project (the search area) were extracted from the Atlas of Living Australia (ALA). However, not all of them were considered likely to be impacted by this project as a result of turbine collision. The assessment noted that turbine collision results in some level of avian mortality at wind farms, but impacts typically become problematic through one of two pathways:

1. A species that is listed as threatened at either a state and/or federal level under the BC Act and/or the EPBC Act is found to have collided with wind turbines.
2. A species that is not listed as threatened at either a state or federal level is found to have collided with wind turbines in relatively high numbers within a relatively short period of time.

Additionally, and noting the above, species were also included for consideration in the assessment if they met either of the two criteria below:

1. The species is in one of the bird orders being considered, is listed as threatened under the BC Act and/or EPBC Act, and either had records in the ALA within 20 kilometres of the subject land, or could be considered as potentially occurring there.
2. The species is in one of the bird orders being considered, and if not listed as threatened at a state or federal level, had over 100 records in the ALA within 20 kilometres of the subject land.

Each species selected through this review for analysis was categorised into groups based on common taxonomy and/or ecological traits. The analysis of each species considered diet, distribution, habitat, breeding ecology, movements, flight behaviour, social behaviour, presence or absence of records within the 20 kilometres search area, abundance of records and conservation status. This assessment included a spatiotemporal (date and location) analysis of the identified records. A summary of the findings are detailed in Table 35 below for each species assessed by Nature Advisory (Nature Advisory 2023e).

#### At-risk waterbirds

A summary of the conclusions provided for each bird assessed is provided below in Table 35.

A key finding of this assessment was the recommendation of a 400-metre buffer between mapped and identified wetlands and proposed turbine blade tips. This recommendation has been adopted such that in the event of major flood events, leading to an expansion of wetland habitat to within 400 metres of a blade tip of an operational turbine, increased mitigation including possible curtailment of the affected turbine would occur. Further detail on mitigation measures to reduce potential collision risk to birds utilising any such wetland habitat is provided in Section 9.1.2. It is important to note that, the scenario where additional mitigation of a turbine occurs due to expansion of wetland conditions within the subject land is considered a possibility only in rare and limited circumstance.

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**Table 35 Summary of literature review on waterbird collision risk ((Nature Advisory 2023e)**

| Species | Risk conclusion and justification |
|---|---|
| **Cormorants and darters** | |
| **Great Cormorant *Phalacrocorax carbo*** | Great Cormorant is known to be highly dispersive, with colonies known to move along the Murray River and Murray-Darling system. Two-way movements of this species between Australia and New Zealand are known. Species known to fly at RSA height, but at low frequency. Presence of any aquatic habitat within the subject land near turbines is unlikely to pose a risk to this species as they are fly low to the water in the context of aquatic habitats, and as such under RSA height in the context of the Junction Rivers Wind Project. At worst, some individuals may pass through the wind farm airspace occasionally (potentially in large flocks), but even when this occurs, most individuals are likely to fly below RSA height. Occasional mortality could occur but are unlikely to be high in frequency or magnitude. |
| **Little Pied Cormorant *Microcarbo melanoleucos*** | These species known to fly at RSA height, but at low frequency. Juveniles can be highly dispersive; however, adults are generally considered sedentary/resident. Presence of any aquatic habitat within the subject land near turbines is unlikely to pose a risk to this species as they are fly low to the water in the context of aquatic habitats, and as such under RSA height in the context of the Junction Rivers Wind Project. At worst, some individuals may pass through the wind farm airspace occasionally (potentially in large flocks), but even when this occurs, most individuals are likely to fly below RSA height. Occasional mortality could occur but are unlikely to be high in frequency or magnitude. |
| **Little Black Cormorant *Phalacrocorax sulcirostris*** | |
| **Black-and-white Shag (Pied Cormorant) *Phalacrocorax varius*** | |
| **Australasian Darter (Arrgarrg) *Anhinga novaehollandiae*** | Analysis determined species is unlikely to occur within the subject land except in mass flooding events. However, this species was noted as dispersive, known to move long distances during breeding season. Species likely to fly at or above RSA height. It is not known what portion of flights made by this species are at RSA height. Australasian Darter is less likely to fly through the wind farm airspace than cormorant species. |
| **Waterfowl (ducks, geese and swans)** | |
| **Pink-eared Duck *Malacorhynchus membranaceus*** | Species are considered nomadic or highly dispersive and move across landscape and region depending on rainfall and water levels of available habitat. Long-distance movements likely to occur above RSA height. However generally fly close to the water when utilising waterbodies as habitat. Black Swan is known to travel long distances at night which increases collision risk, but the species is considered less likely to utilise the subject land as habitat.<br>Species identified as having the potential to occasionally use wind farm airspace, however, this is not considered a regular occurrence and is likely only to occur in flocks during mass flooding events. A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions due to steep ascent/decent trajectories. |
| **Maned Duck (Australian Wood Duck) *Chenonetta jubata*** | |
| **Pacific Black Duck *Anas superciliosa*** | |
| **Black Swan *Cygnus atratus*** | |

| Species | Risk conclusion and justification |
|---|---|
| **Grey (Oceanic) Teal *Anas gracilis*** | Overall species may occur at RSA height within the wind farm airspace on rare occasions and could potentially collide with turbines. however, they are unlikely to unlikely to fly at RSA height majority of the time. At worst, some may pass through the wind farm airspace, occasionally in large flocks, with occasional mortalities that are unlikely to be high in frequency or magnitude. |
| **Australasian Shoveler *Spatula rhynchotis*** | |
| **Freckled Duck *Stictonetta nervosa*** | Freckled Duck known to make long-distance movements to breed inland in ephemeral wetlands. Magpie Goose is somewhat nomadic but known to disperse across floodplains to breed. Species not recorded within the 20 km search area and are not considered likely to occur in the region. These species were identified as having a brief potential occurrence, this minimises collision risk or eliminated collision risk. |
| **Magpie Goose *Anseranas semipalmata*** | |
| **Blue-billed Duck *Oxyura australis*** | Adults of this species are considered likely to be confined to their preferred deep-water habitat within Yanga Lake and are considered unlikely to enter the airspace of the wind farm. However, it was noted that fledglings have the potential of entering the proposed windfarm airspace when dispersing from Yanga Lake. A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions. |
| **Migratory Shorebirds** | |
| **Sharp-tailed Sandpiper *Calidris acuminata*** | These species are migratory, with annual seasonal international movements to and from Australia. These species are not considered likely to use the habitat present within the subject land. Long-distance movements generally occur at heights well above RSA, with steep flight trajectories. A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions, on the rare occasions the species could be present within the subject land. A potential was identified for rare occurrence within the subject land, or for flocks to pass through airspace when travelling between areas of suitable habitat. |
| **Common Greenshank *Tringa nebularia*** | |
| **Curlew Sandpiper *Calidris ferruginea*** | |
| **Pectoral Sandpiper *Calidris melanotos*** | |
| **Marsh Sandpiper *Tringa stagnatilis*** | |
| **Eastern Curlew *Numenius madagascariensis*** | These species were not recorded within the 20 km search area. These species are not considered likely to use the habitat present within the subject land. Long-distance movements generally occur at heights well above RSA, with steep flight trajectories. A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions, on the rare occasions the species could be present within the subject land. A potential was identified for rare occurrence within the subject land, or for flocks to pass through airspace when travelling between areas of suitable habitat. |
| **Common Sandpiper *Actitis hypoleucos*** | |
| **Latham's Snipe *Gallinago hardwickii*** | |
| **Black-tailed Godwit *Limosa limosa*** | |
| **Great Knot *Calidris tenuirostris*** | |

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| Species | Risk conclusion and justification |
|---|---|
| **Non-Migratory Shorebirds** | |
| **Australian Painted-Snipe *Rostratula australis*** | These species are not considered likely to use the habitat present within the subject land. These species were not recorded within the 20 km search area. A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions, on the rare occasions the species could be present within the subject land. A potential was identified for rare occurrence within the subject land, or for flocks to pass through airspace when travelling between areas of suitable habitat. |
| **Red-necked Avocet *Recurvirostra novaehollandiae*** | |
| **Pied Stilt *Himantopus himantopus*** | |
| **Masked Lapwing *Vanellus (Lobipluva) miles*** | Species was identified as having the potential to use habitat within the subject land when conditions are wet or damp (outside of flood events). However, this species was not detected during the BBUS survey effort between 2021 – 2022 and is therefore considered unlikely to occur. Flocks could pass through the airspace when travelling between areas of suitable habitat. |
| **Terns** | |
| **Caspian Tern *Hydropogne caspia*** | Species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. The proportion of flights made at RSA heights is unknown for each species, but known flight behaviour suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat in the subject land near turbines could pose a risk to these species, as they may fly at RSA height in this context. |
| **Gull-billed Tern *Gelochelidon nilotica*** | |
| **Whiskered Tern *Chlidonias hybrida*** | |
| **Very large waterbirds** | |
| **Brolga *Grus rubicunda*** | Species is not considered likely to use habitat within the subject land and was not recorded within the 20 km search area. A potential was identified for flocks to pass through airspace when travelling between areas of suitable habitat. |
| **Australian Pelican *Pelecanus conspicillatus*** | Large flock numbers of these species could seasonally pass through the windfarm airspace, if a large number of individuals were subject to collision during the breeding season a risk could occur to local populations, however regional and national populations are unlikely to be impacted. |
| **Straw-necked Ibis *Threskiornis spinicollis*** | |
| **White-bellied Sea-eagle *Haliaeetus leucogaster*** | It was determined conceivable that one or two mortalities could occur each year, or every second year. This risk could incur a detrimental impact on the local population. |

### 6.1.4. Literature review on habitat use of the Australasian Bittern (Nature Advisory 2023c)

Additional to the collision risk review of waterbirds within the Riverina in relation to the proposed Junction Rivers Wind Project, Nature Advisory were commissioned to complete an independent review of the collision risk potential for Australasian Bittern (Nature Advisory 2023c). The full assessment is presented in Appendix 9 of this BDAR.

A variety of scientific literature on Australasian Bittern was consulted by Nature Advisory, with records of the species' occurrence in the Riverina region were assessed from BioNet and ALA. The records closest to the study area were sorted into clusters that occurred relatively close together(Nature Advisory 2023c).

Flight routes were considered on satellite imagery, by measuring distances between two plausible points between clusters, and between clusters and wetlands identified as potentially attracting the species over long distances. Such wetlands were identified by consulting the scientific literature and using the EPBC Act Protected Maters Search Tool to identify Ramsar wetlands downstream of the study area. Flight routes passing within roughly 10 kilometres of the study area were considered to have potential to pass through the study area (Nature Advisory 2023c).

Key findings from this assessment relevant to collision risk are (Nature Advisory 2023c):

- Based on historical flooding and weather patterns it is estimated that that wetlands in the study area (outside the project's subject land) could flood and serve as breeding habitat for the species no more than once in a potential 20-year period. Based on the behaviour of other waterbirds, the flight behaviour of Australasian Bitterns using local habitat is not thought to expose them to unacceptably high-risks of collision with turbines, provided a 400 m buffer between turbines and wetlands is observed. This is based on the better-known flight behaviour of other waterbirds and the fact that this species is normally very closely tied to their breeding wetlands when using them, and would normally only be found away from them on their approach in and exit out during the start and end of breeding.
- Three two-way flight routes (six routes in total) have been determined to be the likeliest long-distance flight routes that the species may take between seasonal breeding grounds and non-breeding season habitat that may cause them to cross through the airspace of the proposed wind farm. The species is known to fly at RSA height and is known to make long-distance flights at night and in low-light conditions, which are both factors potentially increasing the risk of collision. However, most waterbirds fly above RSA height when making long-distance flights, and only fly at RSA height when almost directly above their destination waterbody (i.e., within 400 metres of it), and assuming Australasian Bitterns fly in a similar way, the risk of them colliding with turbines during long-distance flights is minimal.
- A worst-case scenario (in which most bitterns fly within RSA height when making long-distance movements) would involve a handful of birds colliding with turbines twice a year over the life of the windfarm, which could have long-term detrimental impacts on the migrating population within the Murray-Darling Basin (minimum roughly 475 birds). However, this is a very unlikely scenario, as based on the behaviour of other waterbirds, the species likely flies above RSA height when making long-distance movements, and cumulatively over a decade of mortality monitoring at various wind farms has never discovered either it, or higher-risk and more detectable waterbirds as a mortality attributable to collision with wind turbines.

### 6.1.5. Regent Parrot targeted assessment report (Nature Advisory 2023d)

Nature Advisory was commissioned on behalf of Windlab Pty Ltd to complete a targeted assessment of the Regent Parrot for the proposed Junction Rivers Wind Project. This assessment was commissioned to provide detailed information on the utilisation of the subject land by Regent Parrot, a threatened species identified during the BBUS survey (Nature Advisory 2023d). The aim of this assessment was to:

- Assist Windlab for the purpose of decision-making regarding the layout and design of proposed turbines.

- Provide guidance for mitigation of potential impacts on this species by recommending strategies to reduce or eliminate the risk of turbine strikes.
- Provide guidance to avoid and reduce the potential impact to foraging and roosting habitat (Nature Advisory 2023d).

Design recommendations provided within the assessment (Nature Advisory 2023d) include:

- Ensure a 100 metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable foraging and roosting habitat and along known movement corridors.
- Ensure all suitable roosting and foraging habitat (mallee woodland) is identified and mapped within the development corridor to ensure this habitat is not removed during construction in areas where this habitat is likely to provide a movement corridor for the species.
- Design to avoid the removal of mallee woodland identified as suitable habitat for foraging and roosting in other areas of the subject site where possible.

Data was collated to inform this assessment through background research and field assessments. Background research consisted of a review of existing species records from the BUS survey, information regarding the potential occurrence of listed MNES and a 10 kilometre NSW Bionet Atlas search.

The field assessment included identification of potential roosting, foraging and (if present) breeding habitat. A targeted field assessment was completed. The total survey effort amounted to 50 hours over four days, completing roaming surveys between designated point count locations (Nature Advisory 2023d).

Potential impacts identified within the assessment (Nature Advisory 2023d) on the Regent Parrot that may be result from the construction of the wind farm include the following:

- Potential removal of suitable foraging and roosting habitat.
- Barrier effects if foraging and roosting habitat along established movement corridors is removed.
- Collision with operating turbines.

This species was included within the qualitative risk assessment completed by Nature Advisory (Nature Advisory 2023f) and determined this species to be a low risk for turbine collision, refer to Section 6.1.2. The full assessment is presented in Appendix 9 of this BDAR.

### 6.1.6. 'At-risk' species

The following section summarises species considered to be at risk from collision with turbines such that impacts could occur to the species and/or population levels. A full list of species considered to be at risk as a result of the Nature Advisory assessments outlined above by the proposed Junction Rivers Wind Project is summarised Table 36 and Table 37. A total of 35 species, including 32 species of birds and three species of bats, are considered to be at more than a negligible risk of impact from turbine collisions as a result of the project.

It should be noted that all species assessed are considered to have no more than a negligible risk of impact as a result of barrier effect for the proposed wind farm layout.

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Table 36 Species determined to be at risk of impact fom turbine collision through qualitative risk assessments

| Species | Threat listing | | Risk Assessed Species Risk Conclusion |
|---|---|---|---|
| | EPBC Act | BC Act | |
| **Birds** | | | |
| Black Falcon | - | VU | Low |
| Black-shouldered Kite | - | - | Low |
| Brown Falcon | - | - | Low |
| Black Kite | | | Low |
| Brown Goshawk | - | - | Low |
| Fork-tailed Swift | Mi | - | Low |
| Little Eagle | - | VU | Low |
| Major Mitchell's Cockatoo | EN | VU | Low |
| Nankeen Kestrel | - | - | Low |
| Peregrine Falcon | - | - | Low |
| Regent Parrot (eastern subspecies) | VU | EN | Low |
| Wedge-tailed Eagle | - | - | Low |
| Whistling Kite | - | - | Low |
| White-bellied Sea-Eagle | - | VU | Low |
| **Bats** | | | |
| Gould's Wattled Bat | - | - | Low |
| White-striped Freetail-bat | - | - | Low |
| Yellow-bellied Sheathtail-bat | - | VU | Low |

Table 37 Species not subject to qualitative risk assessment determined to be at risk

| Species | Threat listing | | Recorded in subject land |
|---|---|---|---|
| | EPBC Act | BC Act | |
| Australian Pelican | | | Yes |
| Australasian Bittern | EN | EN | No |
| Australasian Darter (Arrgarrg) | | | No |
| Australasian Shoveler | | | No |
| Black-and-white Shag (Pied Cormorant) | | | No |
| Black Swan | | | Yes |
| Blue-billed Duck | | VU | No |
| Caspian Tern | Mi | | No |

| Species | Threat listing | | Recorded in subject land |
|---|---|---|---|
| | EPBC Act | BC Act | |
| **Great Cormorant** | | | Yes |
| **Grey (Oceanic) Teal** | | | No |
| **Gull-billed Tern** | Mi | | No |
| **Little Black Cormorant** | | | No |
| **Little Pied Cormorant** | | | No |
| **Maned Duck (Australian Wood Duck)** | | | Yes |
| **Pacific Black Duck** | | | No |
| **Pink-eared Duck** | | | No |
| **Straw-necked Ibis** | | | Yes |
| **Whiskered Tern** | | | No |

## 6.2. Collision risk modelling

Collisions of birds and bats with wind turbines have been documented to occur at various frequencies around the world. Quantitative modelling to estimate the number of collision mortalities of threatened and non-threatened taxa is widely used as part of environmental impact assessments for proposed wind energy facilities (Masden & Cook 2016).

Modelling of collision risk is reliant on empirical data for flights by species at the wind farm site. There is no practicable method to obtain species-specific flight data for bats that are likely to utilise the site and bat-call data does not provide information about the number of flights by bats.

The only alternative to a quantitative modelling approach is one of qualitative subjective judgement. All the benefits of using mathematical modelling outlined above are difficult, if not impossible to achieve with a purely qualitative assessment.

Nature Advisory has not completed numerical collision risk modelling for the project.

As assessment of the potential impacts to at risk species' as a result of potential collisions with operational turbines is provided in Section 8.3.5.

## 6.3. Turbine risk assessment

### 6.3.1. Turbine strike consequence

The potential consequence of turbine strike has been assessed for at-risk bird and bat species within the subject land, based on the conclusions of the collision risk assessments (Nature Advisory 2023f) outlined above in Section 6.1, and summarised in Table 36 and Table 37.

The BCS Draft Turbine Risk Assessment and Avoidance Guidance (BCS 2023) relating to the potential consequences of turbine strike has been adapted to include the level of risk each species is considered to be

at from collision with turbines in the context of the subject land. The recommended turbine consequence severity rating included in the BCS guidance applies a 'one size fits all' approach based on threat status and gives no consideration to potential frequency of impact (turbine strike) or local population dynamics. Nor does it consider species listed as Migratory under the EPBC Act. It is important to consider these and other factors when determining how severe the consequences on one (or more) turbines strike may be to any given species.

The adapted BCS turbine strike consequence severity rating is provided in Table 38 below.

**Table 38 Adapted BCS turbine strike consequence matrix**

| Threat status (BC Act or EPBC Act) | Bird or bat species 'at risk' rating | | | | |
|---|---|---|---|---|---|
| | Negligible | Low | Moderate | High | Severe |
| At risk (non-threatened) | Negligible | Minor | Moderate | Moderate | Major |
| Migratory | Negligible | Minor | Moderate | Major | Severe |
| Vulnerable | Negligible | Minor | Moderate | Major | Severe |
| Endangered | Minor | Moderate | Major | Severe | Severe |
| Critically Endangered or potential SAII | Minor | Major | Major | Severe | Severe |

The severity of potential impacts of turbine strike to those species of birds and bats determined to be at more than a negligible risk from turbines strike (as outlined in Section 6.1.6 above) have been assessed, with those species rated as having more than a negligible consequence listed in Table 39 below.

**Table 39 Turbine strike consequence for at-risk threatened species**

| Species | Threat status | Turbine strike consequence rating | Key habitats (refer Figure 6) |
|---|---|---|---|
| **Birds** | | | |
| **Australian Pelican** | At risk | Minor* | Wetlands - PCT 238 |
| **Australasian Bittern** | Endangered – BC Act and EPBC Act | Moderate* | Wetlands - PCT 238 |
| **Australasian Darter (Arrgarrg)** | At risk | Minor* | Wetlands - PCT 238 |
| **Australasian Shoveler** | At risk | Minor* | Wetlands - PCT 238 |
| **Black Falcon** | Vulnerable – BC Act | Minor | Treed PCTs - 15, 16, 21, 23, 57, 58, 170 |
| **Black-shouldered Kite** | At risk | Minor | Treed PCTs - 15, 16, 21, 23, 57, 58, 170 |
| **Black Swan** | At risk | Minor* | Wetlands - PCT 238 |
| **Blue-billed Duck** | Vulnerable – BC Act | Minor* | Wetlands - PCT 238 |

| Species | Threat status | Turbine strike consequence rating | Key habitats (refer Figure 6) |
|---|---|---|---|
| **Brown Falcon** | At risk | Minor | Treed PCTs - 15, 16, 21, 23, 57, 58, 170 |
| **Black Kite** | At risk | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **Black-and-white Shag (Pied Cormorant)** | At risk | Minor* | Wetlands - PCT 238 |
| **Brown Goshawk** | At risk | Minor | Treed PCTs - 15, 16, 21, 23, 57, 58, 170 |
| **Caspian Tern** | Migratory – EPBC Act | Minor* | Wetlands - PCT 238 |
| **Fork-tailed Swift** | Migratory – EPBC Act | Minor | Aerial forage habitat only |
| **Great Cormorant** | At risk | Minor* | Wetlands - PCT 238 |
| **Grey (Oceanic) Teal** | At risk | Minor* | Wetlands - PCT 238 |
| **Gull-billed Tern** | Migratory – EPBC Act | Minor* | Wetlands - PCT 238 |
| **Little Black Cormorant** | At risk | Minor* | Wetlands - PCT 238 |
| **Little Eagle** | Vulnerable – BC Act | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **Little Pied Cormorant** | At risk | Minor* | Wetlands - PCT 238 |
| **Major Mitchell's Cockatoo** | Vulnerable – BC Act, Endangered EPBC Act | Moderate | Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **Maned Duck (Australian Wood Duck)** | At risk | Minor* | Wetlands - PCT 238 |
| **Nankeen Kestrel** | At risk | Minor | Treed PCTs - 15, 16, 21, 23, 57, 58, 170 |
| **Pacific Black Duck** | At risk | Minor* | Wetlands - PCT 238 |
| **Pink-eared Duck** | At risk | Minor* | Wetlands - PCT 238 |
| **Peregrine Falcon** | At risk | Minor | Treed PCTs - 15, 16, 21, 23, 57, 58, 170 |
| **Regent Parrot (eastern subspecies)** | Endangered – BC Act, Vulnerable – EPBC Act | Moderate | Treed PCTs - 15, 16, 58, 170 |
| **Straw-necked Ibis** | At risk | Minor* | Wetlands - PCT 238 |
| **Wedge-tailed Eagle** | At risk | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **Whiskered Tern** | At risk | Minor* | Wetlands - PCT 238 |
| **Whistling Kite** | At risk | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |

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| Species | Threat status | Turbine strike consequence rating | Key habitats (refer Figure 6) |
|---|---|---|---|
| **White-bellied Sea-Eagle** | Vulnerable – BC Act | Minor* | Wetlands - PCT 238, Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **Bats** | | | |
| **Gould's Wattled Bat** | At risk | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **White-striped Freetail-bat** | At risk | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |
| **Yellow-bellied Sheathtail-bat** | Vulnerable – BC Act | Minor | Treed PCTs - 15, 16, 21, 57, 58, 170 |

*** Wetland associated species. Turbine consequence rating relates to flood years, when larger numbers of species/individuals are present in the region.**

Key habitats outlined in Table 39 above include roosting / breeding opportunities for at risk species, and in the context of waterbirds species include wetland forage habitats, where habitual flights are more likely to bring individuals in closer proximity to turbine RSA, and thus increase the risk of collision. Key habitats form the basis of the turbine strike likelihood assessment provided in Section 6.3.2 below.

### 6.3.2. Turbine strike likelihood assessment

Turbine strike likelihood has been assessed relative to the criteria outlined in the BCS Draft Turbine Risk Assessment and Avoidance Guidance (NSW DCCEEW 2023b), with adjustments made to the recommended criteria to better suite site conditions and to focus on potential flightpaths of at-risk species.

Turbine strike likelihood criteria, developed for the project are presented in Table 40 below. The risk assessment has been based on following turbine parameters, which have been included as the 'worst case scenario' turbine being considered for the project, in relation to potential turbine strike:

- Hub height – 140 metres.
- Blade length – 91 metres.
- RSA height – 49 metres above ground (min) – 231 metres tip height (max).

The project's EIS (Umwelt 2024) includes two options for turbines which may be selected during commissioning of the wind farm. This is due to the uncertainties around future turbine technology that could become available, and a consistent approach to assessing the impacts of the 'worst-case scenario' turbine model (which may differ depending on the type of potential impacts assessed). These turbine models being considered in the EIS are illustrated in Plate 1 below.

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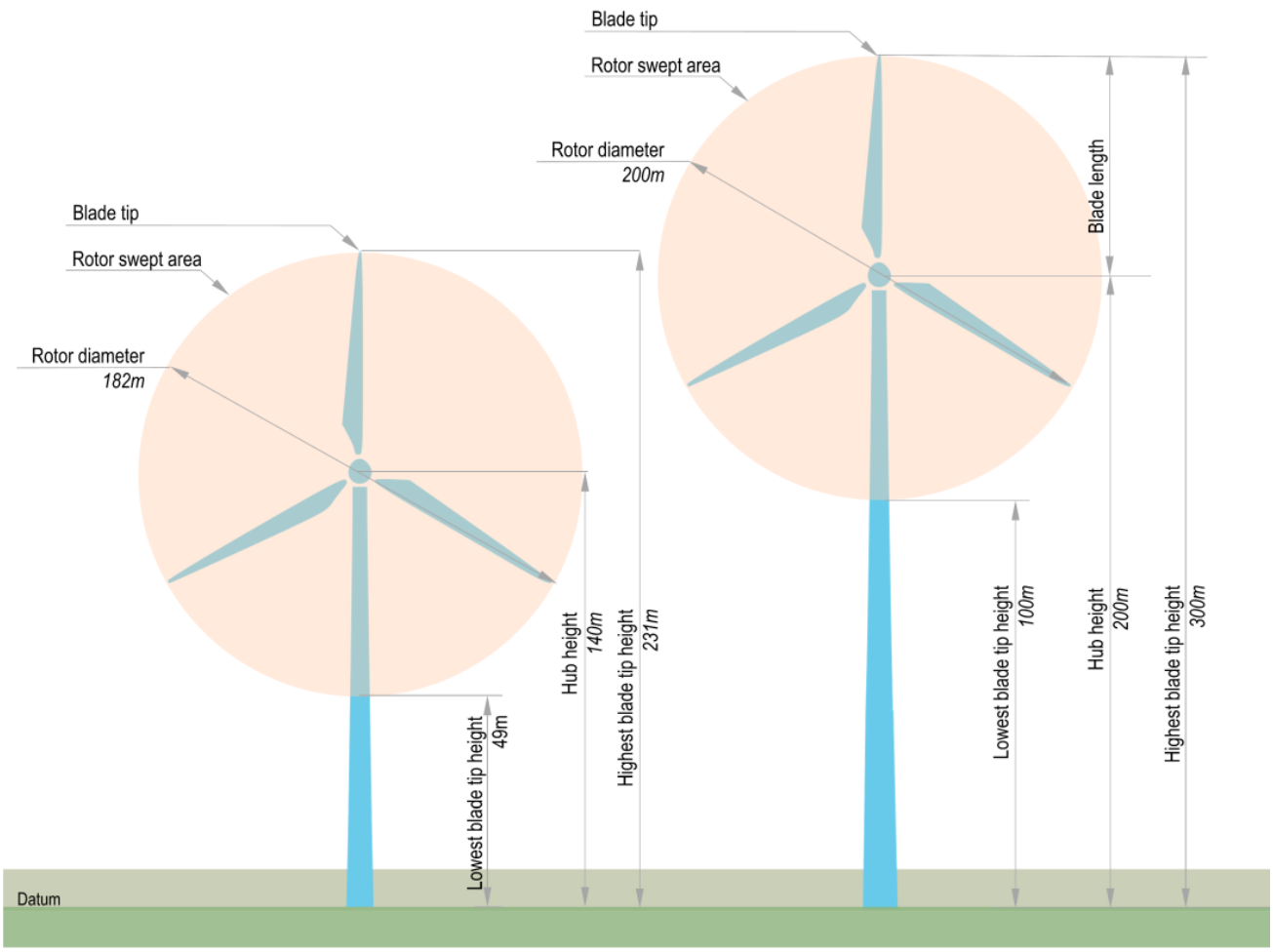



**Plate 1 Turbine model comparison schematic diagram of options assessed in the EIS.**

These two options have been considered as part of this turbine risk assessment and the "smaller" model included above is considered to equate to the potential worst-case scenario option in relation to potential impacts from bird and bat strike, and barrier effect.

The larger model comprises longer blades, and thus a greater overall rotor swept area. However, as the lowest blade tip height is significantly higher (at 100 metres above the ground) when compared to the smaller turbine (at 49 metres), the potential for bird and bat strike is considered substantially reduced due to the lower numbers of flights that occur above 100 metres elevation (see previous BBUS results and discussion). Considerably more birds and bats would have the potential to fly at rotor swept height between 49 metres and 100 metres above ground level, than would based on flights at heights greater than 100 metres above ground level. It is acknowledged that the longer blades on the larger model result in an increased total rotor swept area of 31,400 square metres per turbine, compared to the 26,000 square metres presented by the smaller model. However, again as the number of flights likely to come into contact with the larger blades is less, the increased area is not considered to significantly increase the likelihood of potential impacts. One further consideration is the reduction in undisturbed airspace between the operational turbines (i.e. the gaps between rotors swept areas) that would result from the larger model being commissioned. However as detailed further in Section 7.1 below, a 'nearest neighbour analysis' undertaken in GIS determined that the average gap between rotor swept areas, along stings of turbines, is approximately 450 metres, and the reduction of 18 metres that would result from the larger model, is not considered a substantial increase to risk of collision and barrier effect.

Turbine strike likelihood criteria, developed for the project are presented in Table 40 below.

**Table 40 Turbine strike likelihood criteria**

| Key habitat features | |
|---|---|
| • Key wooded habitats for at-risk species that occur on both sides of a turbine, such that flights between habitat features/patches are more likely to occur within, or in close proximity to, RSA.<br>• Patches are ≥1 ha in area providing larger, higher quality habitat likely to be used more frequently, by more birds and bats, and more regularly by resident species.<br>• Lakes, wetlands and larger watercourses on one (or both) side of a turbine increasing the risk of collisions from fauna flying into or out of the habitat feature. Relevant for flood years only.<br>• Migratory or nomadic species habitual flight path, or key local flyways | |
| **Buffer distance to habitat feature** | **Likelihood of turbine strike** |
| **Key habitat features occur within 200 m buffer from blade tip.** | **Probable**<br>An event is expected to occur in most circumstances (>95%). |
| **Relevant habitat features occur within 200 m to 500 m buffer from blade tip.** | **Possible**<br>An event could occur during most circumstances (>50% - <95%). |
| **Relevant habitat features occur within 500 m to 1000 m buffer from blade tip.** | **Unlikely**<br>An event could occur during some circumstances (>5 - <50%). |
| **Relevant habitat features occur greater than 1000 m from blade tip.** | **Rare**<br>An event may occur only in unusual circumstances (<5%). |

The above criteria are considered to better represent the potential for turbine strike within the subject land than the recommended criteria included in the BCS draft guidance (BCS 2023). This is due to the majority of habitats for bird and bat species within the subject land and present as either isolated patches within larger areas of cleared / cropped agricultural land, associated with waterbodies, or along defined corridors such as travelling stock routes and roadways. Large areas of mostly intact habitat are limited within the subject land, with the exception of the patch of PCT 58 Black Oak – Western Rosewood open woodland within the central portion of the site. Movements through the operational wind farm, with potential to put individuals at risk of collision risk, are more likely to occur when fauna are flying directly between patchy habitats present on either side of a turbine, rather than alongside the linear arrays proposed for the project. Therefore, focussing solely on proximity of habitats supported by treed vegetation is likely to misrepresent the actual likelihood of collisions.

The above criteria also allow for consideration of birds (and possibly to a lesser extent bats) capacity for avoidance of collisions with operational turbines, whether that occurs due to a cognitive response on the part of a bird or not. It should be noted that internationally there is little empirical evidence for the actual avoidance rate for any bird species, however the evidence that is available suggests that avoidance capacity is species-specific and that the great majority of birds have very high avoidance capability that is higher than 98 %. The avoidance rate of some large raptors in Australia has been shown to be between 93 % and 95 % (Smales et al. 2013, Smales 2017). With consideration of avoidance rate, and current RSA free buffer areas across the layout of the wind farm turbine array (see Section 7.1 for further detail), the turbine strike likelihood rating recommended in the BCS guidance are considered overly precautionary and not suitable for the project. As such the adapted criteria outlined in Table 38 have been used to complete the turbine risk assessment for this BDAR.

The turbine strike likelihood assessment buffer distances have been calculated using the formula for calculating buffers to areas of vegetation developed in *Natural England Technical Information Note TIN051 – Bats and onshore wind turbines interim guidance* (Natural England 2009). This method takes into consideration hub height, blade length, habitat feature height (i.e. tree canopies), and the horizontal distance to habitats features and provides a diagram and formula for how buffer distances between blade tips and adjacent habitat features can be calculated (refer Figure 14 below).

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

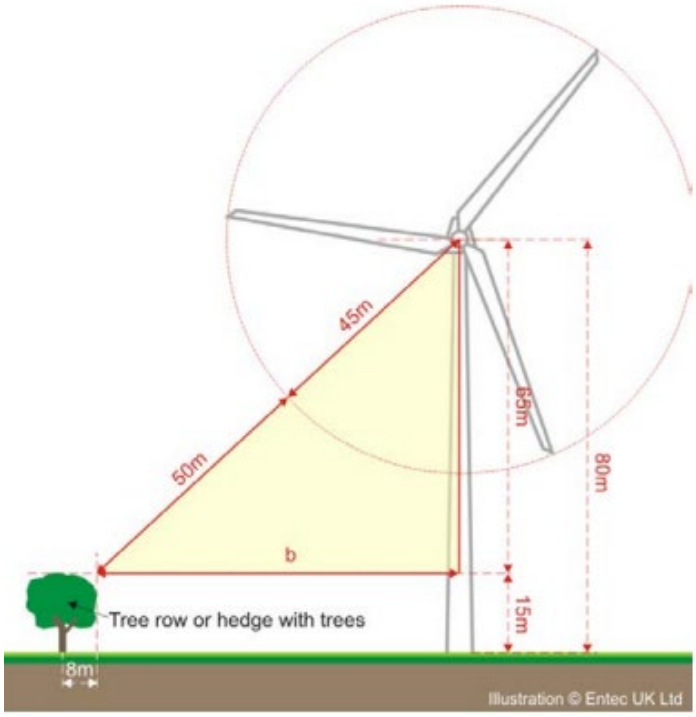



**Figure 14 Extract from Technical Information Note TIN051 Bats and onshore wind turbines, showing how buffer distance is determined from top of canopy to blade tip**

The above formula was used calculate the buffer distances outlined in Table 40 above for assessment of the presence of key habitat features, with the following horizontal distances calculated for each of the assessed buffer distances:

- 200 metre buffer distance from blade tip – 260 metre horizontal buffer to key habitat feature.
- 500 metre buffer distance from blade tip – 576 metre horizontal buffer to key habitat feature.
- 1000 metre buffer distance from blade tip – 1083 metre horizontal buffer to key habitat feature.

The above distances were calculated based on a maximum feature height of 9 metres for treed vegetation, which equates to the tallest mean canopy height value to PCTs within the subject land as outlined in the BioNet Vegetation Classification database.

The results of this analysis are presented in Table 41 below.

**Table 41 Turbine strike likelihood results**

| WTG # | Turbine strike likelihood | Justification |
|---|---|---|
| 1 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 2 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 3 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 4 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 5 | Rare | Limited marginal habitat within 1000 m buffer |
| 6 | Rare | Limited marginal habitat within 1000 m buffer |
| 7 | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| 8 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 9 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 10 | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| 11 | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| 12 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 13 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 14 | Rare | Limited marginal habitat within 1000 m buffer |
| 15 | Rare | Limited marginal habitat within 1000 m buffer |
| 16 | Rare | Limited marginal habitat within 1000 m buffer |
| 17 | Rare | Limited marginal habitat within 1000 m buffer |
| 18 | Probable* | Condoulpe Lake within 200 m buffer** |
| 19 | Unlikely* | Condoulpe Lake within 1000m buffer** |
| 20 | Rare | Limited marginal habitat within 1000 m buffer |
| 21 | Rare | Limited marginal habitat within 1000 m buffer |
| 22 | Rare | Limited marginal habitat within 1000 m buffer |
| 23 | Rare | Limited marginal habitat within 1000 m buffer |
| 24 | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| 25 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 26 | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| 27 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 28 | Unlikely* | Condoulpe Lake within 1000 m buffer** |
| 29 | Possible* | Condoulpe Lake within 500 m buffer** |
| 30 | Probable* | Condoulpe Lake within 200 m buffer** |

| WTG # | Turbine strike likelihood | Justification |
|---|---|---|
| **31** | Rare | Limited marginal habitat within 1000 m buffer |
| **32** | Rare | Limited marginal habitat within 1000 m buffer |
| **33** | Rare | Limited marginal habitat within 1000 m buffer |
| **34** | Rare | Limited marginal habitat within 1000 m buffer |
| **35** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **36** | Rare | Limited marginal habitat within 1000 m buffer |
| **37** | Rare | Limited marginal habitat within 1000 m buffer |
| **38** | Rare | Limited marginal habitat within 1000 m buffer |
| **39** | Rare | Limited marginal habitat within 1000 m buffer |
| **40** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **41** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **42** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **43** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **44** | Rare | Limited marginal habitat within 1000 m buffer |
| **45** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **46** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **47** | Rare | Limited marginal habitat within 1000 m buffer |
| **48** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **49** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **50** | Rare | Limited marginal habitat within 1000 m buffer |
| **51** | Rare | Limited marginal habitat within 1000 m buffer |
| **52** | Rare | Limited marginal habitat within 1000 m buffer |
| **53** | Rare | Limited marginal habitat within 1000 m buffer |
| **54** | Rare | Limited marginal habitat within 1000 m buffer |
| **55** | Rare | Limited marginal habitat within 1000 m buffer |
| **56** | Rare | Limited marginal habitat within 1000 m buffer |
| **57** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **58** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **59** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **60** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **61** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |

| WTG # | Turbine strike likelihood | Justification |
|---|---|---|
| **62** | Probable | Wooded PCTs w/in 200 m buffer on both sides of turbine |
| **63** | Rare | Limited marginal habitat within 1000 m buffer |
| **64** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **65** | Probable | Wooded PCTs w/in 200 m buffer on both sides of turbine |
| **66** | Probable | Wooded PCTs w/in 200 m buffer on both sides of turbine |
| **67** | Probable | Wooded PCTs w/in 200 m buffer on both sides of turbine |
| **68** | Probable | Wooded PCTs w/in 200 m buffer on both sides of turbine |
| **69** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **70** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **71** | Rare | Limited marginal habitat within 1000 m buffer |
| **72** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **73** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **74** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **75** | Rare | Limited marginal habitat within 1000 m buffer |
| **76** | Rare | Limited marginal habitat within 1000 m buffer |
| **77** | Rare | Limited marginal habitat within 1000 m buffer |
| **78** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **79** | Rare | Limited marginal habitat within 1000 m buffer |
| **80** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **81** | Rare | Limited marginal habitat within 1000 m buffer |
| **82** | Rare | Limited marginal habitat within 1000 m buffer |
| **83** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **84** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **85** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **86** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **87** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **88** | Rare | Limited marginal habitat within 1000 m buffer |
| **89** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| **90** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **91** | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| **92** | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |

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| WTG # | Turbine strike likelihood | Justification |
|---|---|---|
| 93 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 94 | Possible | Wooded PCTs w/in 500 m buffer on both sides of turbine |
| 95 | Unlikely | Wooded PCTs w/in 1000 m buffer on both sides of turbine |
| 96 | Probable | Wooded PCTs w/in 200 m buffer on both sides of turbine |

*** Turbine strike likelihood relates to flood years, when larger numbers of waterbird species/individuals are present in the region.**
**** Buffer distances based on desktop assessment of GIS topographic data "HydroArea" polygons, actual lake extent very rarely to occur in stated proximity (refer Section 9.1.2).**

### 6.3.3. Turbine risk assessment

Turbine risk combines the results of the assessment of turbine strike consequence and turbine strike likelihood and has again been based on the BCS Draft Turbine Risk Assessment and Avoidance Guidance (BCS 2023). Adjustments have again been made to the recommended risk rating to better reflect the habitats, aerial faun, and movements patterns within the subject land, as well as the conclusions of the risk assessments undertaken for all at risk species.

The turbine risk assessment matrix applied to the project is outlined in Table 42.

**Table 42 Turbine risk assessment matrix**

| Likelihood criteria | Consequence criteria | | | |
|---|---|---|---|---|
| | **Severe** | **Major** | **Moderate** | **Minor** |
| **Probable** | Very high | Very high | High | Moderate |
| **Possible** | Very high | High | Moderate | Moderate |
| **Unlikely** | High | High | Moderate | Low |
| **Rare** | High | Moderate | Low | Low |

Final turbine risk assessment results are presented in Table 43.

**Table 43 Turbine risk assessment results**

| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| 1 | Unlikely | Moderate | Moderate |
| 2 | Unlikely | Moderate | Moderate |
| 3 | Unlikely | Moderate | Moderate |
| 4 | Unlikely | Moderate | Moderate |
| 5 | Rare | Moderate | Low |
| 6 | Rare | Moderate | Low |
| 7 | Possible | Moderate | Moderate |
| 8 | Unlikely | Moderate | Moderate |
| 9 | Unlikely | Moderate | Moderate |

| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| **10** | Possible | Moderate | Moderate |
| **11** | Possible | Moderate | Moderate |
| **12** | Unlikely | Moderate | Moderate |
| **13** | Unlikely | Moderate | Moderate |
| **14** | Rare | Moderate | Low |
| **15** | Rare | Moderate | Low |
| **16** | Rare | Moderate | Low |
| **17** | Rare | Moderate | Low |
| **18** | Probable | Moderate | High* |
| **19** | Unlikely | Moderate | Moderate* |
| **20** | Rare | Moderate | Low |
| **21** | Rare | Moderate | Low |
| **22** | Rare | Moderate | Low |
| **23** | Rare | Moderate | Low |
| **24** | Possible | Moderate | Moderate |
| **25** | Unlikely | Moderate | Moderate |
| **26** | Possible | Moderate | Moderate |
| **27** | Unlikely | Moderate | Moderate |
| **28** | Unlikely | Moderate | Moderate* |
| **29** | Possible | Moderate | Moderate* |
| **30** | Probable | Moderate | High* |
| **31** | Rare | Moderate | Low |
| **32** | Rare | Moderate | Low |
| **33** | Rare | Moderate | Low |
| **34** | Rare | Moderate | Low |
| **35** | Unlikely | Moderate | Moderate |
| **36** | Rare | Moderate | Low |
| **37** | Rare | Moderate | Low |
| **38** | Rare | Moderate | Low |
| **39** | Rare | Moderate | Low |
| **40** | Unlikely | Moderate | Moderate |

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| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| **41** | Possible | Moderate | Moderate |
| **42** | Possible | Moderate | Moderate |
| **43** | Unlikely | Moderate | Moderate |
| **44** | Rare | Moderate | Low |
| **45** | Possible | Moderate | Moderate |
| **46** | Possible | Moderate | Moderate |
| **47** | Rare | Moderate | Low |
| **48** | Possible | Moderate | Moderate |
| **49** | Unlikely | Moderate | Moderate |
| **50** | Rare | Moderate | Low |
| **51** | Rare | Moderate | Low |
| **52** | Rare | Moderate | Low |
| **53** | Rare | Moderate | Low |
| **54** | Rare | Moderate | Low |
| **55** | Rare | Moderate | Low |
| **56** | Rare | Moderate | Low |
| **57** | Possible | Moderate | Moderate |
| **58** | Possible | Moderate | Moderate |
| **59** | Possible | Moderate | Moderate |
| **60** | Possible | Moderate | Moderate |
| **61** | Possible | Moderate | Moderate |
| **62** | Probable | Moderate | High |
| **63** | Rare | Moderate | Low |
| **64** | Unlikely | Moderate | Moderate |
| **65** | Probable | Moderate | High |
| **66** | Probable | Moderate | High |
| **67** | Probable | Moderate | High |
| **68** | Probable | Moderate | High |
| **69** | Possible | Moderate | Moderate |
| **70** | Possible | Moderate | Moderate |
| **71** | Rare | Moderate | Low |

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| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| **72** | Possible | Moderate | Moderate |
| **73** | Unlikely | Moderate | Moderate |
| **74** | Possible | Moderate | Moderate |
| **75** | Rare | Moderate | Low |
| **76** | Rare | Moderate | Low |
| **77** | Rare | Moderate | Low |
| **78** | Possible | Moderate | Moderate |
| **79** | Rare | Moderate | Low |
| **80** | Unlikely | Moderate | Moderate |
| **81** | Rare | Moderate | Low |
| **82** | Rare | Moderate | Low |
| **83** | Possible | Moderate | Moderate |
| **84** | Possible | Moderate | Moderate |
| **85** | Possible | Moderate | Moderate |
| **86** | Possible | Moderate | Moderate |
| **87** | Unlikely | Moderate | Moderate |
| **88** | Rare | Moderate | Low |
| **89** | Unlikely | Moderate | Moderate |
| **90** | Possible | Moderate | Moderate |
| **91** | Possible | Moderate | Moderate |
| **92** | Unlikely | Moderate | Moderate |
| **93** | Unlikely | Moderate | Moderate |
| **94** | Possible | Moderate | Moderate |
| **95** | Unlikely | Moderate | Moderate |
| **96** | Probable | Moderate | High |

*** Turbine risk rating relates to flood years, when larger numbers of waterbird species/individuals are present in the region.**

Table 44 below summarises then number of turbines within each risk category for the project.

**Table 44 Turbine risk assessment summary**

| Turbine risk | No. of turbines | Comments |
|---|---|---|
| **Very High** | 0 | - |
| **High** | 8 | Two turbines (WTG 18, WTG 30) considered High-risk only during flood years and collision risk for Australasian Bittern and other seasonal wetland species is elevated above average years |
| **Moderate** | 52 | Three turbines (WTG 19, WTG 28, WTG 29) considered Moderate risk only during flood years and collision risk for Australasian Bittern and other seasonal wetland species is elevated above average years. |
| **Low** | 36 | - |

The potential impacts associated with the turbine risk assessment are assessed in Sections 8.2 and 8.3.5 below, with the turbine risk ratings illustrated on Figure 19.

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# STAGE 2 — IMPACT ASSESSMENT

# 7. Avoid and minimise impacts

This section demonstrates the efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the project in accordance with BAM, including an analysis of:

- Alternative locations' potential impacts on biodiversity values and justification for selecting the project location.
- Efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design.
- Routes that avoid and minimise impacts on biodiversity values.
- Technologies that would avoid or minimise impacts on biodiversity values.

## 7.1. Actions to avoid/minimise project impacts

The project has implemented design changes prior to and since preliminary biodiversity assessments were completed in spring 2021. The project design has been informed through biodiversity field surveys, including targeted flora and fauna surveys and identification of low to high constraint areas. Figure 16 shows aspects of the project design that have been refined to avoid and minimise impacts to biodiversity value, while Figure 18 the final development footprint.

### 7.1.1. Alternative locations' potential impacts on biodiversity values and justification for selecting the project location

During initial phases of the project feasibility, other properties and regions within the broader Riverina and South West REZ were considered. The South West REZ as a whole was chosen for multiple reasons including renewable energy resource potential, existing (and planned) electricity network (i.e. Project EnergyConnect), low human population densities and existing land use patterns (i.e. intensive dryland cropping of historically cleared land). However, many of the proposed renewable energy developments in the South West REZ are sited in areas that support native vegetation cover, particularly in the central to eastern portions of the REZ. The prevalence of native vegetation in these areas is due to land use practices and patterns of agricultural development. Lower rainfall areas and non-arable areas away from irrigation infrastructure still support large tracts of native vegetation where broadacre grazing takes place. Government policy and community pressure has meant future renewable energy development in the South West REZ is now largely focussed on the undeveloped grazing land that supports native vegetation rather than on the areas of high value agricultural land. This has made complete avoidance of biodiversity impacts at a landscape and site selection level challenging within the South West REZ. Whilst avoidance of native vegetation is challenging in the South West REZ, a key focus at the site selection stage of the project was the avoidance and minimisation of impacts to native vegetation. This aim has been considerably well realised with the location of the project, and the relatively low impacts to native vegetation, especially when compared to other similar projects in the South West REZ.

The project has been sited such that the majority of WTGs are located in dryland cropping paddocks generally lacking native vegetation, with the majority of the subject land located on Category 1 – Exempt land. Category 1 – Exempt land encompasses:

- Approximately 79% of the subject land (8,500 hectares of 10,800 hectares total area).

- Approximately 86% of the development corridor (1,800 hectares of 2,100 hectares total area).
- Approximately 90% of the development footprint (680 hectares of 768 hectares total area).

Further to the above, of the approximately 90 hectares of the development footprint located outside Category 1 – Exempt land, further avoidance has been realised such that impacts will occur to 75.68 hectares of native vegetation.

Table 45 below provides a detailed summary of efforts undertaken to date during project design to avoid and minimise impacts to biodiversity values, as well as commitments made to continue to minimise potential operation impacts through the life of the wind farm.

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**Table 45 Avoidance and minimisation of impact**

| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| **Direct impacts** | | | | |
| ***Project design*** | Project design workshops | • Project design workshops were held on multiple occasions between Biosis ecologists, project designers/engineers and environmental approvals specialists to work through opportunities and constraints relating to how impacts to biodiversity values could be avoided and minimised through project design and the location of infrastructure.<br>• Priorities for consideration that resulted in the outcomes listed below included:<br>– Avoidance of threatened species populations/habitat and TECs.<br>– Avoidance of hollow-bearing trees and stick nests.<br>– Preferential location of infrastructure on Category 1 – Exempt Land and areas of existing disturbance.<br>– Maximising separation between WTGs / RSA and tree canopies.<br>– Maximising separation gaps between RSAs.<br>– Minimising required disturbance areas through further designs, and minimising the widths required for access tracks and other linear infrastructure components.<br>– Maximising setbacks from habitat features such as waterbodies and vegetated corridors. | Early project planning | Proponent |
| | Reduction in number of WTGs since project scoping stage | • The project has reduced the number of WTGs being proposed from 107 down to 96. This has had a commensurate reduction in impacts to biodiversity value, including a reduction in direct, indirect and prescribed impacts. | Early project planning | Proponent |
| | Redesign and reduction of the proposed network connection to the Balranald substation to avoid impacts to '10 Mile' Travelling Stock Reserve (TSR) and a population of *Austrostipa metatoris*. | • Avoidance of impacts to 10 Mile TSR, noted as a High conservation value TSR (LLS 2017).<br>• Avoidance of impacts to identified population of BC Act and EPBC Act Vulnerable listed *Austrostipa metatoris*, supporting over 50 individual plants over an area of approximately 1.3 ha.<br>• Avoidance of impact to known Regent Parrot movement corridor and forage habitat (Nature Advisory 2023d). | Early project planning | Proponent |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | • Avoidance of impacts to approximately 12.5 ha of native vegetation, comprising PCT 170 and PCT 58 in various condition states. | | |
| | Redesign of the proposed footprint to avoid identified population of *Santalum murrayanum* by over 45 m from the closest individual. | • Avoidance of impacts to a populations of the BC Act Endangered Bitter Quandong, supporting 21 individuals.<br>• Avoidance of around 4.5 ha of PCT 58 in various condition states.<br>• In avoiding impacts to both *Austrostipa metatoris* and Bitter Quandong the project has avoided impacts to all known populations of threatened flora species | Early project planning | Proponent |
| | Redesign of the electrical reticulation / access track east of WTG 62 to avoid a patch of Yarran Shrubland TEC | • Development footprint was move to the north to avoid two patches on BC Act listed Yarran Shrubland.<br>• Avoidance of impact to approximately 0.4 ha of TEC vegetation. | Early project planning | Proponent |
| | Redesign of proposed network connection and access tracks along the western boundary of the subject land avoids impact to Yarran Shrubland TEC | • An approximately 2.5 ha patch of Yarran Shrubland TEC, previously within the project's development corridor, will not be impacted. | Early project planning | Proponent |
| | Access across Balranald-Moulamein Road designed to avoid impact to Yarran Shrubland TEC | • Yarran Shrubland TEC occurs patchily (and relatively commonly) along Balranald-Moulamein Road. Access tracks from Balranald-Moulamein Road to infrastructure proposed within the adjacent paddock have been located avoid impacts to the TEC wherever possible.<br>• Impacts to the TEC at the corner of Balranald-Moulamein Road and Arundel Road and adjacent to WTG 69 are unavoidable due to turbine component haul route access requirements. | Early project planning | Proponent |
| | Design of development footprint between WTG 85 and WTG 86, and WTG 73 to avoid/minimise impacts to patches of Sandhill Pine Woodland TEC | • Development footprint components have been designed to ensure direct impact to an approximately 1.5 hectare area of Sandhill Pine Woodland TEC adjacent to WTG 85 and WTG 86 will be avoided.<br>• Access tracks north of WTG 73 have been designed and located to avoid impact to Cypress Pine trees present within a patch of the TEC. Impacts have been minimised such that clearing of the trees will not be required and the track is located in the lower condition patch edges only. This also minimises fragmentation of the patch of the TEC. | Early project planning | Proponent |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | Redesign of development corridor and development footprint between WTG 78 and WTG 85 (also relocating WTG 78 north approximately 180 m) | • Removal of planned infrastructure in this area reduced the development corridor in this portion of the subject land by approximately 21 ha.<br>• Impacts have been avoided to PCT 16 and PCT 170 in this location. | Early project planning | Proponent |
| | Redesign of project footprint between WTG 44 and WTG 47 to move infrastructure out of Category 2 – Regulated land and into Category 1 – Exempt land | • Early design was based on an existing access track location however there would have been impact along one edge to higher condition PCT 16 vegetation as well as BC Act listed Yarran Shrubland.<br>• Infrastructure was moved north to avoid impacts to approximately 1100 lineal metres of native vegetation, include a TEC. | Early project planning | Proponent |
| | Redesign of WTG locations to preferentially located turbines on Category 1 – Exempt land, and reduction in total number of turbines | • The final design footprint includes 88 of the total 96 WTG as being located on Category 1 – Exempt land.<br>• Previous design iterations included only 82 from a total of 98 WTGs on Category 1 – Exempt land. | Early project planning | Proponent |
| | Avoidance of hollow-bearing trees and scattered paddock trees | • Following completion of hollow-bearing tree and scattered paddock tree mapping, the GIS data was provided to the design team who specifically looked to avoid these habitat features in developing the final design.<br>• Of the 252 hollow-bearing trees mapped during Major Mitchell's Cockatoo habitat assessment, only 14 occur within the development footprint.<br>• Of the 269 scattered paddock trees mapped within the development corridor during the application of 'Streamlined assessment module – Scattered trees assessment', 165 have been avoided (note approximately 30 impacted trees were found not to conform to the definition of scattered trees, and became part of 'paddock tree' vegetation zones).<br>• Of the 36 hollow-bearing trees mapped by NGH Consulting only 3 occur within the development footprint.<br>• The above avoidance of paddock trees also directly avoided potential breeding habitat for Major Mitchell's Cockatoo. This is illustrated by no additional habitat being added to the species' habitat polygon on the basis of hollow-bearing trees mapping by NGH Consulting, despite 27 of | Early project planning | Proponent |

| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | the 36 trees meeting the species' habitat parameters, and not being located on Category 1 – Exempt land. | | |
| | Redesign of access across Balranald-Moulamein Road near WTG 16 and WTG 25, via the Myall Yards TSR | • Infrastructure was proposed across Balranald-Moulamein Road to allow access from the WTGs on the southern side of the road to those on the north. Initial designs investigated a 200 m wide corridor (approx. 20 ha total area) through areas of PCT 58, PCT 163 and PCT 170 in various condition states. Final design includes a 30 m to 60 m wide area of impact, reduce to a narrower corridor where impacts will occur to small patch moderate condition PCT 58, with the remaining wider area impacting upon DNG condition PCT 58 only.<br>• Minimisation of impacts to the Lillas Dam & Myall Yards TSR, noted as a High conservation value TSR (LLS 2017). | Early project planning | Proponent |
| | Redesign of access from Arundel Road to proposed Collector Substation #2 | • Access was initially proposed from Arundel Road heading in an east-north-east direction towards WTG 61 and WTG 62. This option would have impacted upon areas of PCT 16, PCT 170 and Yarran Shrubland TEC. The project design was updated to run the access along the southern side of the fenceline, within Category 1 – Exempt land, removing approximately 27.5 ha of the above PCTs/TEC from the project development corridor. | Early project planning | Proponent |
| | Relocation of WTG locations | • WTG locations have been modified multiple times since the project conception. Turbine locations have been removed, or relocated to avoid impacts to native vegetation, including re-located further away from areas of native vegetation to reduce turbine strikes.<br>• Relocation of WTG 2 (approx.300 north), WTG 3 (approx.100 m north), WTG 8 (approx.300 m east) and WTG 31 (approx.200 m east) to avoid known Regent Parrot habitat along the 10 Mile TSR, and within patches of mallee woodland along the western boundary of the subject land. These relocations ensured a 100 m turbine blade free buffer from areas of known habitat for the species (as recommended by Nature Advisory).<br>There was also a commensurate reduction in impact associated with electrical reticulation and access tracks not being required within the southern-most patch of mallee woodland (known Regent Parrot habitat). | Early project planning | Proponent |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | • As outlined above relocation of turbines such that six more turbines are located on Category 1 – Exempt land, and a reduction in WTGs from 98 to 96.<br>• Relocation of WTGs in the central portion of the subject land (WTGs 66-70) to substantially increase separation between rotor swept areas and allow for greater turbine free flyways in this location. | | |
| | Final WTG layout maximising separation from surrounding habitat values | • As outlined in Section 6.3.3 separation between WTG RSA and habitat features has been maximised such that the potential for bird and bat collision with operational turbines could be reduced to the fullest extent possible. The final WTG layout has resulted in:<br>– 25 % of WTGs with a blade strike likelihood rating of 'Unlikely'<br>– 38 % of WTGs with a blade strike likelihood rating of 'Rare'<br>– 29 % of WTGs with a blade strike likelihood rating of 'Possible'<br>– 8 % of WTGs with a blade strike likelihood rating of 'Probable' | Early project planning | Proponent |
| ***Routes that avoid or minimise impacts on biodiversity values*** | Selection of transport haul route for project components from Port Adelaide to the subject land | • The transport haul route selected will result in minimal impacts to biodiversity values, with three of the six corners where the swept path of the vehicles carrying the turbine blades will impact upon the road verge supporting no vegetation, one supporting only landscaped vegetation or non-indigenous Eucalypts (in Balranald township), and two impacting upon native vegetation where the vehicles turn onto and off Balranald-Moulamein Road. These impacts along Balranald-Moulamein Road are considered unavoidable. | Early project planning | Proponent |
| | Avoidance and minimisation through general project design. | • Avoidance and minimisation of impacts to native entities by prioritising cropped and disturbed land for proposed impacts.<br>• Use of existing tracks, roads and fencelines to delineate sections of the project and used preferentially for locating access tracks and linear infrastructure.<br>• As outlined above, route selection for access to Collector Substation #2 has minimised impacts to PCTs and TEC vegetation and associated habitats.<br>• Predictive detailed design at pre-approvals stage to understand development footprint requirements such as hardstands, crane laydowns and cable trench widths. | Early project planning | Proponent |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| **Prescribed and indirect impacts** | | | | |
| **Wind turbine strikes** | | | | |
| ***Design and selection of WTGs*** | Detailed WTG and footprint design | • Strict maintenance of lowest tip height to be above 49 m, to ensure a minimum 35 – 40 m separation from retained tree canopies, has informed turbine model optionality and TSIs.<br>• Completion of predictive detailed design to understand footprint specifics such as hardstands, crane laydowns and cable trench widths etc. has ensured impacts assessed are as close to actual area required as possible, minimising the need for overestimation of impacts assessed and approved. | Early project planning | Proponent |
| | Reduction in number of WTGs | • The reduction in the number of WTGs being proposed from the original 107 down to 96, has resulted in a 10 % (approx.) reduction in the potential for turbine strikes. | Early project planning | Proponent |
| | Consideration of WTG layout and locations to maximise gaps between RSA to reduce potential barrier effect through the site and minimise collision risk | • WTG locations have been determined with ongoing consideration for maximising the 'gaps' between RSA to allow for minimal impediment to bird and bat movements through and within the subject land.<br>• A 'nearest neighbour analysis' undertaken in GIS has determined that the average gap between RSAs along strings of turbines throughout the subject land is approximately 450 m. There is evidence that birds are known to fly through gaps in RSAs less than half this size (see Section 8.3.5), thus the current separation is considered to minimise potential barrier effects along turbine strings.<br>• When the overall layout is considered there are numerous gaps of over 1 km allowing movement along habitat corridors and through the wind farm. Further detail and analysis of WTG locations, pinch points and flyways is provided below (refer to Figure 15 and Table 46 below).<br>• To the south on Condoulpe Lake a large turbine free buffer zone has been designed to allow movement through the operational wind farm between WTG 30 and WTG 63, WTG 63 and WTG40, WTG 40 and WTG 58, and WTG 58 and WTG 55 – no gaps are less than 2 km between RSAs, with the average gaps in this location being approximately 2.8 km. the entire turbine free area comprises an area of over 15 $km^2$ (Figure 15). | Early project planning | Proponent |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | Further detail and analysis of WTG locations, pinch pints and flyways is provided below. | | |
| | Consideration of WTG layout and locations to maximise gaps between RSA to reduce potential barrier effect through the site and minimise collision risk | Specific WTGs relocated resulting in increased spacing between turbines include:<br>• Relocation of WTGs 37 and 38 increased the RSA separation from approximately 700 m to approximately 850 m.<br>• Relocation of WTGs 47 and 57 increased the RSA separation from approximately 680 m to approximately 900 m.<br>• Relocation of WTGs 62, 67 and 70 (and removal of one WTG in this area) increased the RSA separation from approximately 650 m, 500 m, 600 m, and 610 m between five turbines to approximately 1800 m, and 1400 m between two turbines. These turbines occur within the most vegetated portion of the subject land, and include some of the project's highest risk turbines (see Section 6.3), increasing RSA separation in this location illustrates considerable effort to minimise potential barrier effect ad collision risk impacts.<br>• Relocation of WTGs 81 and 82 have increased the RSA separation across Balranald-Moulamein Road and the High conservation values (LLS 2017) 19 Mile Balranald-Moulamein Road TSR from approximately 1400 m and 1700 m to 1600 and 1900 m. | Early project planning | Proponent |
| ***Operational impact minimisation strategies including technologies that would avoid or minimise impacts on biodiversity values*** | Seasonal (event-based) turbine curtailments. | • As per the key finding of the Nature Advisory analysis of potential waterbird collision years (Nature Advisory 2023e), a minimum 400 metre buffer of non-operational turbines (or other suitable mitigation measures) from flooded lake / wetland habitat will be maintained during flood events to minimise the potential for waterbird collisions at the times when these birds are abundant in the landscape. | Operational project | Proponent and operator |
| | Bird and Bat Adaptive Management Plan (BBAMP) and ongoing monitoring | • A BBAMP has been developed to accompany this BDAR (and EIS) that details the Proponent's commitment to ongoing impact minimisation over the operational life of the wind farm.<br>• The BBAMP provides details on how monitoring on the efficacy of impact mitigation strategies will be undertaken, along with responsive management triggers, that have been committed to by the Proponent. | Operational project | Proponent and operator |

| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | • This includes a schedule of proposed carcass searches utilising trained sniffer dogs (when available and given access to the land) focusing on an intensive search period over the initial period of operation (including at a minimum the first spring/summer season) whilst animals habituate to the presence of the turbines. This is then followed by regular ongoing searches of turbines for a period of three to five years, and then ongoing based on the results of the searches.<br>• Triggers have been developed and committed to, which based on the results of the carcass searches, will ensure that mitigation strategies (scaled based on the severity of the trigger) are promptly implemented and will arrest the occurrence of any unacceptable events (i.e. strikes). | | |
| | Impact minimisation and mitigation strategies | • Effective mitigation strategies include:<br>– Pest animal control to reduce the occurrence of foxes, cats and dogs, likely to scavenge microbat carcasses, potentially skewing the results or searches.<br>– Establishment of lighting systems that reduce insect (prey) attraction.<br>– Minimising availability of raptor perches on infrastructure within close proximity to turbines and overhead powerlines.<br>– Prompt animal carcass removal within the 200 m of a turbine (within 24 hrs of discovery) to minimise raptor scavenging opportunities and reviewed annually.<br>– Changes to land use practices such as stubble burning that might attract raptors.<br>– Annual reporting requiring accounting for all events over the preceding 12 months and reinvestigation the effectiveness of the current mitigation strategy. | Operational project | Proponent and operator |
| | Using technology to mitigate strikes | • Mitigation strategies include the ongoing opportunities for alternative actions to turbine curtailment such as audible and ultrasonic noise broadcasting to create avoidance behaviour, or the use of radar to induce turbine shutdowns, with such technologies expected to develop | Operational project | Proponent and operator |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | greatly over the life of the project. technology based impact minimisation strategies outlined in the BBAMP include:<br>– SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics.<br>– Consideration of radar (or optical sensor) or live camera technologies for automatic, reactive and temporary curtailment of turbines, such as the IdentiFlight avian detection system.<br>– Avoiding or limiting the use of artificial lighting (synchronising flashing red light if required) on turbines and other infrastructure within close proximity to turbines.<br>– Consider novel deterrent techniques related to blade visibility, such a painting one turbine blade black. | | |
| **Habitat connectivity** | | | | |
| ***Project design*** | Minimising impacts to habitat connectivity has been considered during project design | • The proposed design was sited, where possible within areas of non-native vegetation to avoid and minimise impacts to native vegetation.<br>• Impacts to key movement corridors and TSRs have been avoided and minimised to the fullest extent possible. This includes avoidance of impacts through redesign and setbacks from 10 Mile TSR along the project's western boundary, and minimisation of the size and number of crossing of Balranald-Moulamein Road impacting upon higher condition native vegetation within the Lillas Dam and Yards and the 19 Mile Balranald-Moulamein Road TSRs.<br>• As outlined above, substantial efforts have been made to maximise separation distances between WTG RSAs for the proposes of maintaining habitat connectivity for birds and bats through and within the wind farm.<br>• Habitat connectivity was considered, the proposed design was sited to reduce edge effect by avoiding and minimising large areas of native vegetation where possible.<br>• Existing tracks and disturbed areas were used to avoid and minimise impacts to less disturbed areas. | Early project planning | Proponent |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| **Waterbodies, water quality and hydrological processes** | | | | |
| ***Project design*** | Key waterbodies avoided during project design | • Key waterbodies and sources within the subject land have been avoided, including, Condoulpe Lake, Condoulpe Creek, The Forest Creek and majority of the watercourses feeding into Lake Talbetts directly west of the subject land.<br>• Where impacts to mapped watercourses are expected to occur, this has been limited to watercourses modified and disturbed from historic agricultural use and clearing. | Early project planning | Proponent |
| ***Construction and operational phase impact minimisation*** | Preparation of construction and operational phase management plans | • Soil and Erosion Control Management Plans will ensure indirect impacts to retained waterbodies will be prevented during the construction and operational phases of the project. | Operational project | Operator |
| **Vehicle strikes** | | | | |
| ***Construction and operational phase impact minimisation*** | Preparation of construction and operational phase management plans | • Biodiversity Management Plans will include specific considerations to reduce the potential for vehicle strikes to threatened species, such as speed limits and education (inductions) around the threatened species likely to be present within the site. | Operational project | Operator |
| **Habitat loss for local populations of biodiversity values** | | | | |
| ***Establishment of Biodiversity Stewardship Sites*** | Feasibility assessment of adjacent and nearby locations for potential establishment of a Biodiversity Stewardship Site. | • Two locations within 2.5 km of the subject land are under assessment for feasibility of establishment as Biodiversity Stewardship Sites to offset the impacts of the project.<br>• Once active management has commenced, the management plan will be implemented ensuring ongoing restoration and management of the lands proximal to the subject land, helping to compensate and minimise the impact of habitat loss for local populations of biodiversity values.<br>• Management actions will include regular weed control, rehabilitation and revegetation activities, erosion control, feral pest control, fire management, threatened species habitat management and regular monitoring. All these actions will prevent indirect degradation of the vegetation within areas connected to the Subject Land via natural corridors. | From project approval and in perpetuity within the Biodiversity Stewardship Site. | Proponent, Operator and Biodiversity Stewardship Site Owner |

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| Avoid and minimise component | Action | Outcome | Timing | Responsibility |
|---|---|---|---|---|
| | | – The establishment of a Biodiversity Stewardship Site will benefit all threatened and non-threatened species known or predicted to occur within the retained portions of the Subject Land. | | |

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## WTG locations, pinch points and flyways

Figure 15 and Table 46 below illustrate the potential pinch points where birds and bats may come closer to RSA when flying through or within the operational wind farm, increasing the potential for collision. Black lines shown on the figure are potential flight paths birds and bats are likely to take when avoiding rows of turbines and are essentially being 'funnelled' through the wind farm and towards pinch points. The coloured bars represent locations where birds and bats may come into closest proximity to turbines' RSA whilst moving along the nominal flight paths, and the circles represent the worst-case scenario 182 metre diameter RSA. This diameter was chosen to ensure consistency with the risk assessment undertaken in Section 6.3.3, which outlines the different turbine models under consideration. Table 46 provides approximate distances between each set of turbines, and these distances represent the airspace through which the bids and bats can move without coming into contact with turbine blades.

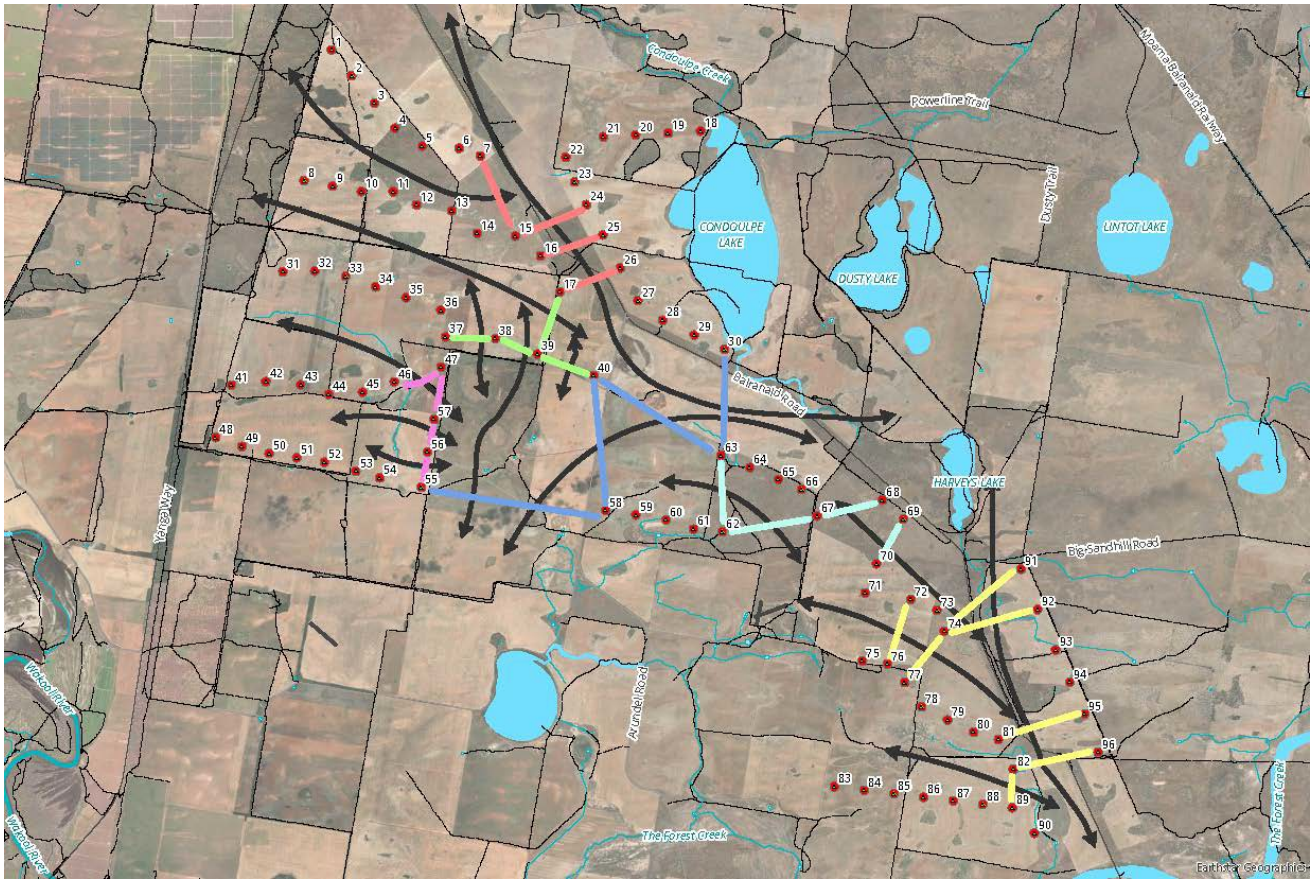



**Figure 15 WTG location, pinch points and flyways**

**Table 46 WTG separation distances (row colourings match RSA gaps displayed in above figure)**

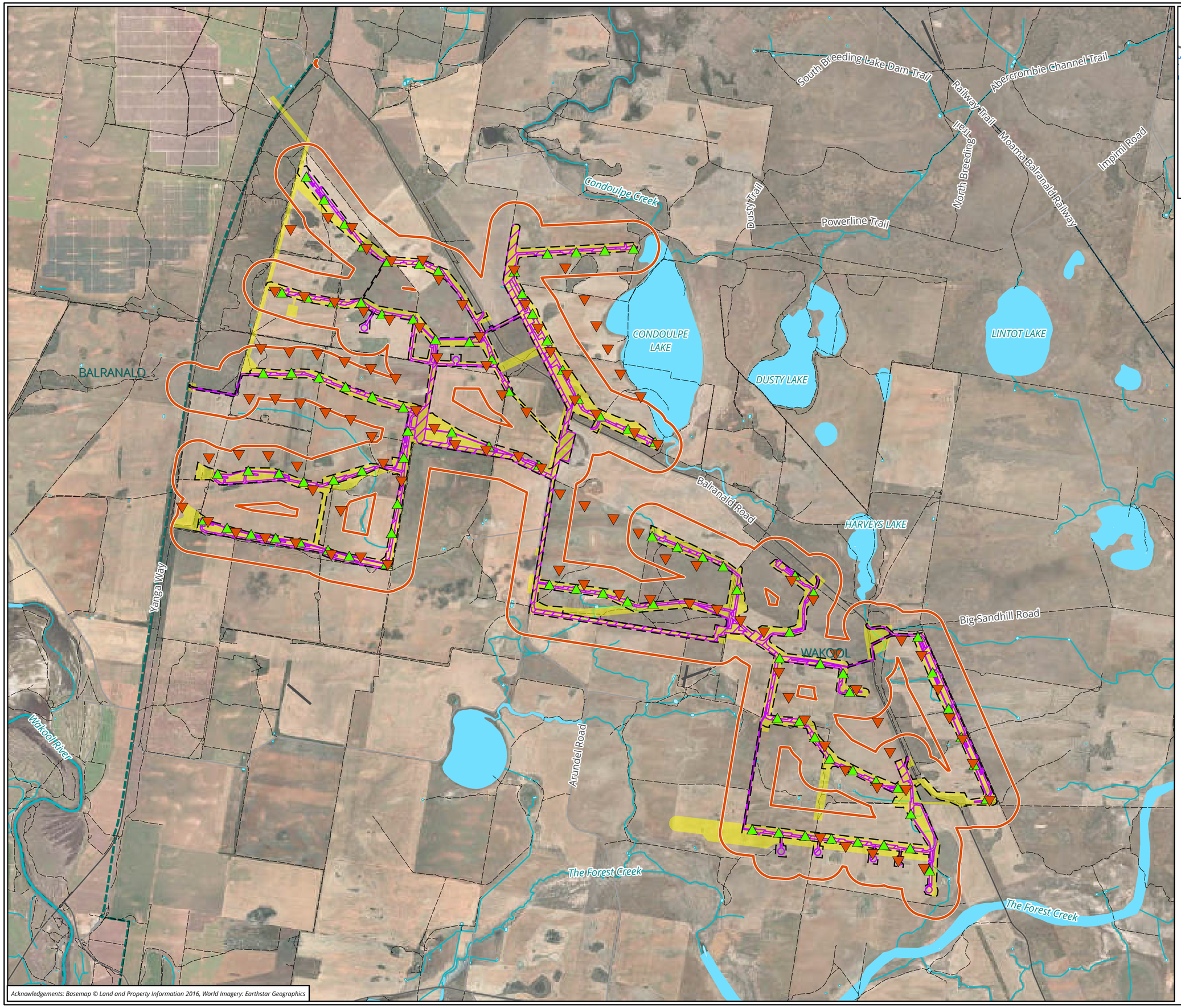
| From WTG | To WTG | RSA gap distance (m) | Avg gap at pinch point (m) |
|---|---|---|---|
| 17 | 26 | 1162 | - |
| 16 | 25 | 1169 | - |
| 15 | 24 | 1400 | - |
| 7 | 15 | 1600 | 1332.75 |
| 69 | 70 | 902 | - |
| 67 | 68 | 1207 | - |
| 62 | 63 | 1380 | - |

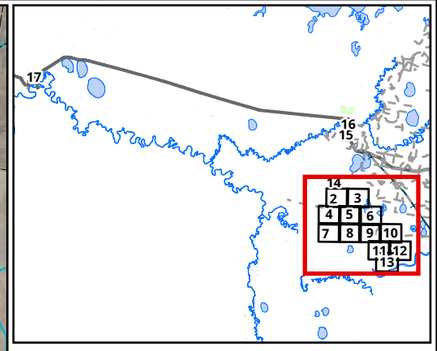
| From WTG | To WTG | RSA gap distance (m) | Avg gap at pinch point (m) |
|---|---|---|---|
| 62 | 67 | 1797 | 1321.5 |
| 38 | 39 | 744 | - |
| 37 | 38 | 844 | - |
| 39 | 40 | 1059 | - |
| 17 | 39 | 1182 | 957.25 |
| 82 | 89 | 620 | - |
| 74 | 77 | 1170 | - |
| 72 | 76 | 1231 | - |
| 82 | 96 | 1599 | - |
| 81 | 95 | 1675 | - |
| 74 | 92 | 1783 | - |
| 74 | 91 | 1871 | 1421.286 |
| 56 | 57 | 521 | - |
| 55 | 56 | 559 | - |
| 46 | 47 | 844 | - |
| 57 | 47 | 905 | 707.25 |
| 58 | 40 | 2587 | - |
| 40 | 63 | 2907 | - |
| 55 | 58 | 3607 | - |
| 30 | 63 | 2003 | 2776 |

It can be seen from Figure 15 and Table 46 above that pinch point separation distances between RSAs are no less than 520 metres between rows of turbines, and approximately 70 % of the locations included above RSA separation gaps are greater than 1 kilometre. Average RSA separation along the nominal flight paths, though pinch points range from approximately 700 metres to 2.7 kilometres, with three of the six areas analysed comprising gaps of over 1 kilometre.

Barrier effect and collision risk have been minimised as a result of the proposed layout of WTGs, with substantial areas of airspace remaining available for birds and bats to move through once the wind farm becomes operational. The south-eastern potion of the wind farm encompasses the area where turbines remain closest together and RSA separation is lowest (WTGs 46 – 55), however bird and bat movement through this area are unlikely to be as common as elsewhere within the subject land due to a lack of habitat features providing or supporting flyways compared to elsewhere within and surround the subject land (Figure 15).

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.1 Alternate options and avoidance**

0 1,000 2,000 3,000 4,000 N

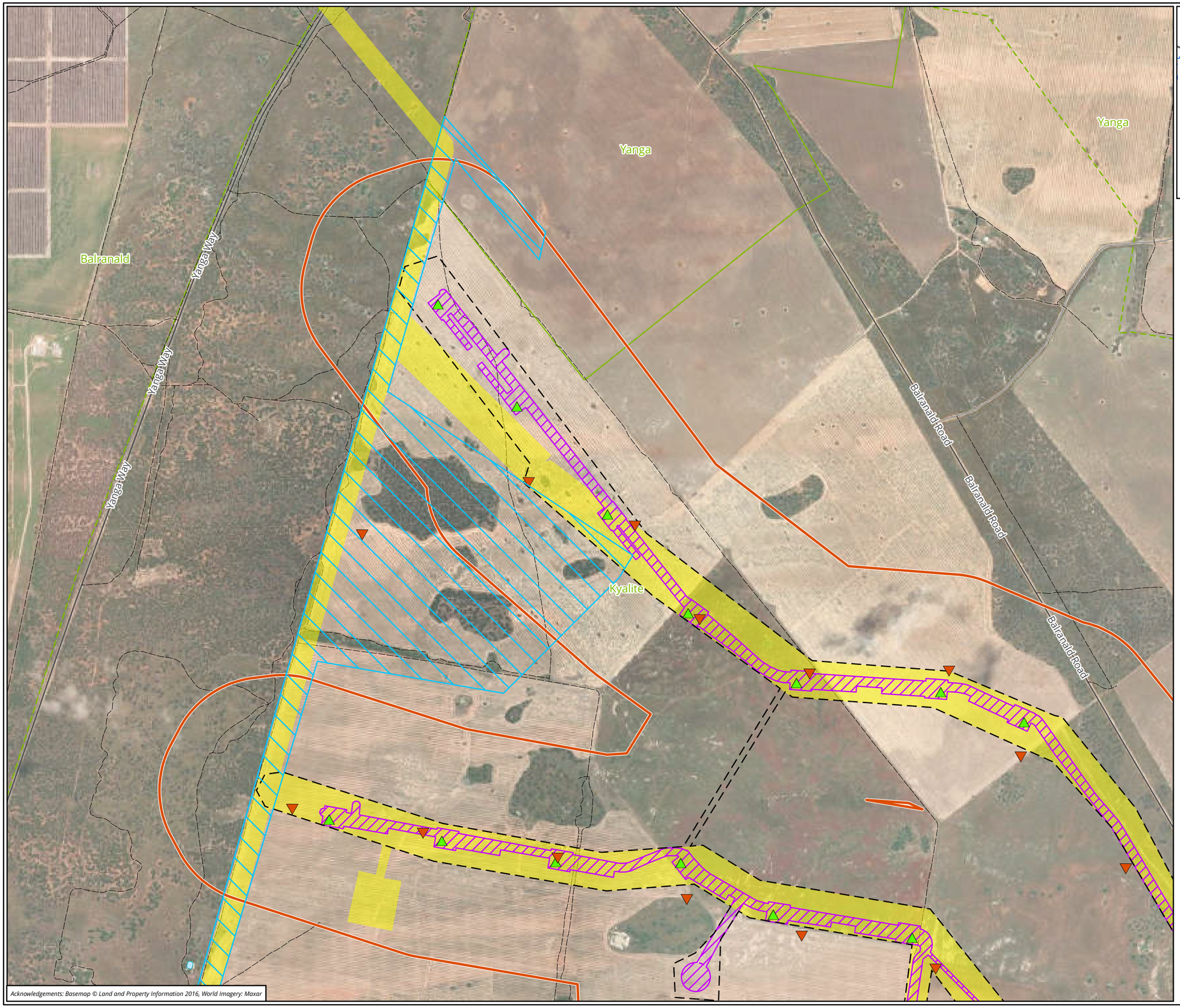
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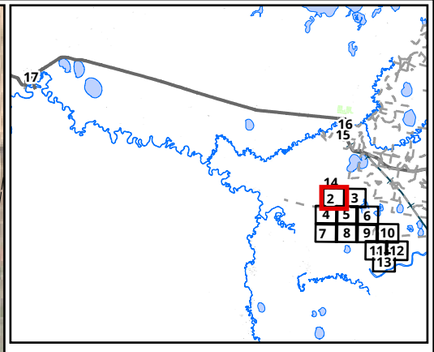
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*Coordinate System: GDA2020 MGA Zone 54*

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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Regent Parrot habitat buffer
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.2 Alternate options and avoidance**

0 230 460 690 920 N

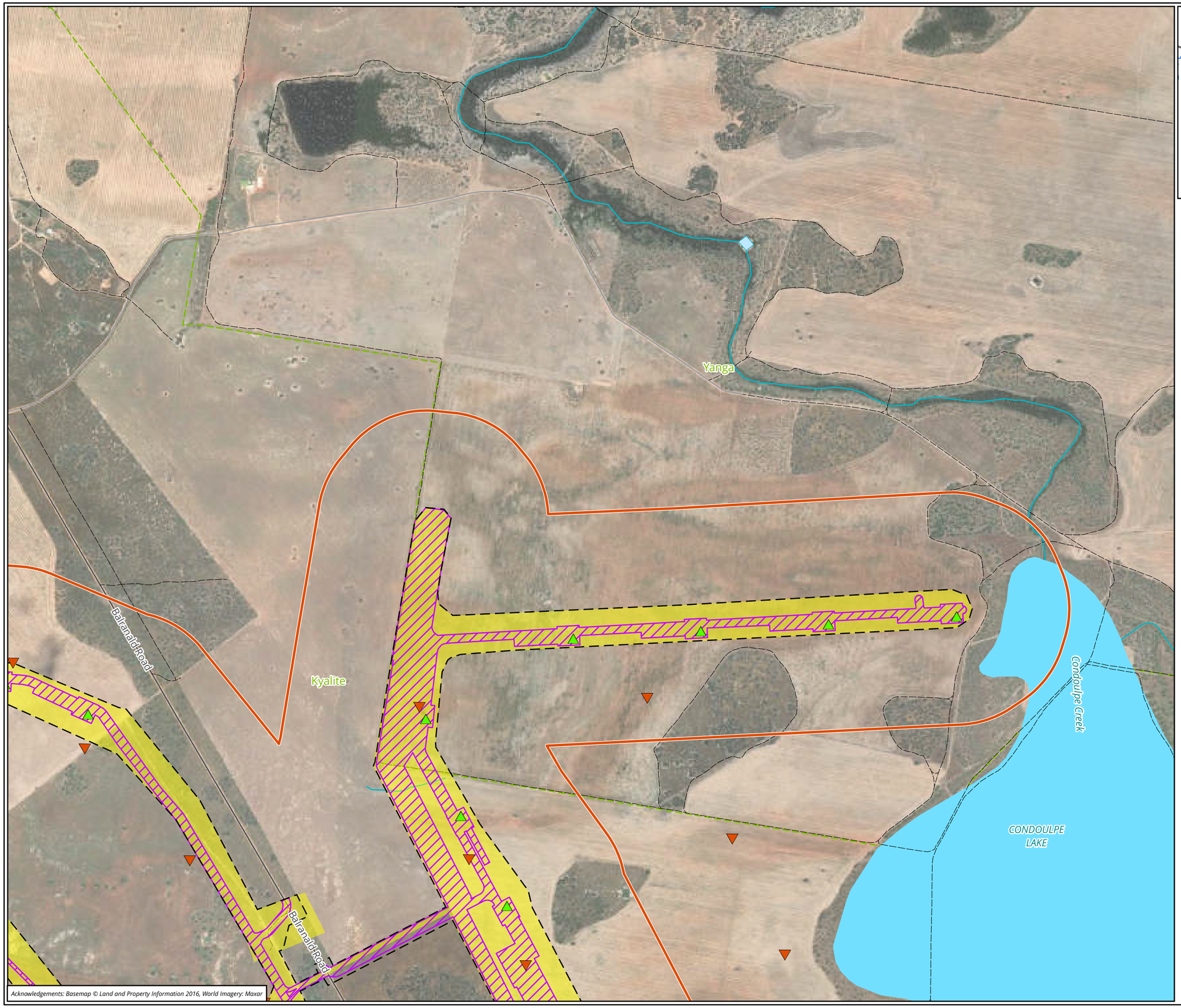
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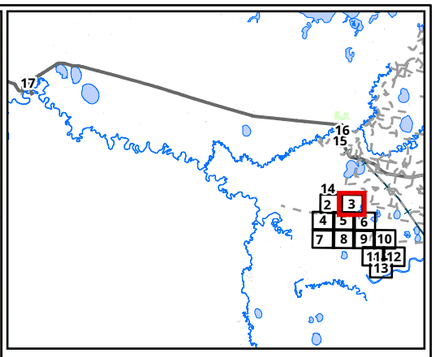
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

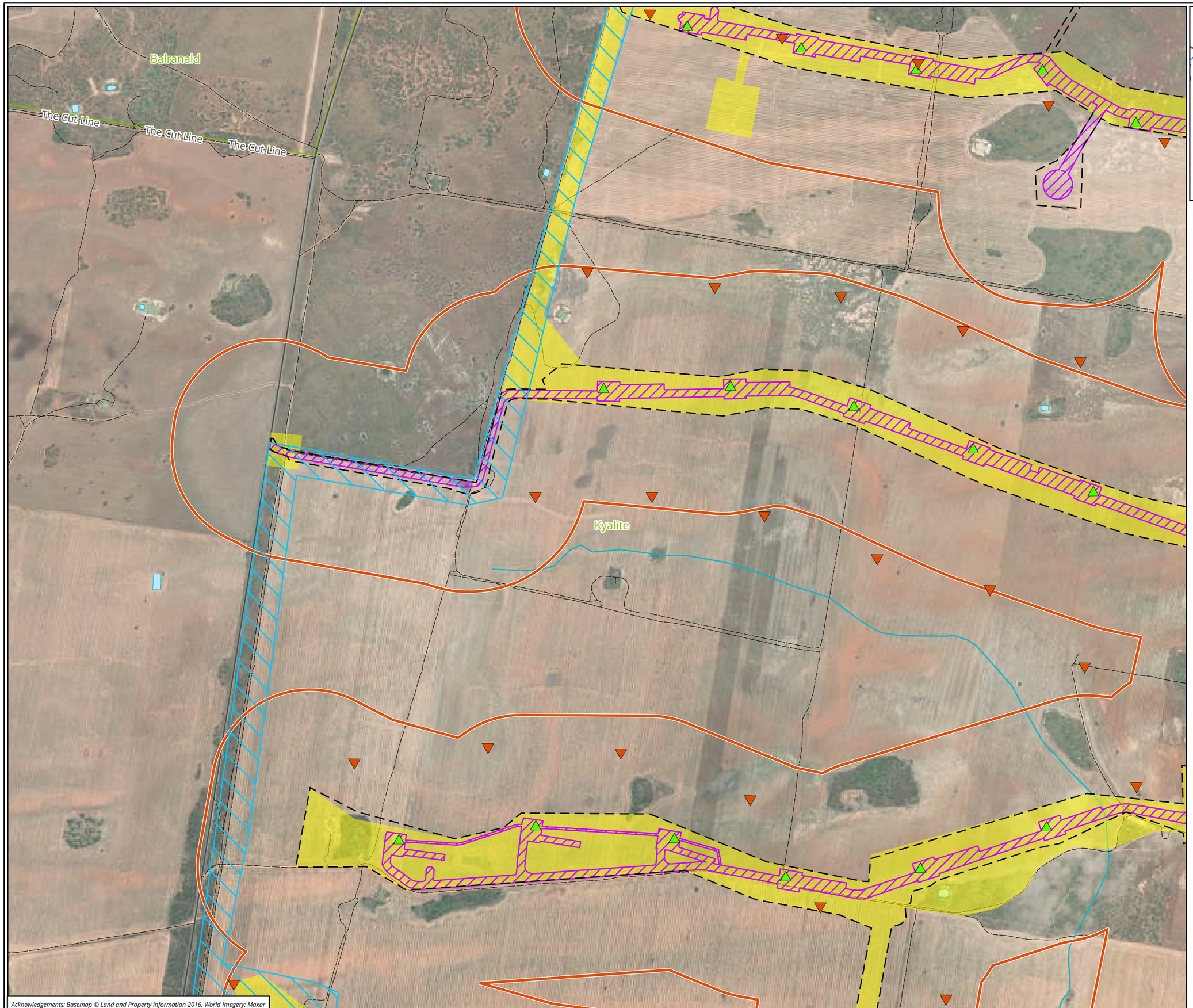
**Figure 16.3 Alternate options and avoidance**

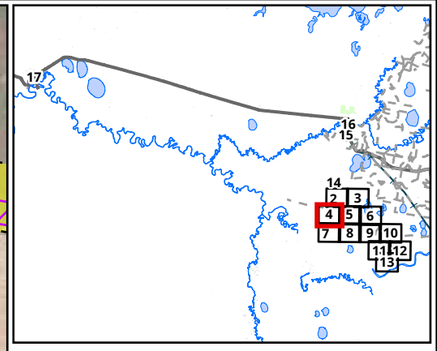
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Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Regent Parrot habitat buffer
- Current 96 WTG layout
- Project scoping 107 WTG

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

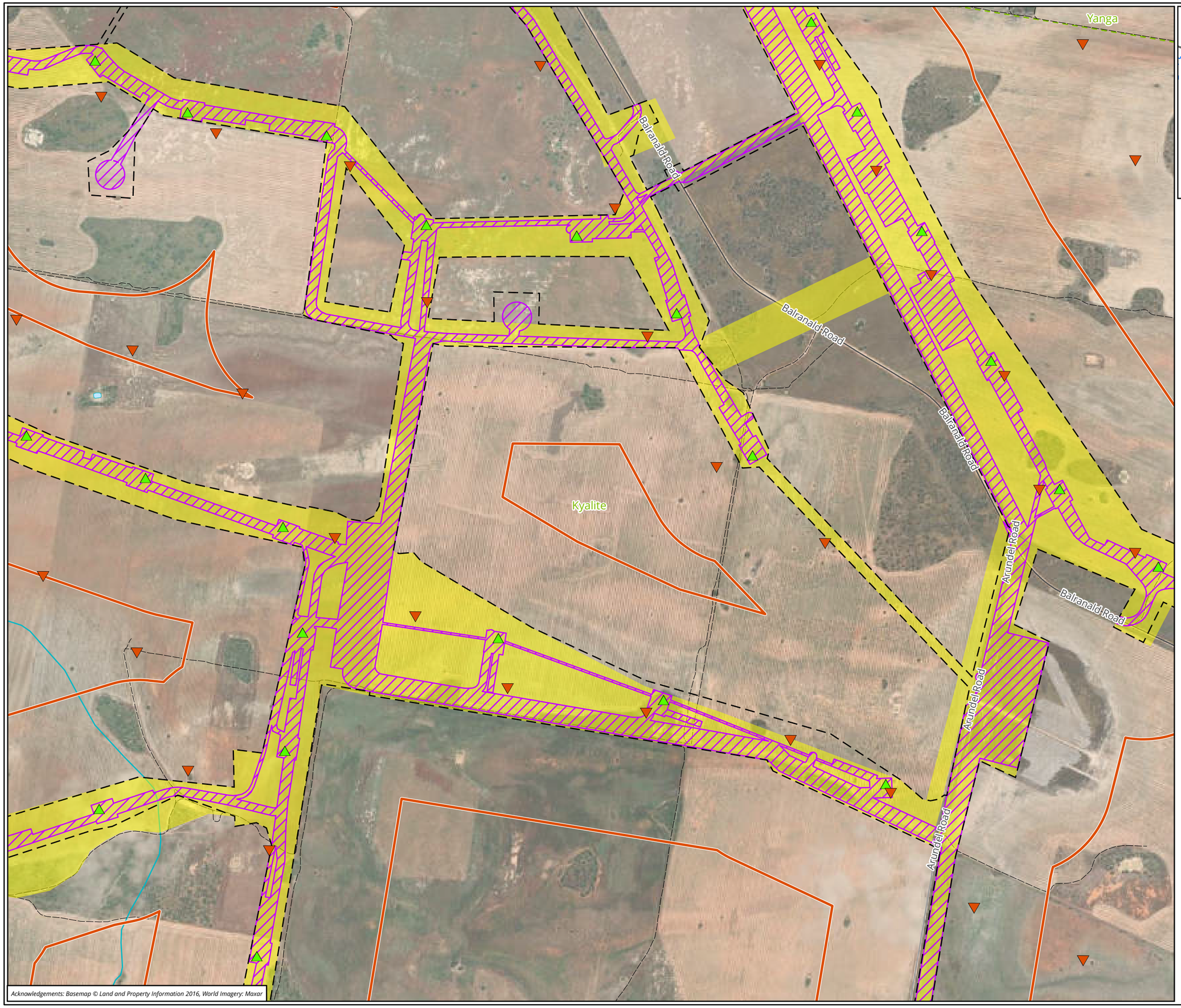
## Figure 16.4 Alternate options and avoidance

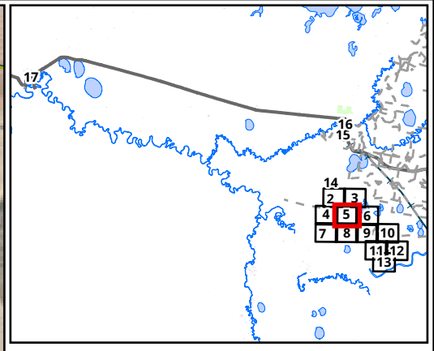
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

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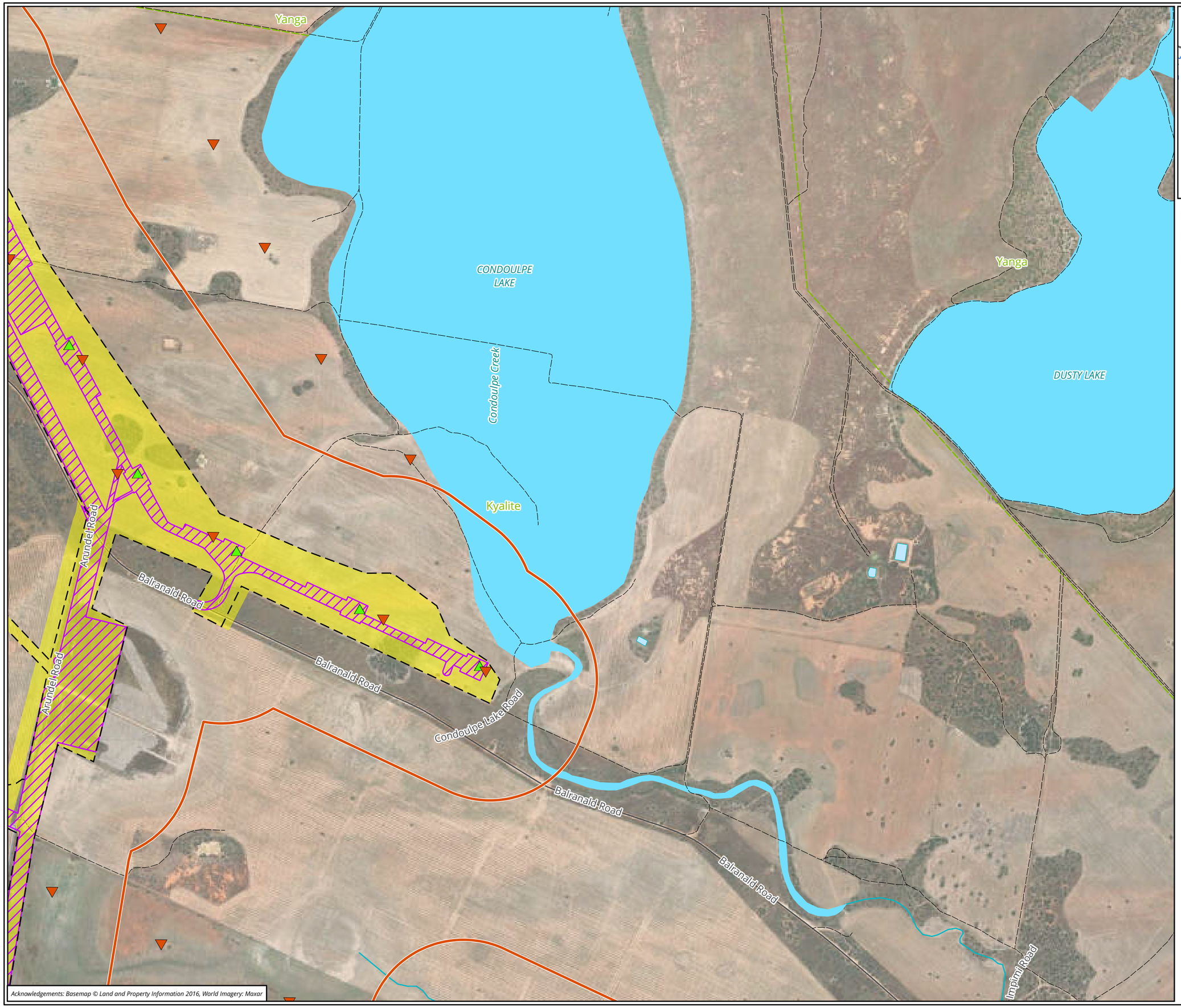
**Figure 16.5 Alternate options and avoidance**

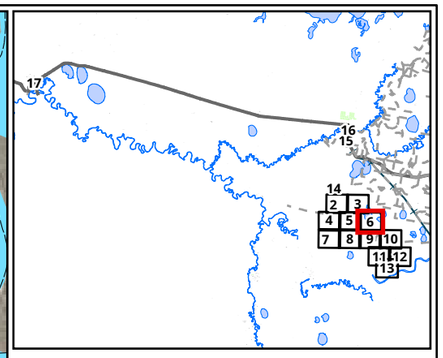
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Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.6 Alternate options and avoidance**

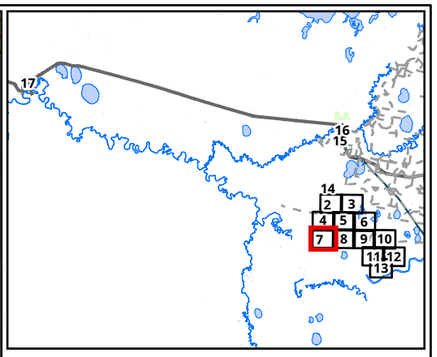
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Regent Parrot habitat buffer
- Current 96 WTG layout
- Project scoping 107 WTG

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

## Figure 16.7 Alternate options and avoidance

0 230 460 690 920 N

Meters

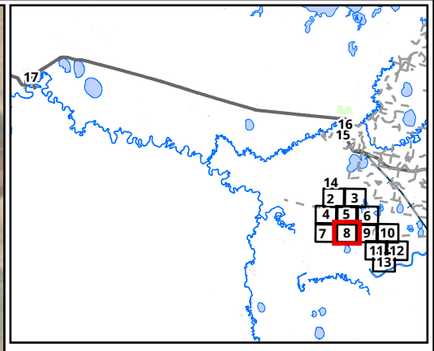
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*Coordinate System:*
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Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.8 Alternate options and avoidance**

0 230 460 690 920 N

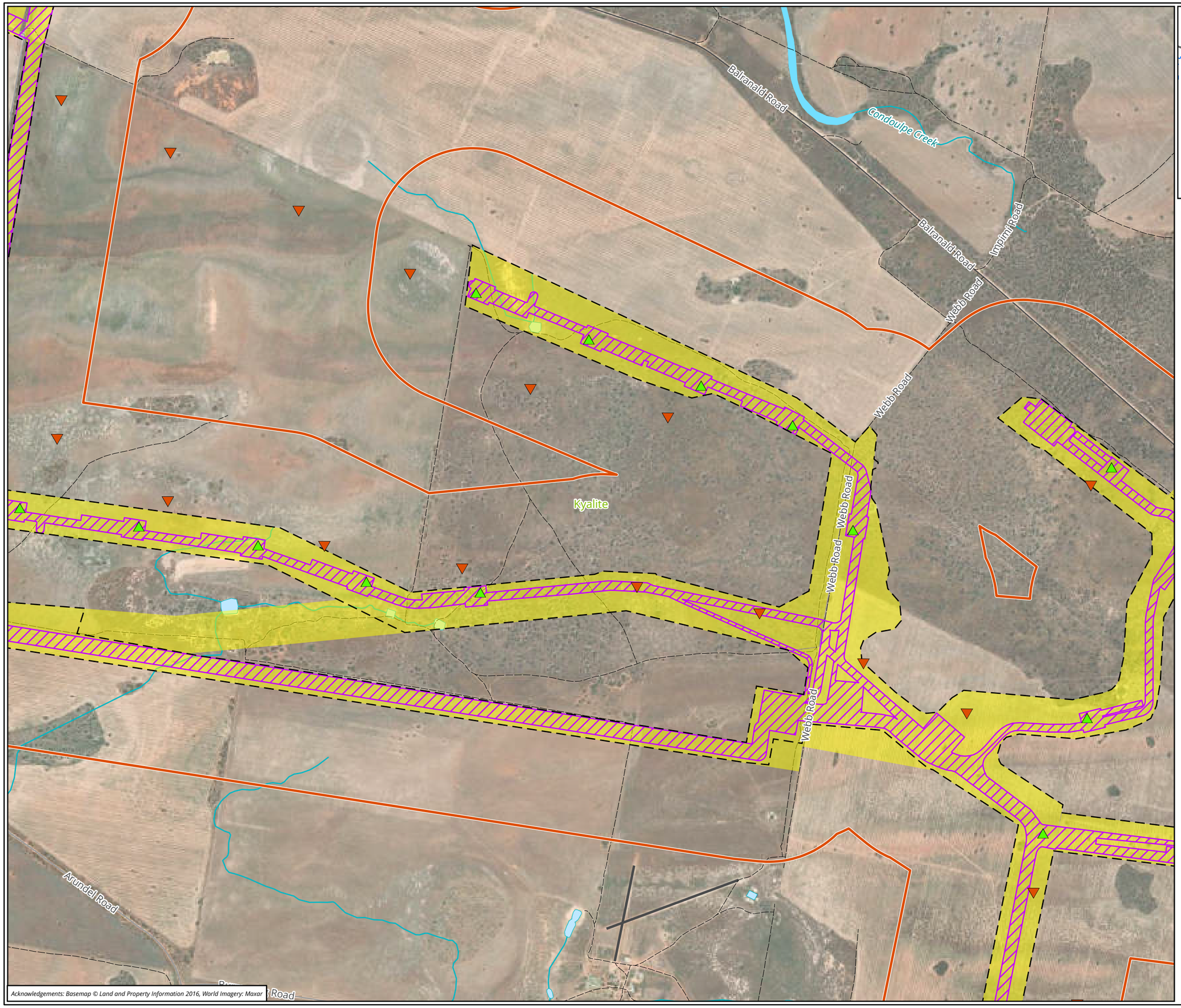
Meters

Scale: 1:18,000 @ A3

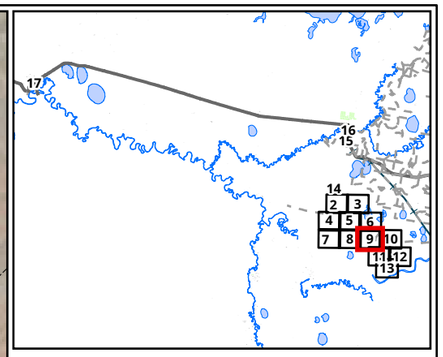
*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.9 Alternate options and avoidance**

0 230 460 690 920

Meters

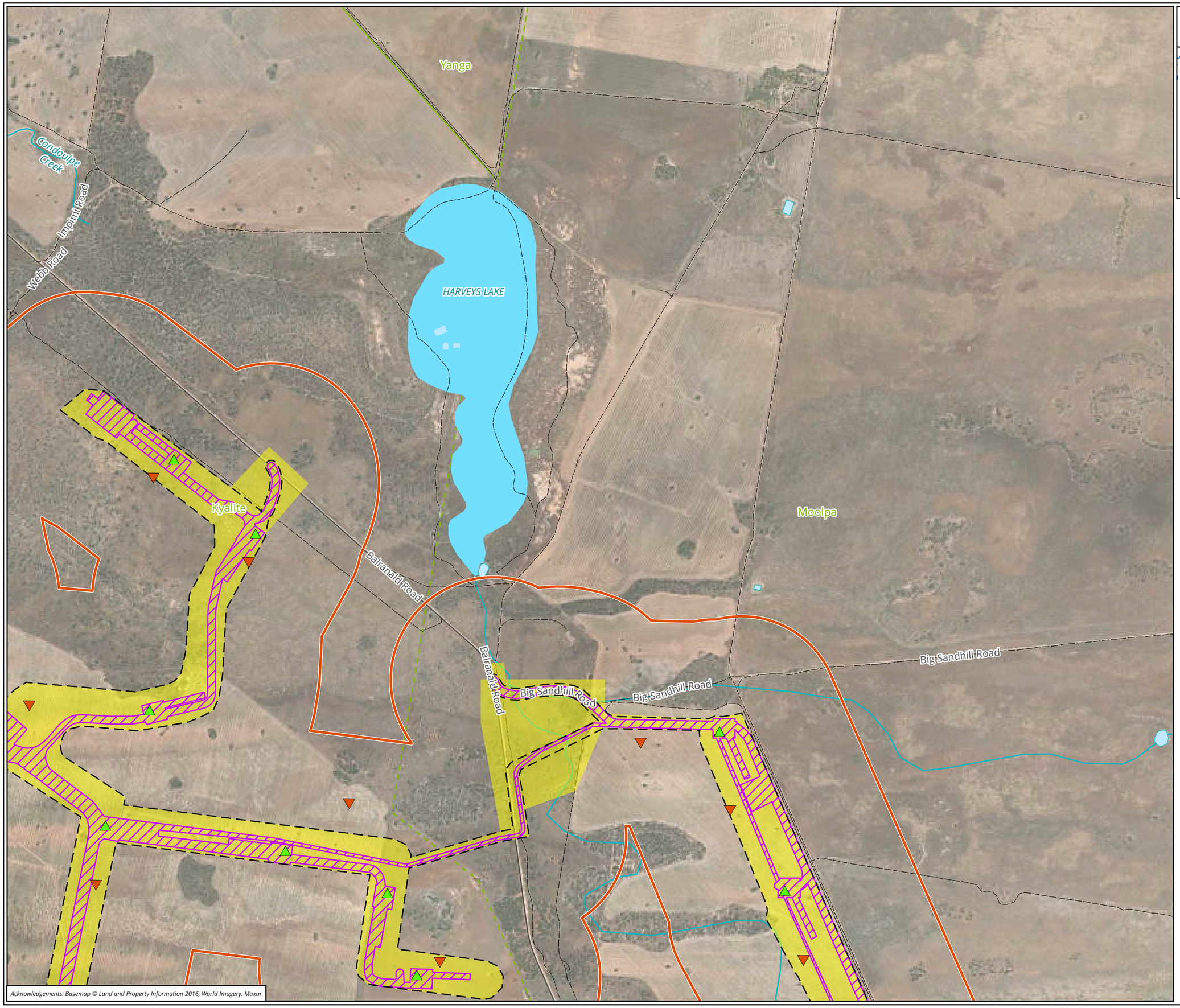
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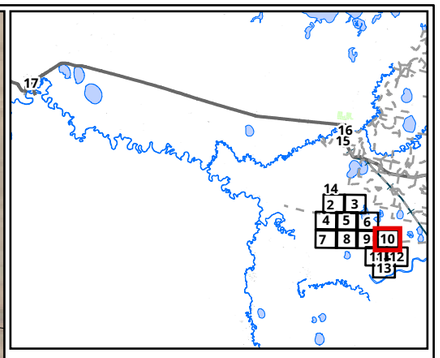
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.10 Alternate options and avoidance**

0 230 460 690 920 N

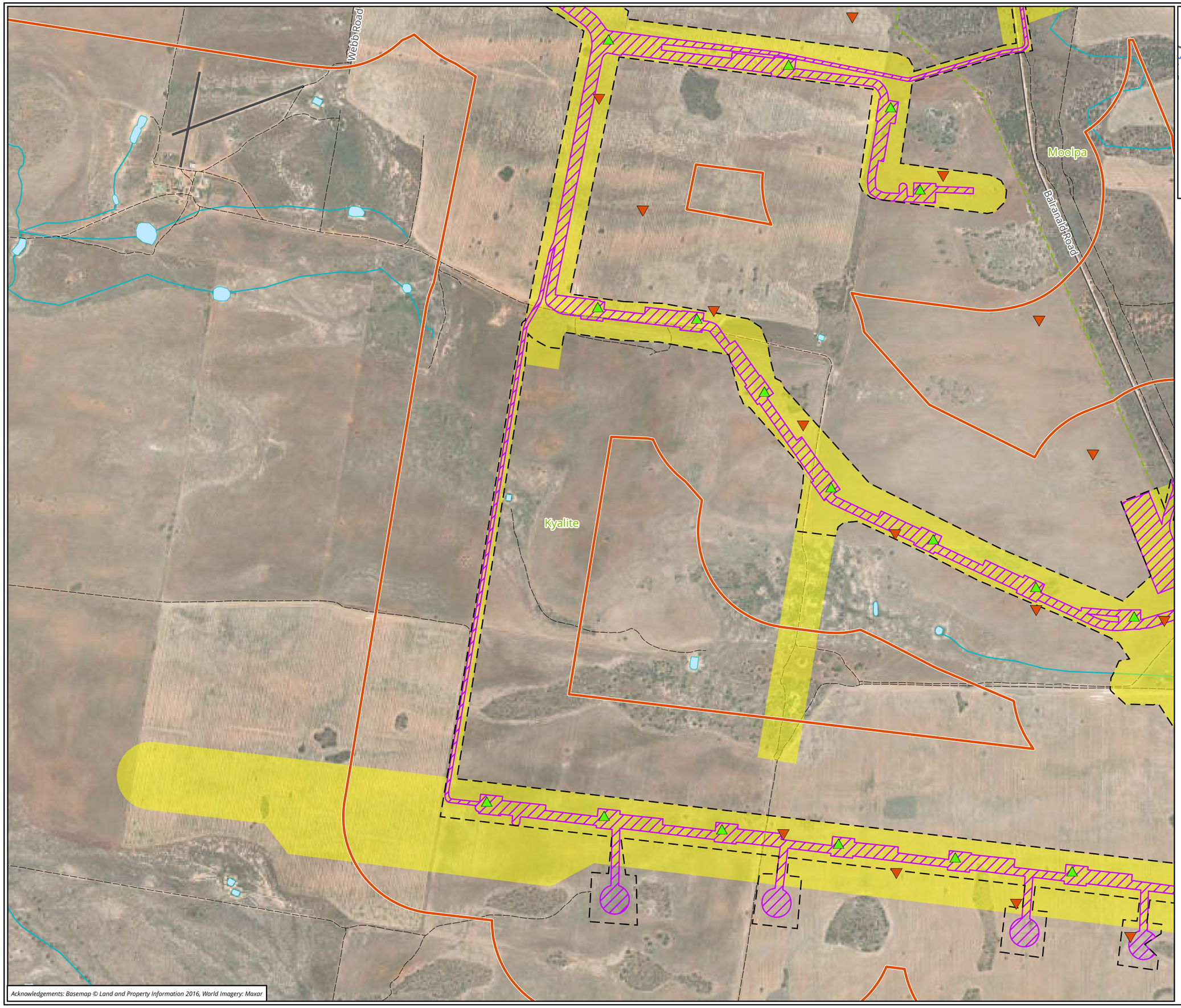
Meters

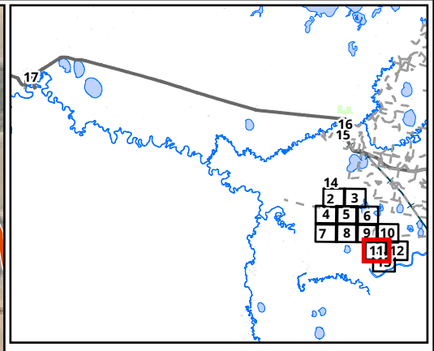
Scale: 1:18,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.11 Alternate options and avoidance**

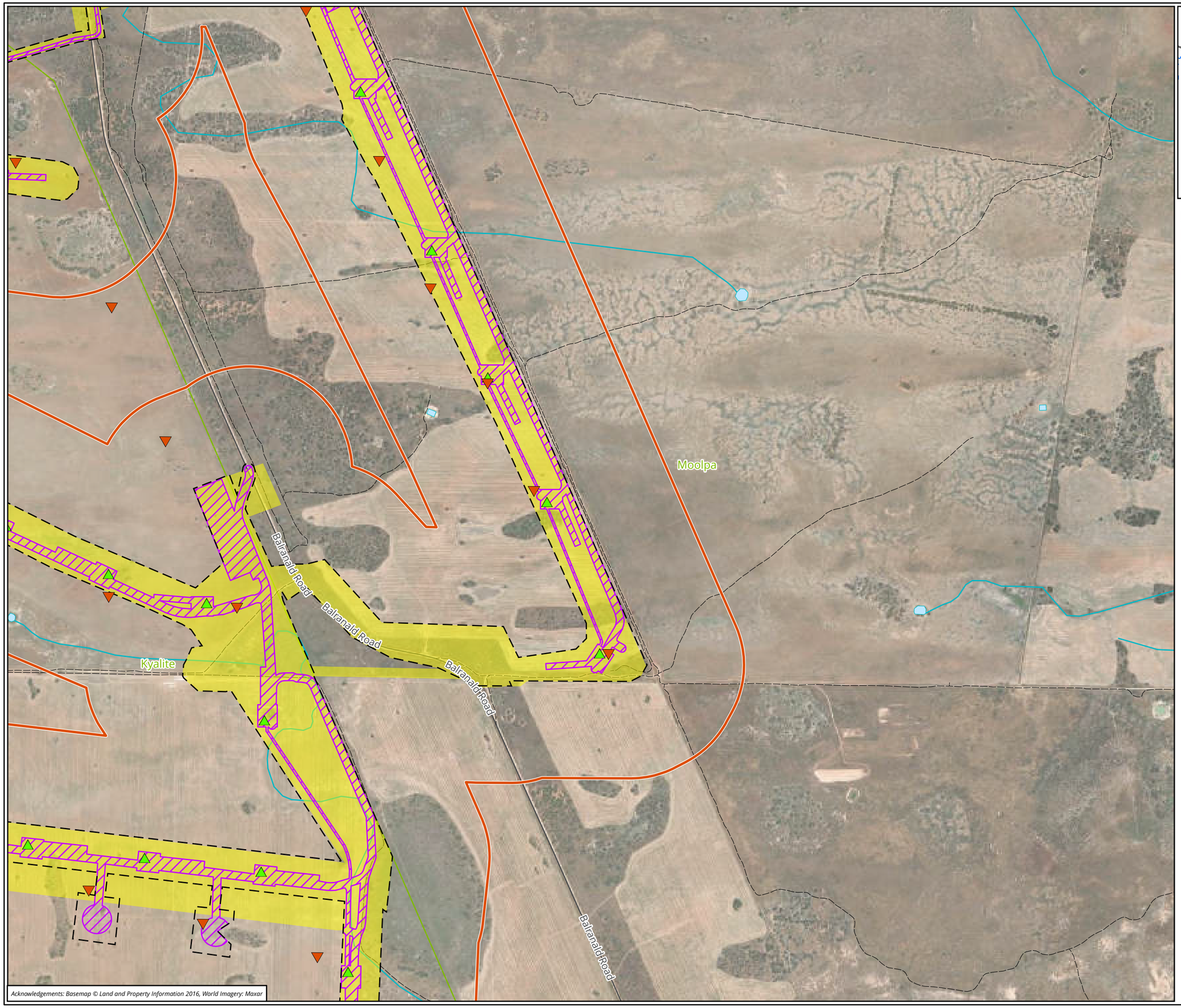
0 230 460 690 920 N

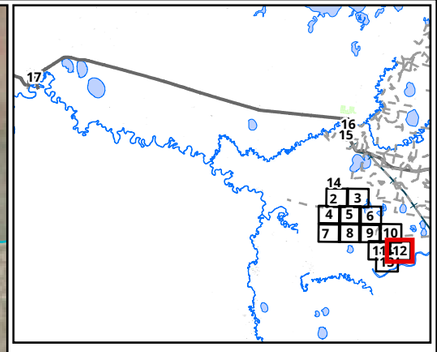
Meters
Scale: 1:18,000 @ A3
*Coordinate System:*
*GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

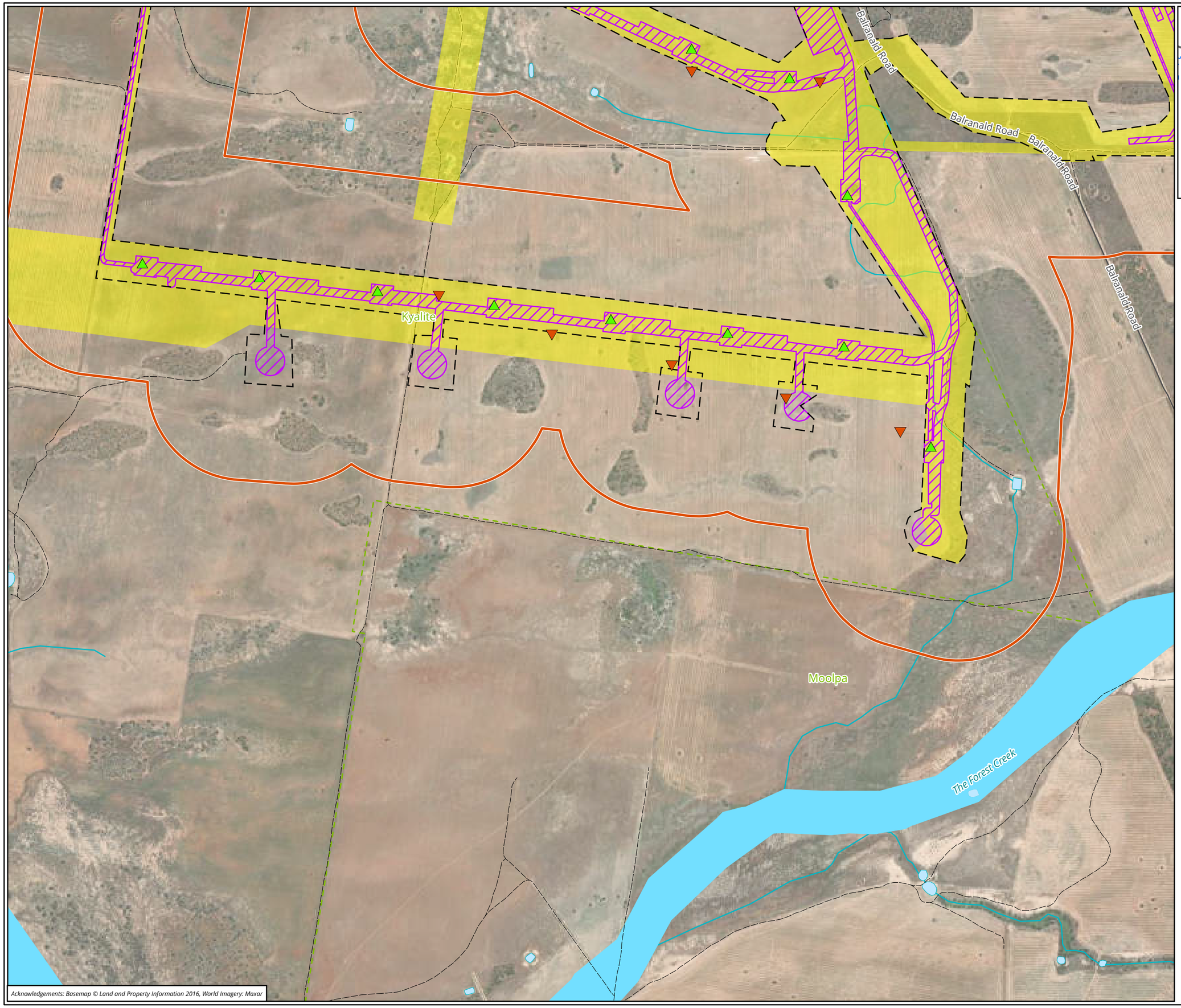
**Figure 16.12 Alternate options and avoidance**

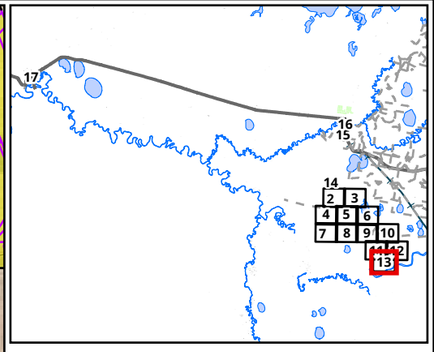
0 230 460 690 920 N

Meters
Scale: 1:18,000 @ A3
*Coordinate System:*
*GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development corridor
- Development footprint
- Alternative development corridors / footprints considered
- Current 96 WTG layout
- Project scoping 107 WTG

**Figure 16.13 Alternate options and avoidance**

0 230 460 690 920 N

Meters

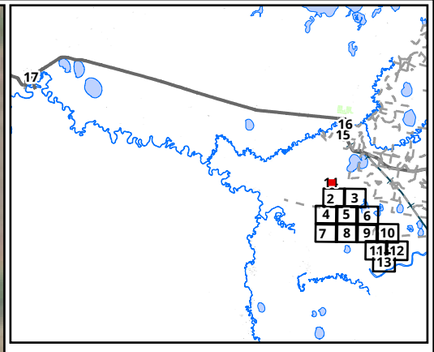
Scale: 1:18,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development footprint

## Figure 16.14 Alternate options and avoidance

0 25 50 75 100 N

Meters

Scale: 1:2,000 @ A3

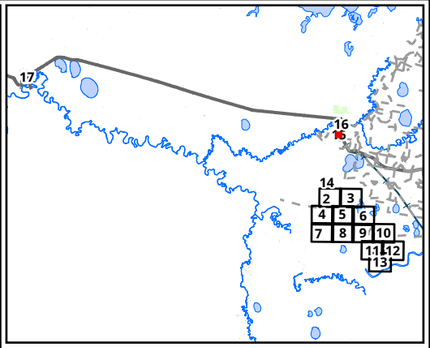
*Coordinate System:*
*GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative

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**Legend**

- Subject land
- Development footprint

**Figure 16.15 Alternate options and avoidance**

0 25 50 75 100 N

Meters

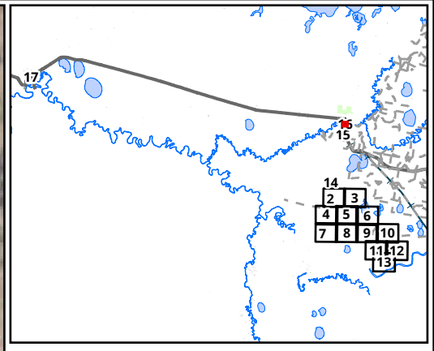
Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative




**Legend**

- Subject land
- Development footprint

**Figure 16.16 Alternate options and avoidance**

0 25 50 75 100 N

Meters

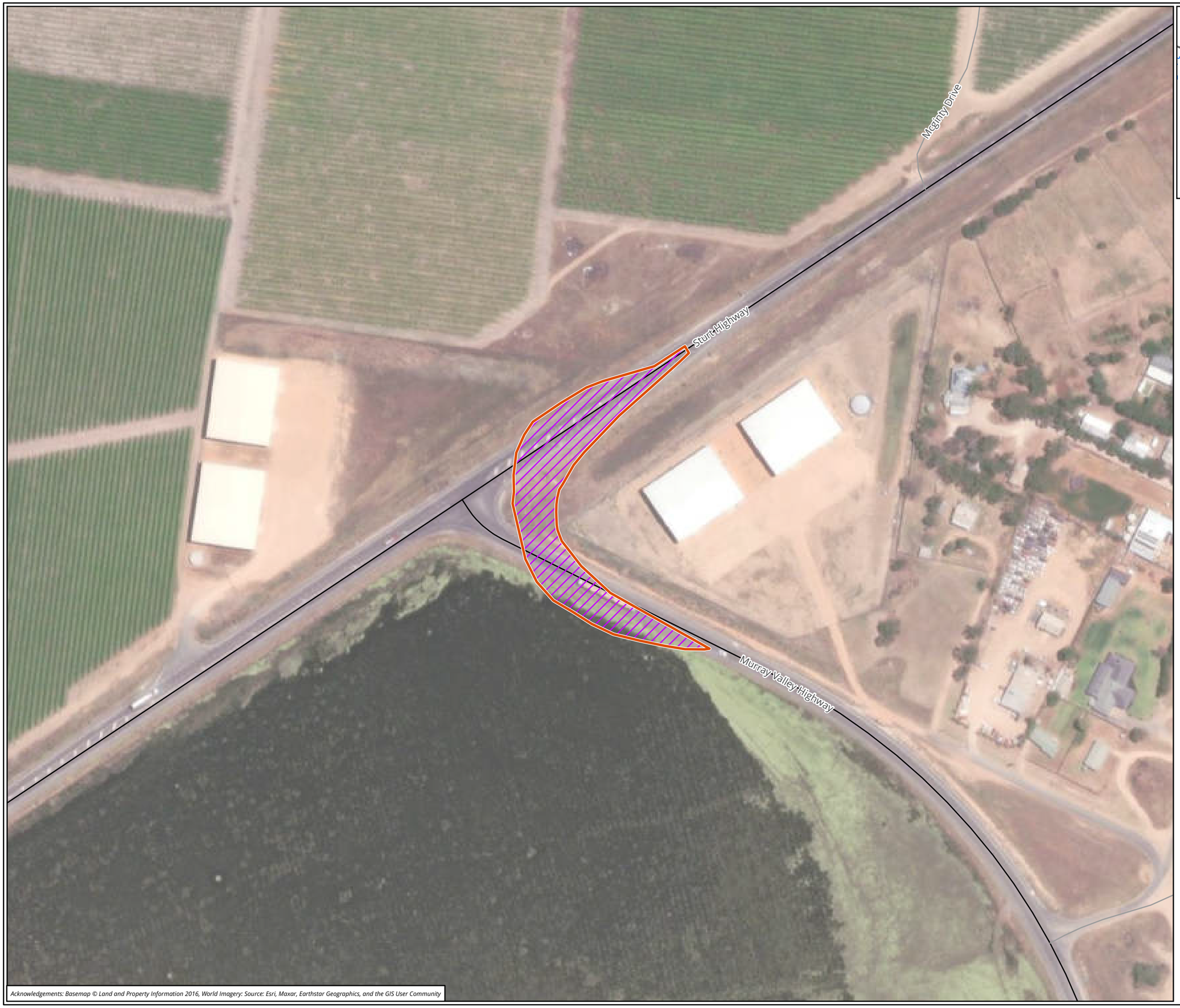
Scale: 1:2,000 @ A3

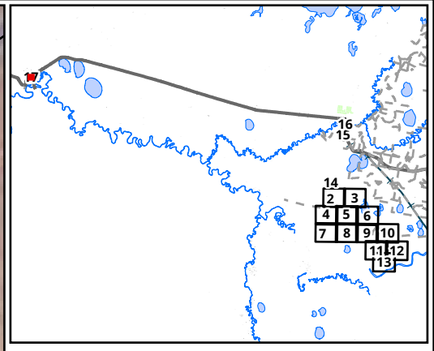
*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative

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**Legend**

- Subject land
- Development footprint

**Figure 16.17 Alternate options and avoidance**

0 25 50 75 100 N

Meters

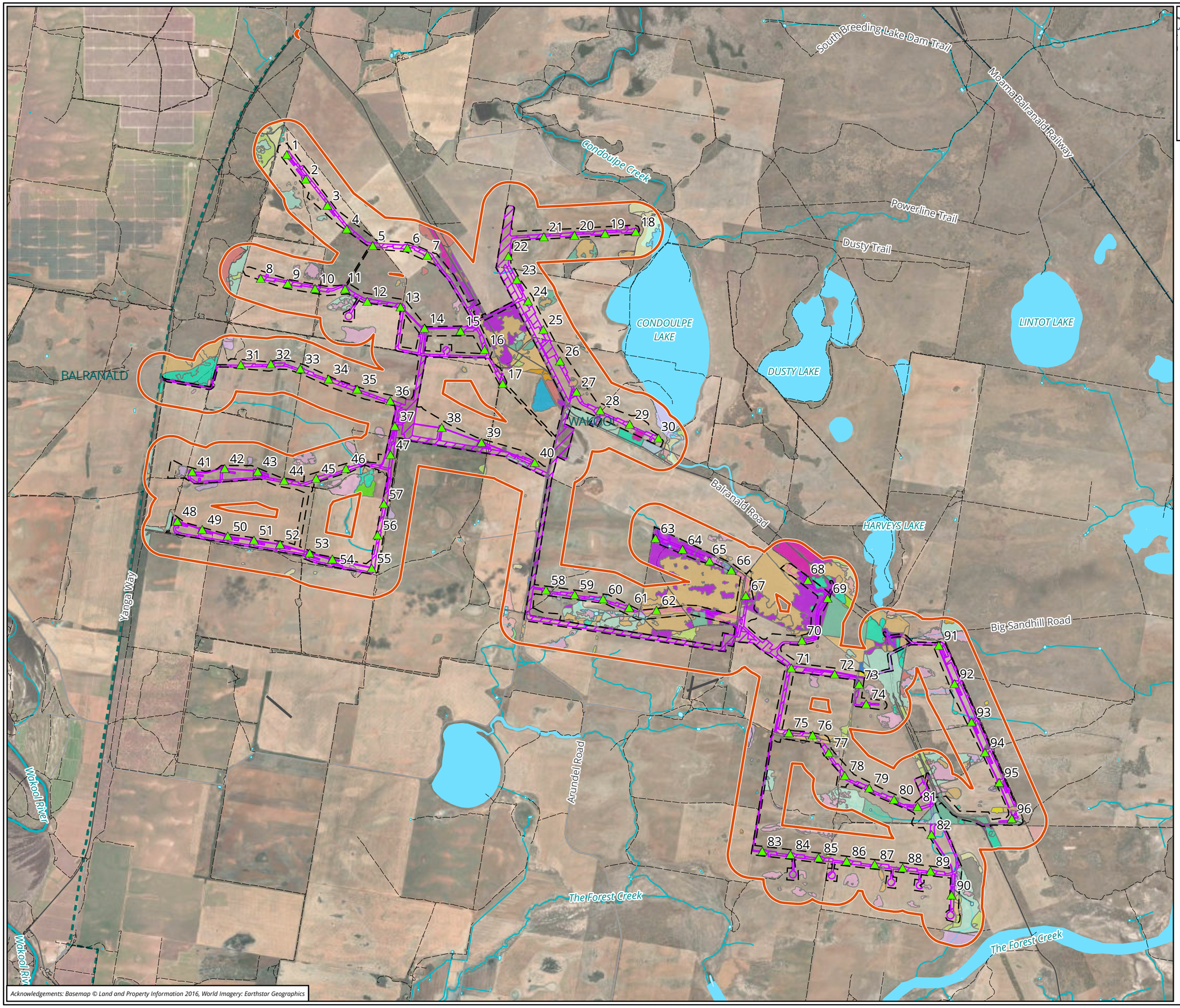
Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F16_Alternative

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Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics

**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Vegetation zones**

- 15 - DNG
- 15 - High
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - High
- 16 - Low
- 16 - Moderate
- 16 - Paddock trees
- 21 - Low
- 21 - Moderate
- 23 - DNG
- 23 - High
- 23 - Moderate
- 57 - Low
- 57 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 165 - Moderate
- 170 - DNG
- 170 - High
- 170 - Low
- 170 - Moderate
- 170 - Paddock trees
- 238 - Moderate

**Figure 17.1 Final development footprint**

0 750 1,500 2,250 3,000

Meters

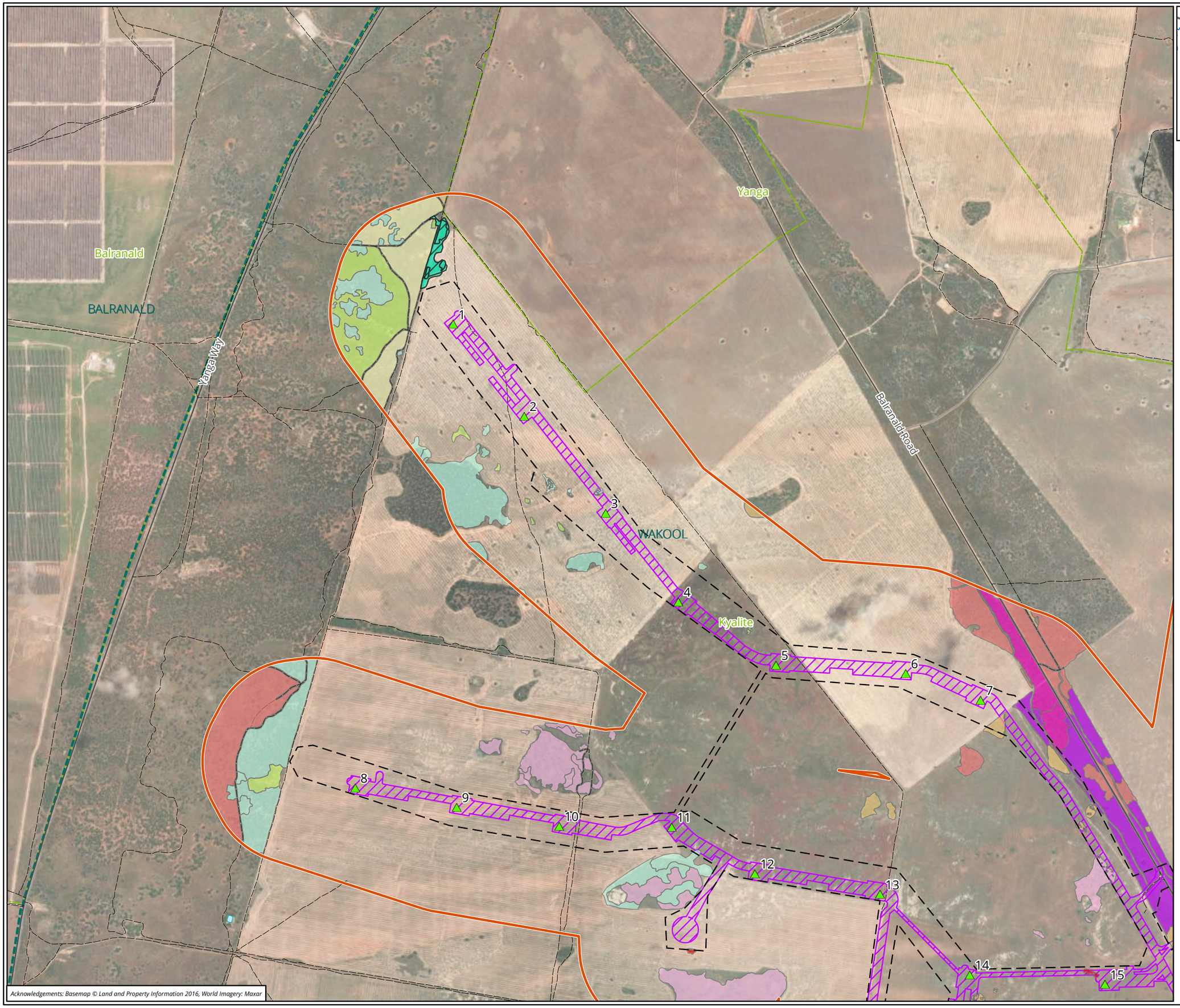
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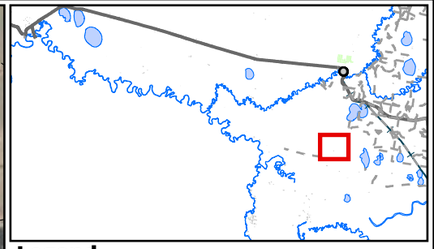
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland

**Vegetation zones**

- 15 - Moderate
- 16 - DNG
- 16 - Moderate
- 16 - Paddock trees
- 23 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 170 - DNG
- 170 - High
- 170 - Low
- 170 - Moderate

**Figure 17.2 Final development footprint**

0 200 400 600 800

Meters

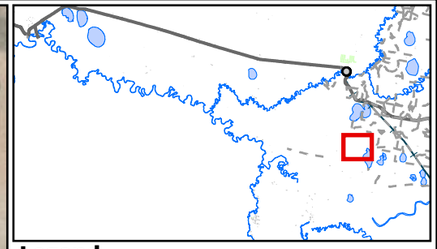
Scale: 1:20,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Vegetation zones**

- 15 - Low
- 16 - Moderate
- 16 - Paddock trees
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 165 - Moderate
- 170 - DNG
- 170 - Moderate

Yanga

WAKOOL

Kyalite

Balranald Road

Condoulpe Creek

CONDOULPE LAKE

6 7 13 14 15 18 19 20 21 22 23 24 25

**Figure 17.3 Final development footprint**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

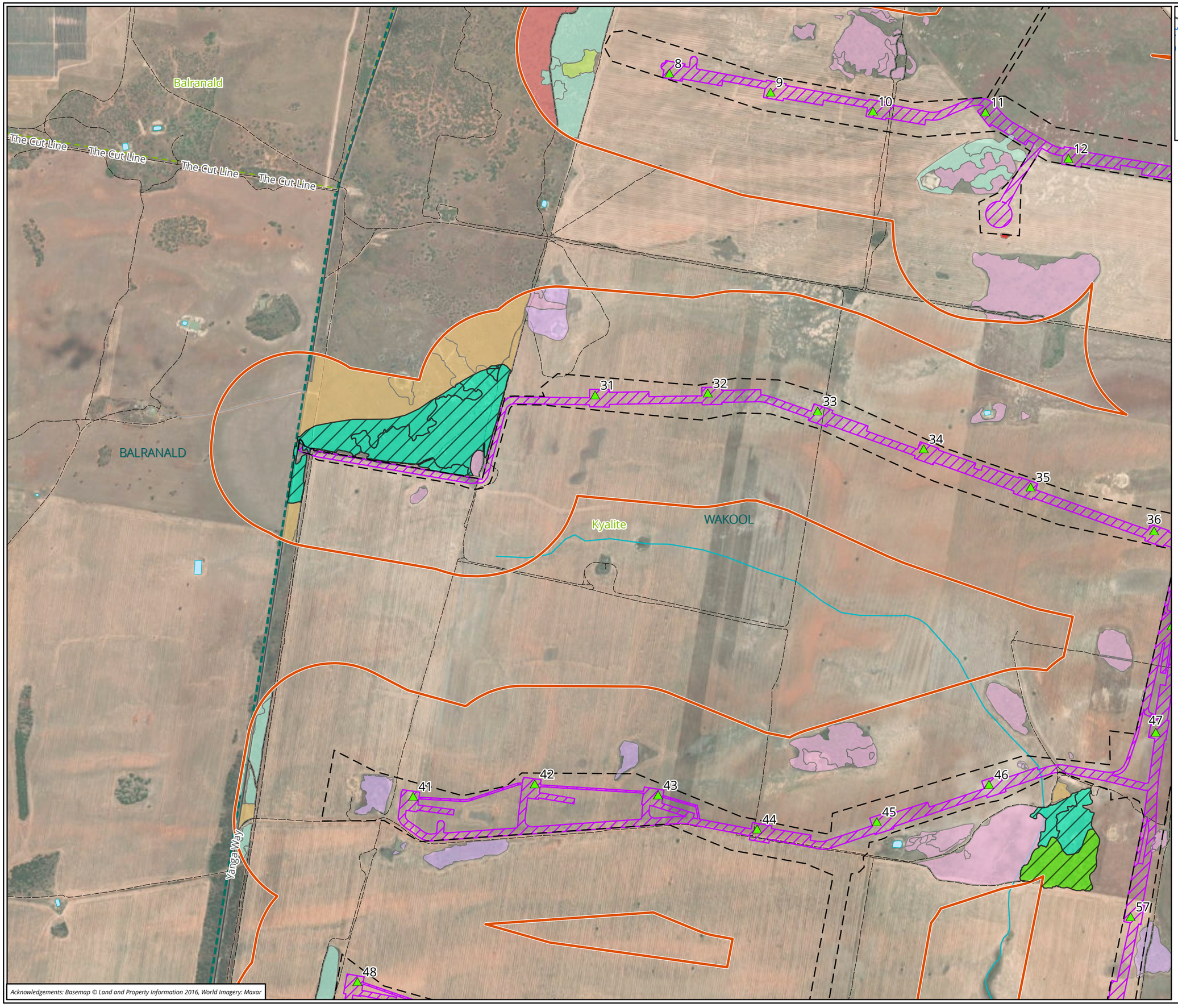
*Coordinate System: GDA2020 MGA Zone 54*

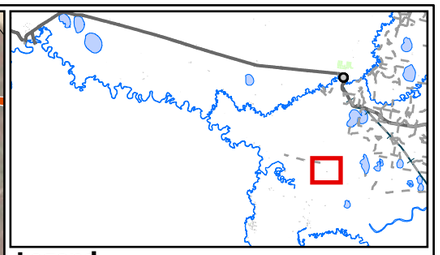
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biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland

**Vegetation zones**

- 16 - DNG
- 16 - Low
- 16 - Moderate
- 16 - Paddock trees
- 23 - High
- 23 - Moderate
- 58 - Low
- 58 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 17.4 Final development footprint**

0 200 400 600 800

Meters

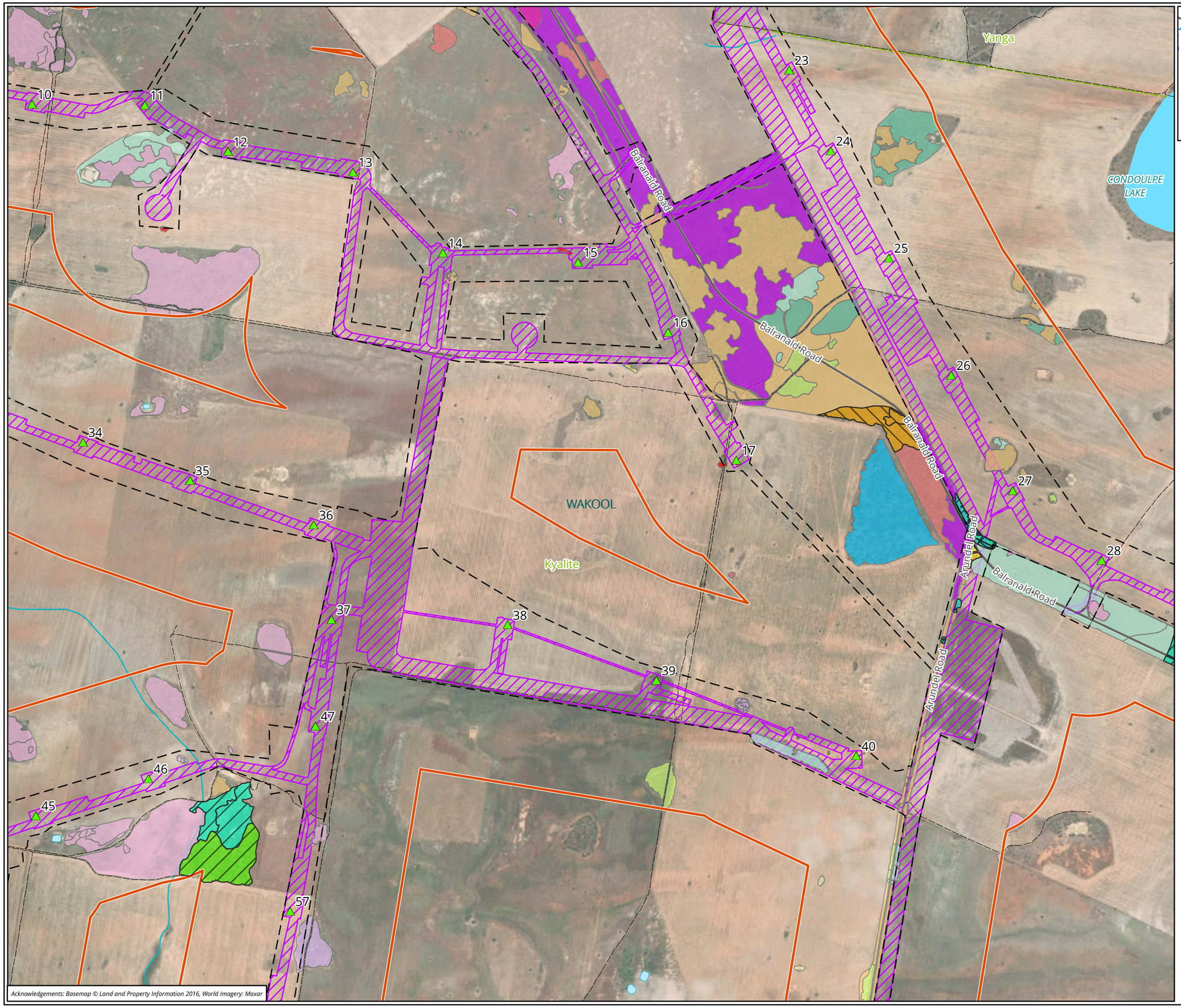
Scale: 1:20,000 @ A3

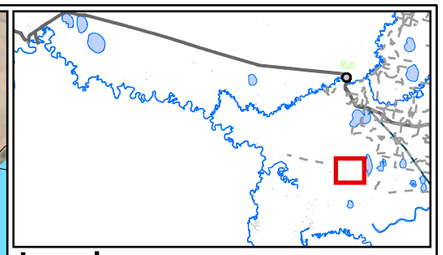
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



## Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 16 - Paddock trees
- 21 - Low
- 21 - Moderate
- 23 - High
- 23 - Moderate
- 57 - Low
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate
- 170 - Paddock trees

**Figure 17.5 Final development footprint**

0 200 400 600 800

Meters

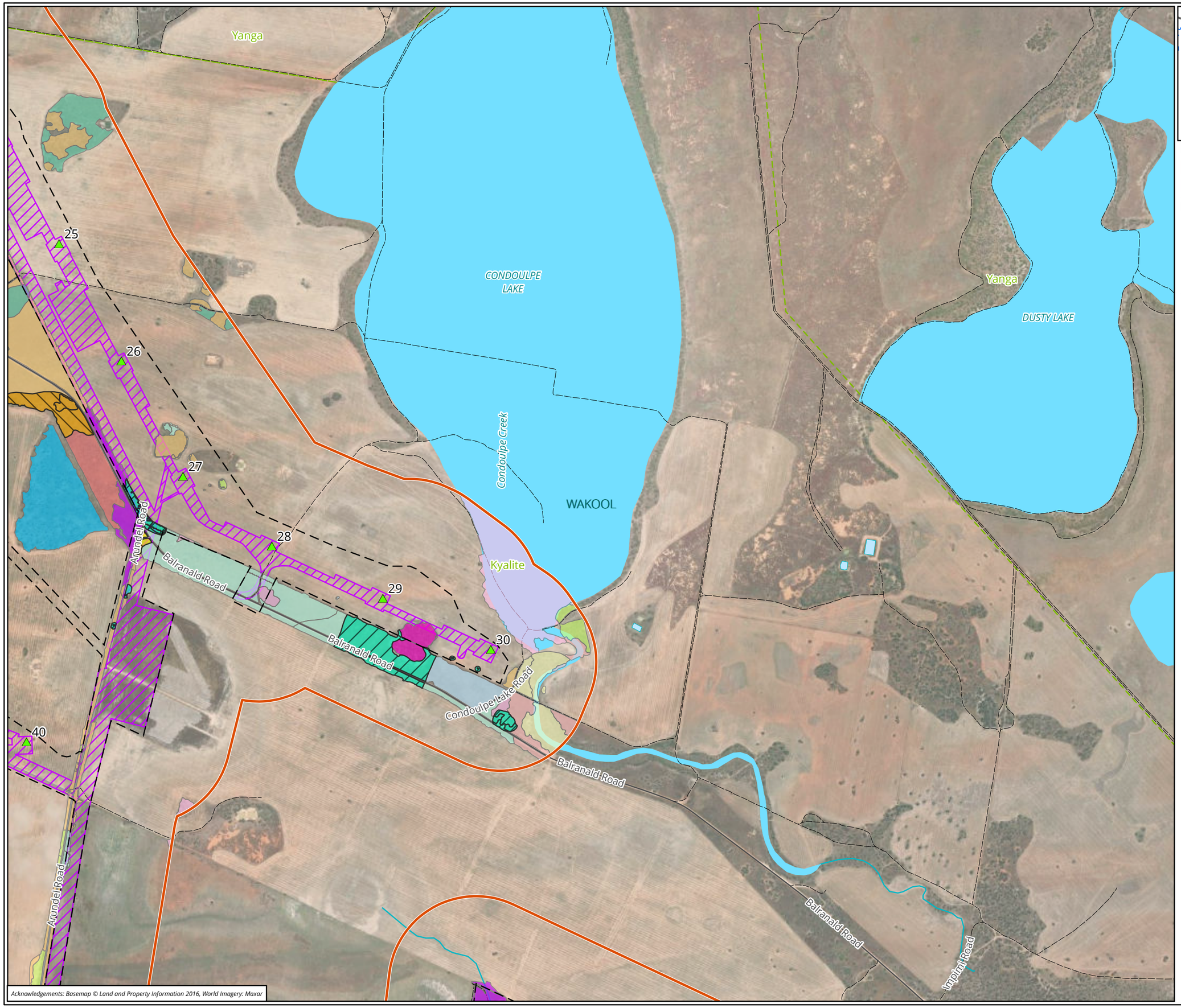
Scale: 1:20,000 @ A3

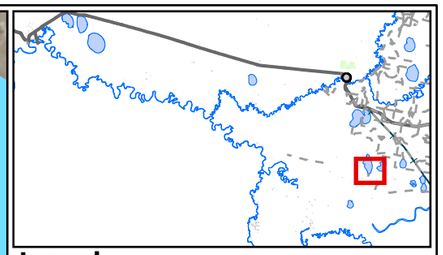
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - DNG
- 15 - High
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - High
- 16 - Moderate
- 21 - Low
- 21 - Moderate
- 23 - Moderate
- 57 - Low
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate
- 170 - Paddock trees
- 238 - Moderate

**Figure 17.6 Final development footprint**

0 200 400 600 800

Meters

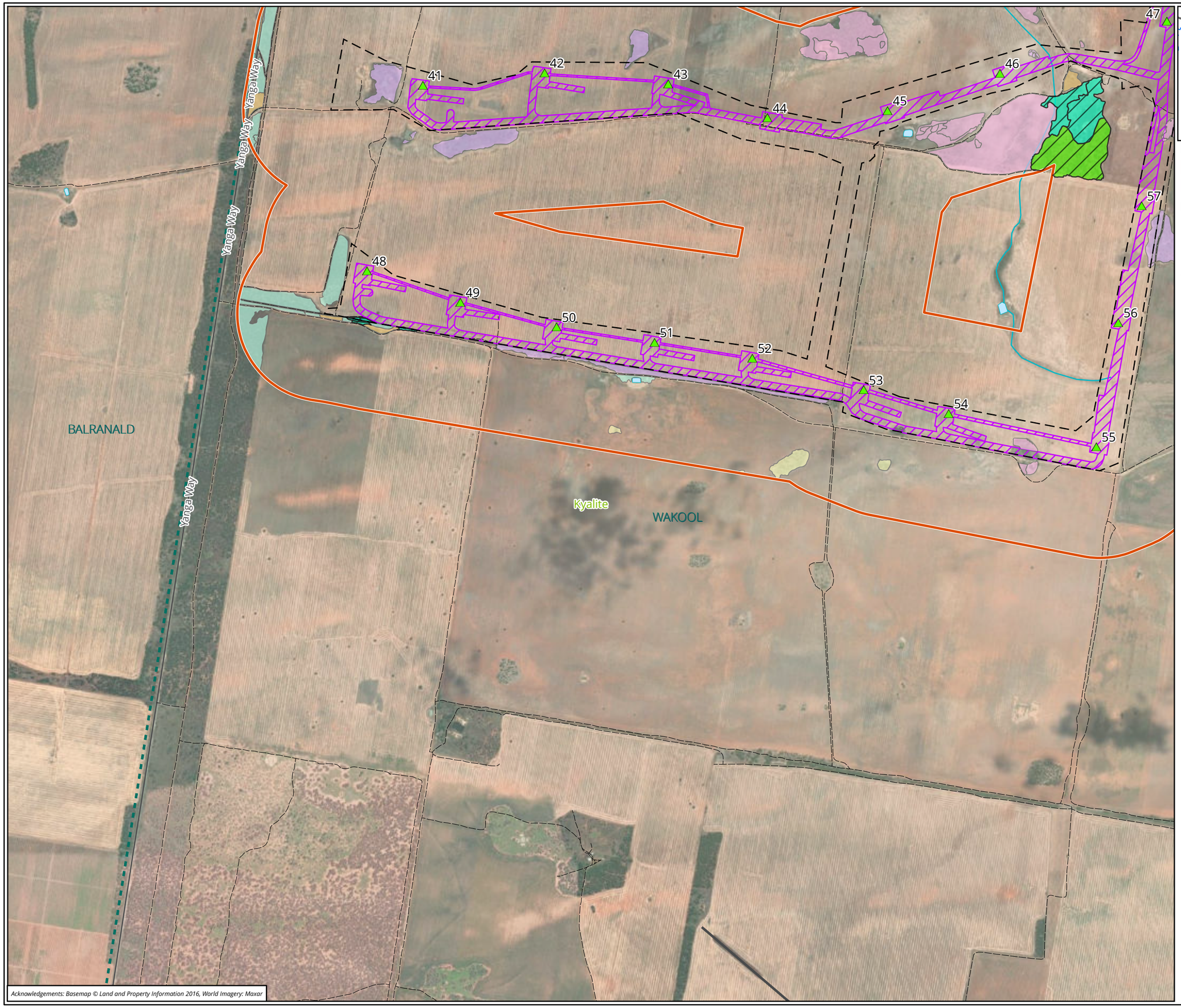
Scale: 1:20,000 @ A3

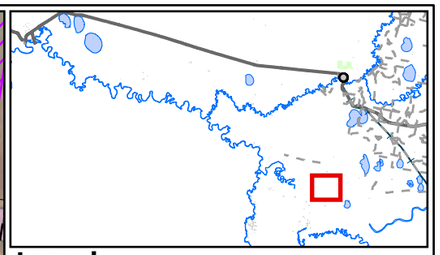
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland

**Vegetation zones**

- 15 - Low
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 23 - High
- 23 - Moderate
- 58 - Moderate
- 170 - DNG
- 170 - Moderate

**Figure 17.7 Final development footprint**

0 200 400 600 800

Meters

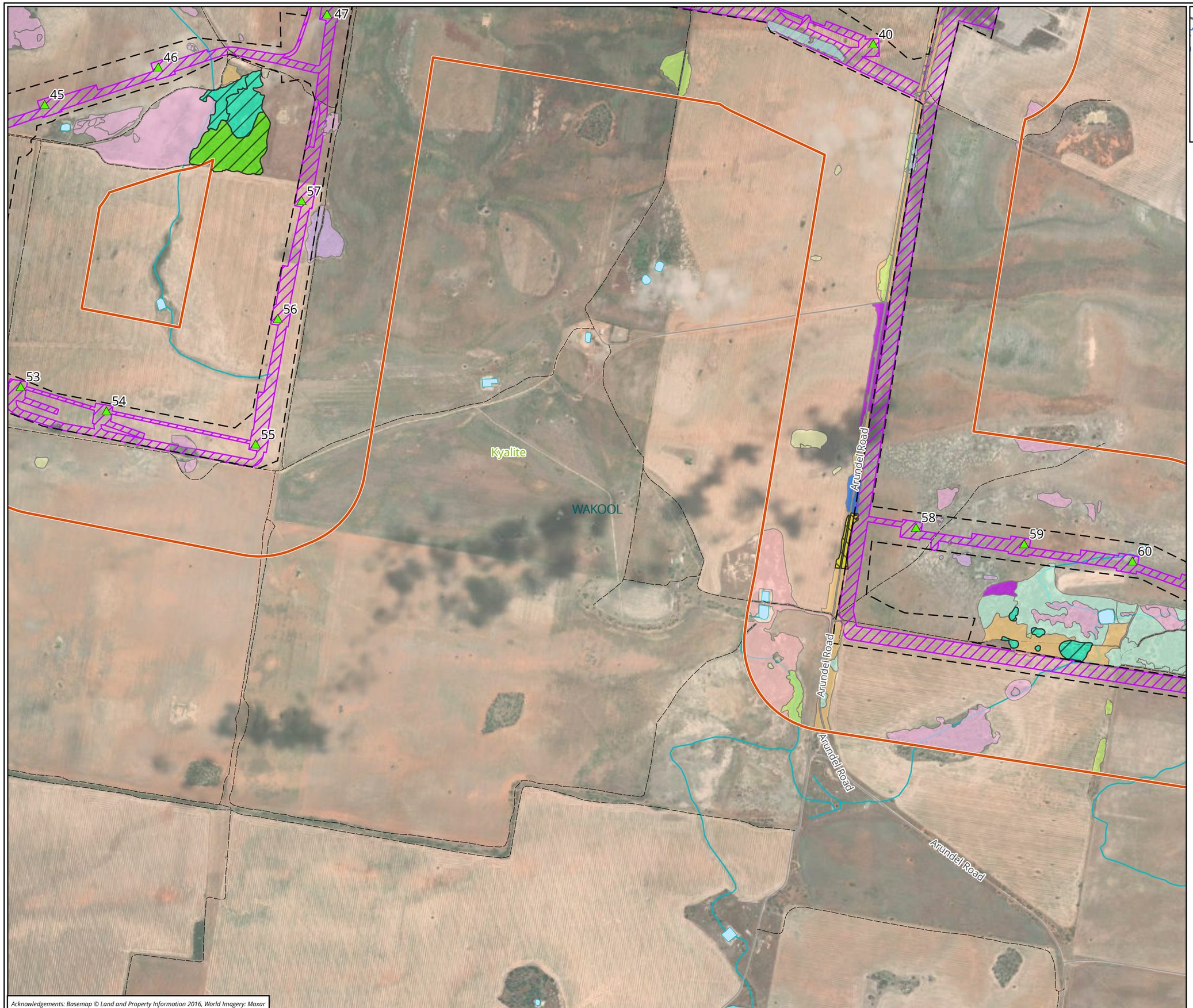
Scale: 1:20,000 @ A3

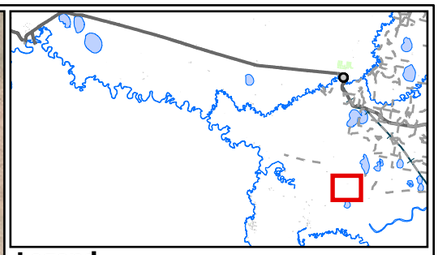
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Moderate
- 23 - High
- 23 - Moderate
- 57 - Moderate
- 58 - DNG
- 58 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

## Figure 17.8 Final development footprint

0 200 400 600 800

Meters

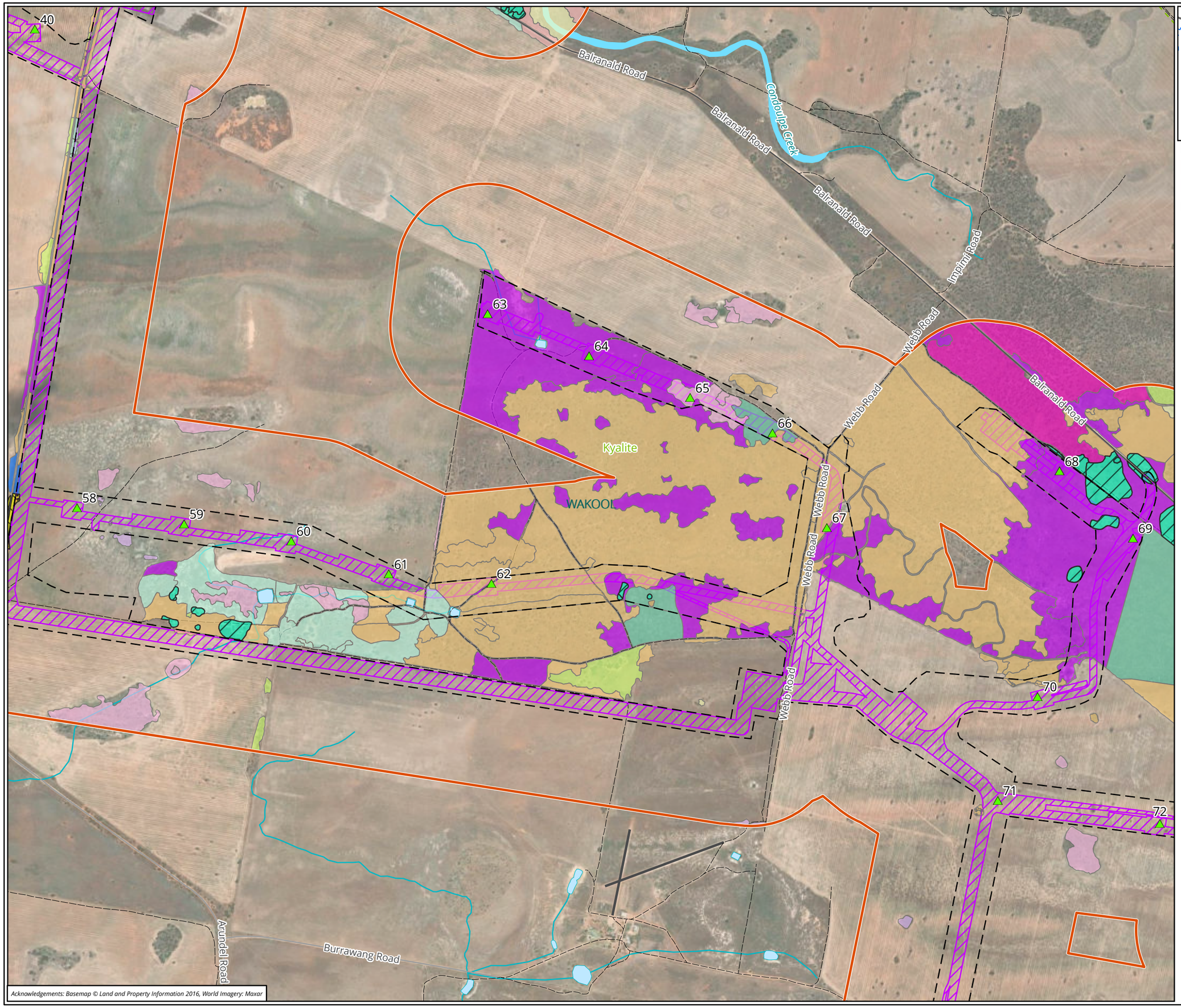
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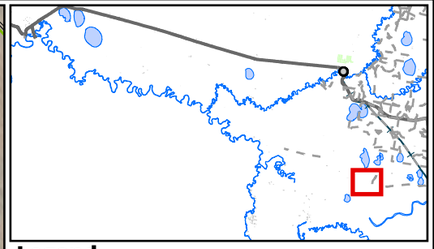
*Coordinate System: GDA2020 MGA Zone 54*

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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Moderate
- 23 - Moderate
- 57 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 17.9 Final development footprint**

0 200 400 600 800

Meters

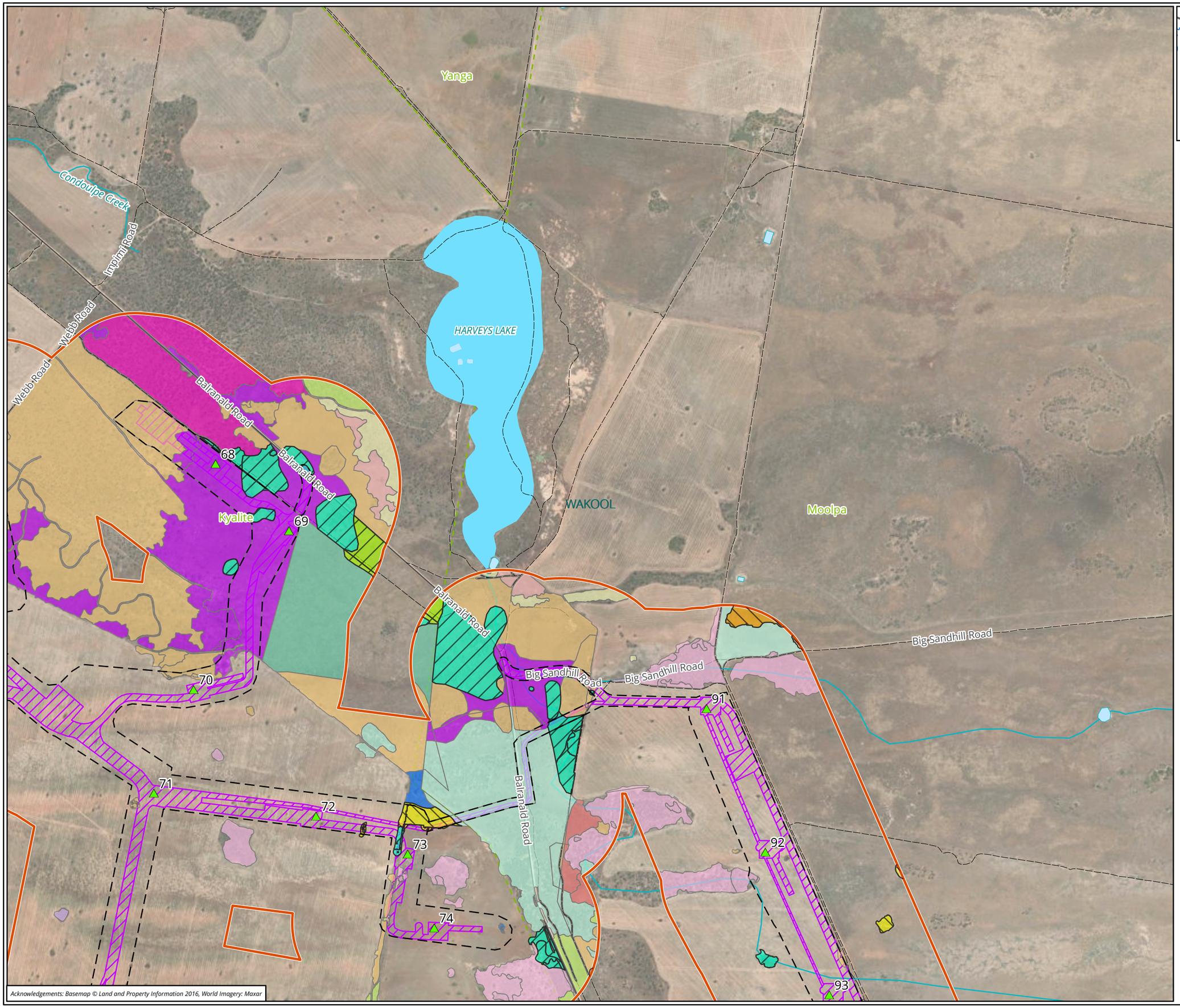
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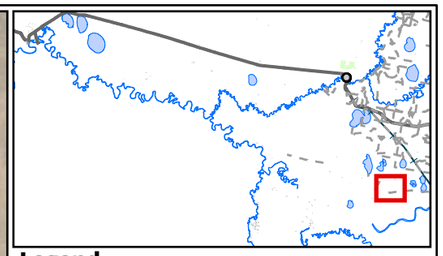
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Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 15 - Moderate
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Low
- 21 - Moderate
- 23 - DNG
- 23 - Moderate
- 57 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 17.10 Final development footprint**

0 200 400 600 800

Meters

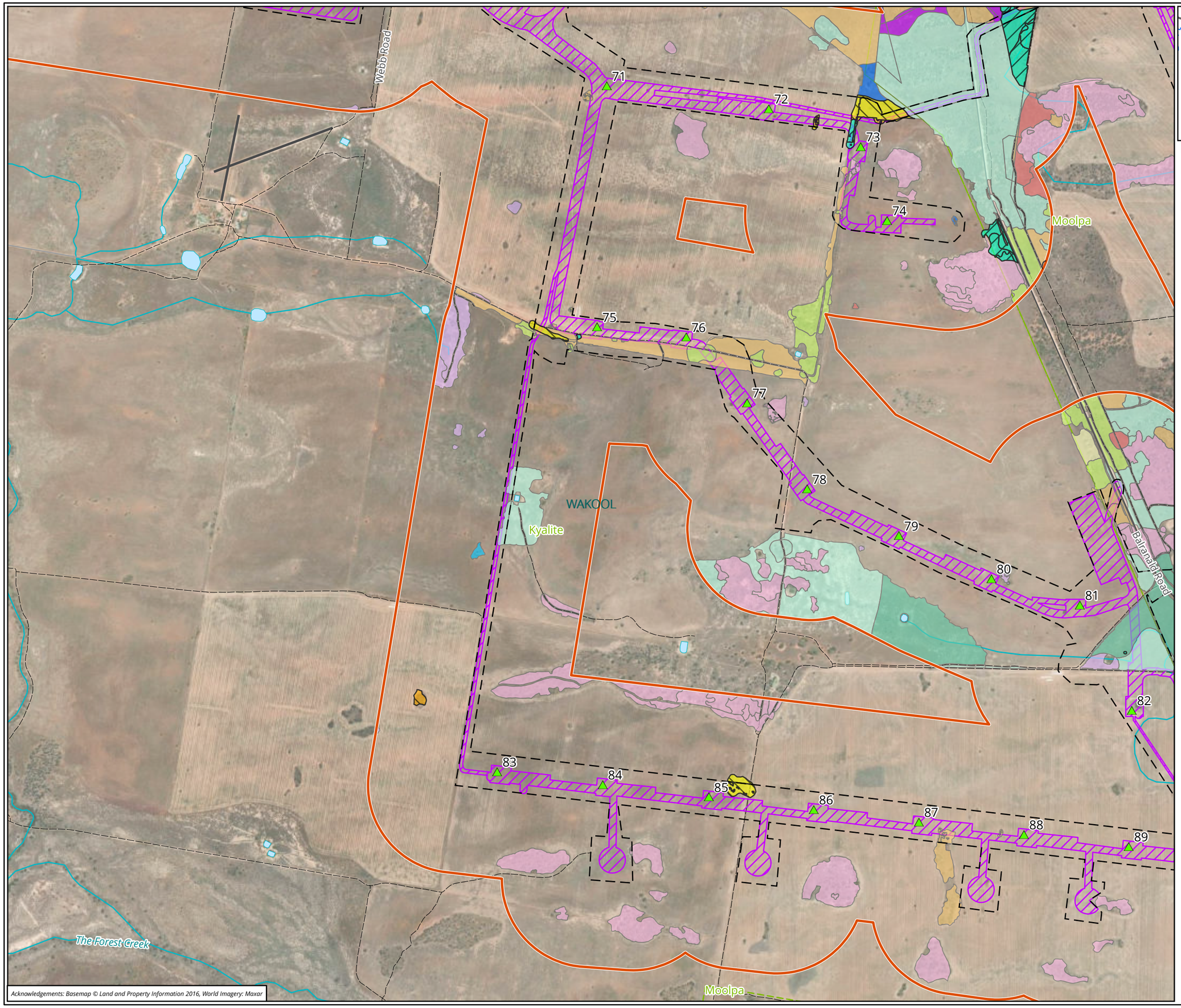
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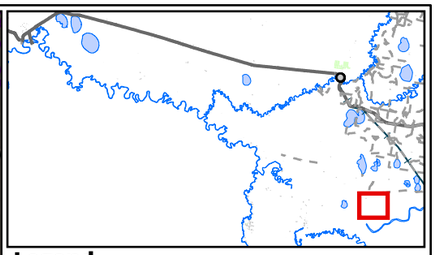
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - Low
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Low
- 21 - Moderate
- 23 - Moderate
- 57 - Low
- 57 - Moderate
- 58 - DNG
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 17.11 Final development footprint**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

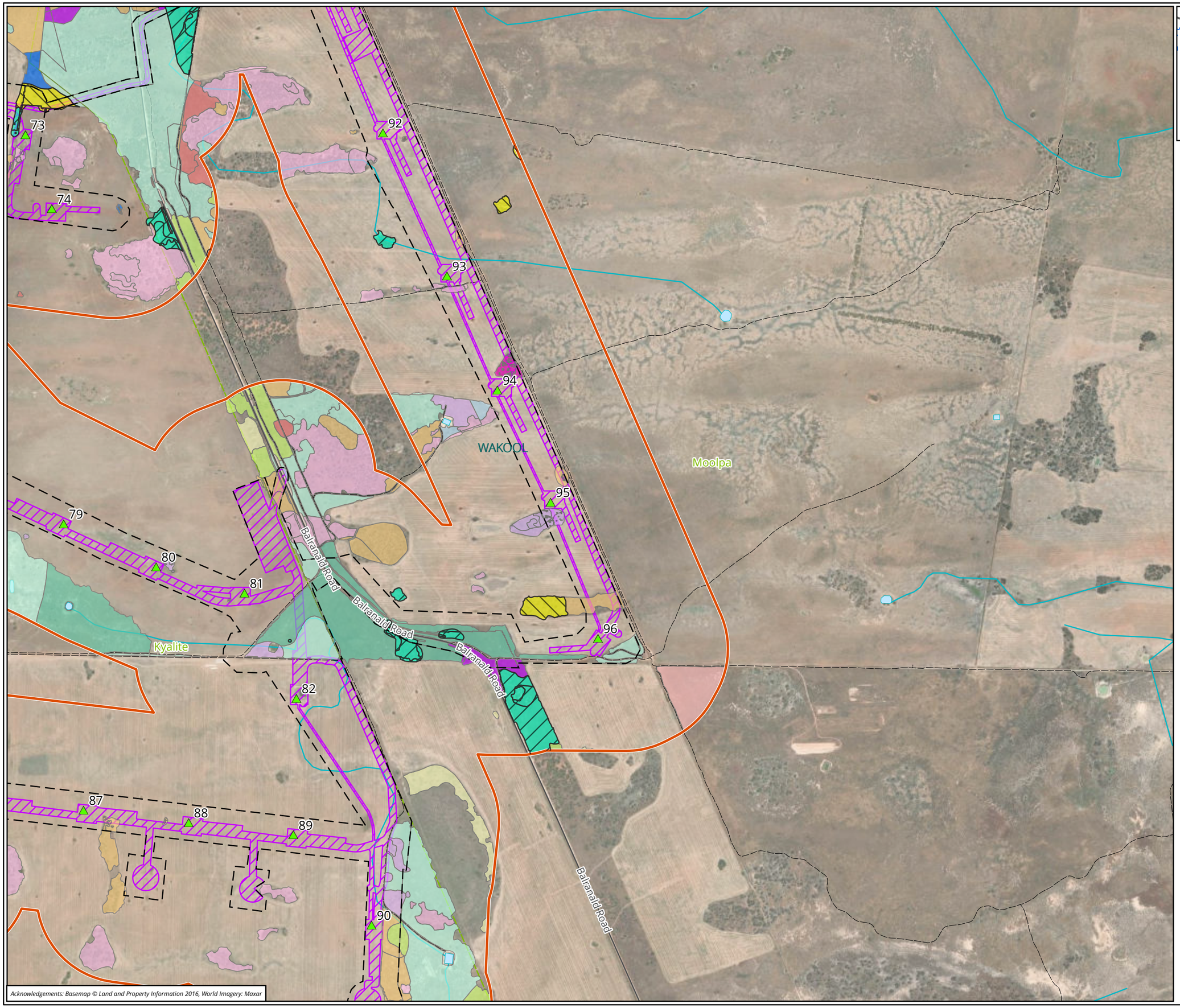
*Coordinate System: GDA2020 MGA Zone 54*

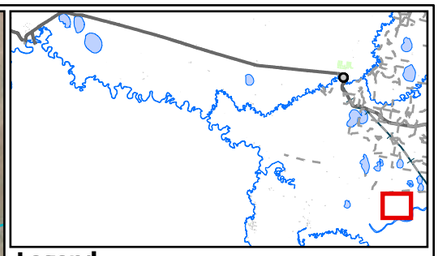
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - DNG
- 15 - Low
- 16 - DNG
- 16 - High
- 16 - Low
- 16 - Moderate
- 21 - Moderate
- 23 - Moderate
- 57 - Moderate
- 58 - DNG
- 58 - High
- 58 - Low
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 17.12 Final development footprint**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

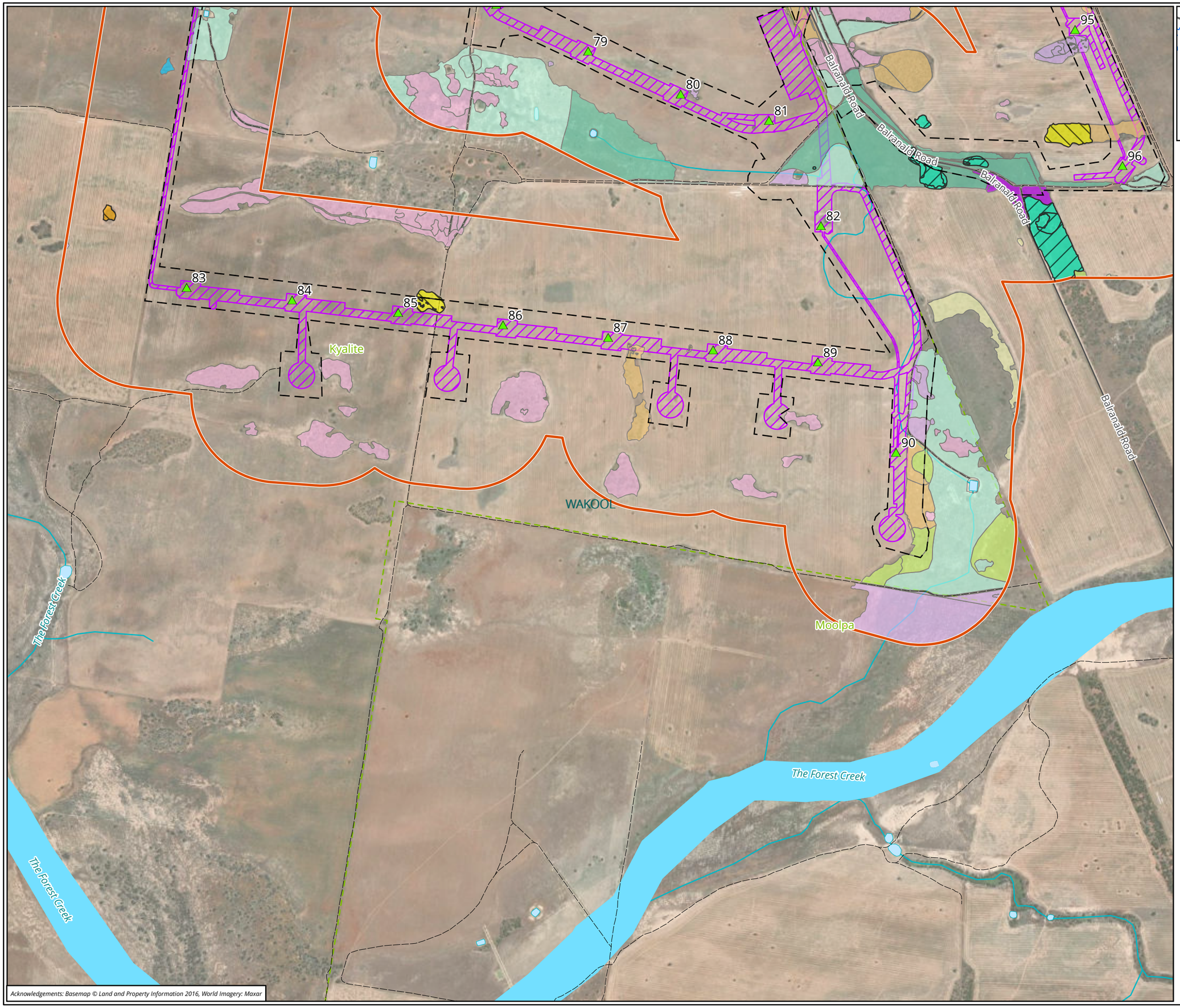
*Coordinate System: GDA2020 MGA Zone 54*

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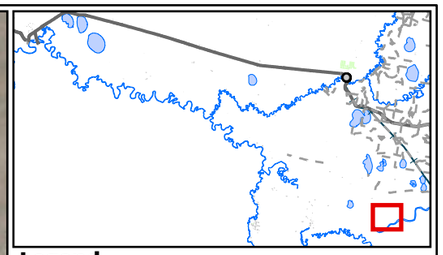
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**Legend**

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland

**Vegetation zones**

- 15 - Low
- 16 - DNG
- 16 - Low
- 16 - Moderate
- 21 - Low
- 21 - Moderate
- 23 - Moderate
- 57 - Low
- 58 - DNG
- 58 - Moderate
- 58 - Paddock trees
- 163 - Moderate
- 170 - DNG
- 170 - Low
- 170 - Moderate

**Figure 17.13 Final development footprint**

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

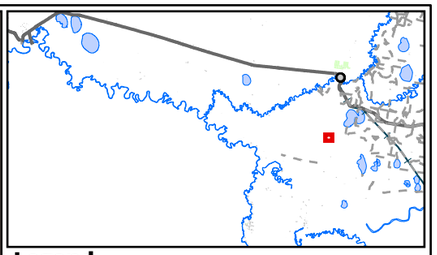
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Wind turbine generators

**Vegetation zones**

- 170 - DNG
- 170 - Low

**Figure 17.14 Final development footprint**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

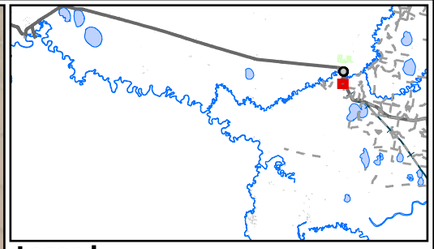
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development footprint
- Wind turbine generators

**Figure 17.15 Final development footprint**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

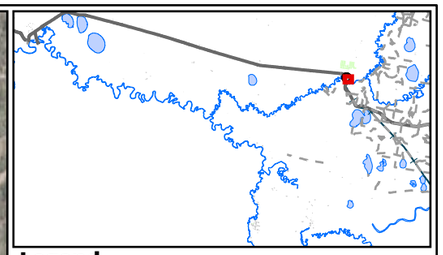
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GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development footprint
- Wind turbine generators

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**Figure 17.16 Final development footprint**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

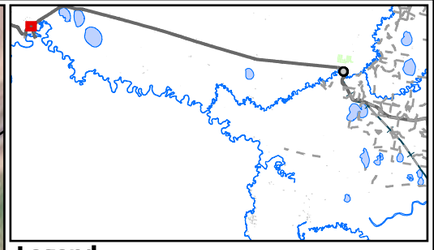
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 15 May 2024
GIS: JET, Checked by: CW, Last edited by: amackegard
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint



**Legend**

- Subject land
- Development footprint
- Wind turbine generators

**Figure 17.17 Final development footprint**

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 15 May 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F17_FinalDevFootprint

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# 8. Assessment of impacts unable to be avoided

Assessment of direct and indirect impacts unable to be avoided (residual impacts) has been undertaken in accordance with the BAM (DPIE 2020a). The following direct and indirect impacts are unable to be avoided in progressing the proposed development.

## 8.1. Direct impacts

Direct impacts arising from the project include:

- Removal of native vegetation and flora and fauna habitats.
- Removal of BC Act listed TECs.
- Removal of known habitat for threatened fauna species.
- Removal of assumed habitat for threatened flora species.
- Removal of hollow-bearing trees and scattered paddock trees.

A summary and assessment of the above impacts are provided in Table 47 and Table 48 and Table 50, these impacts will be permanent and will occur over the course of the construction phase of the project. Mitigation measures outlined in Section 9 will help to minimise the potential impacts to biodiversity values that remain present within the subject land.

No direct impacts are expected to occur as a result of the proposed wind farm to the Yanga National Park Yanga Nature Reserve, or the Yanga State Conservation Area. Refer to Section 8.3.3.

### 8.1.1. Summary of direct impacts

A summary of direct impacts as a result of the project are provided in Table 47 below.

**Table 47 Summary of direct impacts to vegetation**

| Zone | PCT | TEC | Area impacted (ha) | VI Score |
|---|---|---|---|---|
| **VZ1** | 16_Moderate | | 3.80 | 54.4 |
| **VZ2** | 16_Low | | 0.36 | 29.5 |
| **VZ3** | 16_DNG | | 2.78 | 14.7 |
| **VZ4** | 16_Paddock Trees | | 0.21 | 10.7 |
| **VZ5** | 21_Moderate | Sandhill Pine Woodland | 1.17 | 64.6 |
| **VZ6** | 23_Moderate | *Acacia melvillei* Shrubland | 2.03 | 62.7 |
| **VZ7** | 57_Moderate | | 0.19 | 61.1 |
| **VZ8** | 58_High | | 0.85 | 91 |
| **VZ9** | 58_Moderate | | 20.91 | 74.8 |
| **VZ10** | 58_DNG | | 31.01 | 17.7 |

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| Zone | PCT | TEC | Area impacted (ha) | VI Score |
|---|---|---|---|---|
| **VZ11** | 58_Paddock Trees | | 0.07 | 46.6 |
| **VZ12** | 163_Moderate | | 3.58 | 59.5 |
| **VZ13** | 170_Moderate | | 4.67 | 61.5 |
| **VZ14** | 170_Low | | 0.56 | 29.7 |
| **VZ15** | 170_DNG | | 3.50 | 12.8 |

**Table 48 Summary of direct impacts species credit habitat or individuals**

| Species | Biodiversity Risk Weighting | Area impacts (ha) |
|---|---|---|
| **Major Mitchell's Cockatoo** | 2.0 | 37.40 |
| **Menindee Nightshade** | 1.5 | 2.34 (assumed) |
| **Mossgiel Daisy** | 2.0 | 3.91 (assumed) |
| **Winged Peppercress** | 2.0 | 3.66 (assumed) |

**Table 49 Summary of direct impacts to scattered trees**

| Class | No. trees impacted |
|---|---|
| **1** | 7 |
| **2** | 11 |
| **3** | 59 |
| **Associated TEC impacts*** | |
| **Trees conforming to Sandhill Pine Woodland** | 5 |
| **Trees conforming to *Acacia melvillei* Shrubland** | 14 |

***Tress noted as TECs are included in those listed above, 77 scattered trees are impacted in total**

### 8.1.2. Assessment of direct impacts

An assessment of the unavoidable direct impacts as a result of the project is provided in Table 50 below.

**Table 50 Summary and assessment of direct impacts**

| Direct impact | Description of impact | Assessment of impact |
|---|---|---|
| Removal of native vegetation and flora and fauna habitats | Removal of 75.68 ha of native vegetation comprising 7 PCTs throughout the development footprint, supporting habitat for a range of threatened and non-threatened flora and fauna species. | Following all efforts made to reduce and minimise impacts as outlined in Section 7 above, the project will result in the removal of:<br>• 0.85 ha of vegetation in high condition with a VI Score of 91.0<br>• 36.35 ha of vegetation in moderate condition states with VI Scores ranging from 74.8 to 53.4<br>• 38.48 ha of vegetation in lower conditions states (including Low, DNG, and Paddock trees) with VI scores ranging from 46.6 to 10.7<br>• Impacted vegetation is generally patchy, highly fragmented and edge effected, being in the most part surrounded by cleared agricultural cropping land.<br>The project has been sited to minimise impacts to native vegetation and habitats with the majority of the subject land, development corridor and development footprint occurring on Category 1 – Exempt land, the breakdown of which includes:<br>• Approximately 79% of the subject land (8,500 ha of 10,800 ha total area).<br>• Approximately 86% of the development corridor (1,800 ha of 2,100 ha total area).<br>• Approximately 90% of the development footprint (690 ha of 768 ha total area).<br>The removal of 75.68 ha of native vegetation and habitats is considered a relatively low level of impacts for a project of this scale with a 768 ha (approximate) development footprint and equates to <10 % of the total impact footprint. Impacts will primarily occur to native vegetation in a moderate or lower condition state, with VI scores ranging from 10.7 to 74.8 for over 99 % of the impacted native vegetation.<br>The project will also remove up to 17 mapped hollow-bearing trees, with ≥10 cm diameter hollows, from within vegetation patches mapped as vegetation zones, with more trees with smaller hollows likely to be impacted and a total of 53 hollow-bearing trees conforming to the BAM definition for scattered paddock trees.<br>The vegetation to be removed supports habitat for a range of flora and fauna species, including threatened species known and predicted to occur within the subject area, and impacts will be offset in accordance with the NSW BAM, and Commonwealth EPBC Act Offsets Policy if a significant impact to Commonwealth species is determined as likely to occur. Offsets will ensure No Net Loss to the ecosystems present within the development site as a result of the project. Areas of habitat will be retained within the subject land and will continue to provide habitat value to locally occurring flora and fauna species. |

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| Direct impact | Description of impact | Assessment of impact |
|---|---|---|
| Removal of BC Act TECs | The project will result in the removal of the following TECs:<br>• 2.03 ha of *Acacia melvillei* Shrubland, and 5 Yarran individuals occurring as scattered paddock trees<br>• 1.17 ha of Sandhill Pine Woodland, and 14 Slender Cypress Pine individuals occurring as scattered paddock trees | *Acacia melvillei* Shrubland occurs patchily across the subject land associated with prior streams and aeolian source-bordering dunes. The TEC was most common along the road verge of Arundel Road and along the western boundary of the subject land, with the largest patch occurring in relatively high condition between WTGs 46 and 57. The understorey of the TEC was generally sparse, and in some cases infested with exotic species such as Wiry Noon Flower, and the overstorey occurs in a generally moderate condition, with the TEC's VI score calculated at 62.7. The project has avoided impacts to the TEC to the fullest extent possible, and impact will not occur to large or high condition patches. The TEC is relatively common within the subject land including areas outside the development footprint and development corridor, and the project will not result in substantial or significant impacts that would threaten the long-term existence or viability of the TEC in the locality.<br>As with *Acacia melvillei* Shrubland, Sandhill Pine Woodland occurs in a highly fragmented state, and generally occurs as isolated patches of less than five Slender Pine Trees, and as individual Paddock Trees. The TEC's VI score has been calculated as 64.6, with some individual plots scoring >75, however the condition of the patches of TEC were found to be highly degraded on-ground, being heavily weed infested and the understorey being dominated by a low diversity of chenopod shrubs. The TEC is less common throughout the subject land than *Acacia melvillei* Shrubland, however the project's impacts are also not considered likely to threaten the long-term existence or viability of the TEC in the locality. |
| Removal of known habitat for threatened fauna species | The project will result in the removal of the following known habitat for threatened fauna species credit species:<br>• 37.40 ha of native vegetation supporting forage and assumed breeding habitat for Major Mitchell's Cockatoo.<br>The project will result in the removal of the known habitat for the following threatened fauna ecosystem credit species:<br>• Up to 75.68 of native vegetation supporting habitat for; Black Falcon, Regent Parrot, Spotted Harrier and White-fronted Chat. | As outlined above the project has been sited to minimise impacts to native vegetation and habitats, including known habitat for a number of threatened fauna species, including species credit and ecosystem credit species.<br>Major Mitchell's Cockatoo has been assumed to be breeding within the subject land due to it being considered a resident species, its common occurrence within the subject land throughout the biodiversity surveys undertaken by Nature Advisory, NHG Consulting and Biosis, and its recorded indictive breeding activity – pairs of birds investigating hollows around breeding season.<br>In accordance with the BAM, impacts are based on 200 m radius buffers from confirmed potential breeding trees, and well as buffers from areas potentially supporting additional breeding trees, and include all mapped vegetation condition states, with the exception of Low condition vegetation (considered too degraded to support forage habitat for the species). The inclusion of non-treed areas (i.e., DNG condition states, and chenopod shrubland PCTs) ensures impacts to potential ground-level forage habitats are included in the impact calculations. A total of 113 trees potentially suitable for Major Mitchell's Cockatoo breeding have been mapped within the subject land, and impact have been avoided to the majority, with only 17 trees within the final development footprint.<br>The species has specific preference of nesting hollows close to wooded areas, using these areas for travel between forage habitats and nesting or roosting sites. In fragmented landscapes such as the subject land, vegetated |

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| Direct impact | Description of impact | Assessment of impact |
|---|---|---|
| | | corridors tend to be the preference for travel and including roadside remnant vegetation patches (DCCEEW, 2023). Impacts to these types of movement corridors has largely been avoided including TSRs and road corridors within and immediately adject to the subject land. Impacts will occur to the large area of mainly intact PCT 58 Black Oak Western Rosewood open woodland in the centre of the subject land. Hollow-bearing tree surveys of this patch of vegetation record a low abundance of hollows in the area. However, it is possible this central patch is being utilised for the species' breeding, even with a low density of hollows, based on the species nesting behaviour of nests being at least 1 km apart, with no more than one pair every 30 square km. Based on this estimated density of nests, the subject land could be expected to support a total of 5-6 breeding pairs.<br>Whilst the project will result in direct impacts to assumed breeding and known forage habitat for the species, the habitat impacted is of no greater quality that that being retained within the subject land, or that which will remain within the home ranges of the impacted birds, outside the subject land. Habitats present within the 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs, and other TSRs, in the locality are noted as of high conservation value (LLS 2017) and will remain largely unimpacted by the project, and continue to provide suitable forage and breeding habitat for the species. Habitat will also remain around Condoulpe Lake, and within the Yanga State Conservation Area approximately 2.5 km from the eastern extent of the subject land. The population of the species that will remain on site during and post construction of the project, may be subject to potential collision risk with operational turbines, however this will be managed and minimised over the life of the wind farm (refer Section 6 and Section 8.3.5)<br>Regent Parrot was commonly recorded by Nature Advisory during their biodiversity surveys within the subject land. As outlined in Section 6.1.5 above, Nature Advisory undertook a specific study on utilisation of the subject land by Regent Parrot (Nature Advisory 2023d), and found that the species utilises the study area as foraging habitat and commutes between patches of remanent mallee within and outside the study area. Areas of breeding habitat are likely to occur outside the study area within River Red Gum habitat along the Murrumbidgee and Edwards Rivers. Daily movements to and from these areas result in Regent Parrot movements along the western boundary of the subject land along the TSRs that follow Yanga Way and Balranald-Moulamein Road.<br>Impacts to Regent Parrot habitat are considered to include primarily moderate condition PCT 170 Chenopod sandplain mallee, and to a lesser extent PCT 16 Black Box grassy open woodland wetland and PCT 58 Black Oak - Western Rosewood open woodland (as associated in BioNet).<br>As with Major Mitchell's Cockatoo, Regent Parrot habitat impacted by the project is of no greater quality that that being retained within the subject land, or that which will remain within the home ranges of the impacted birds, outside the subject land. Habitats present within the 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs, and other TSRs, in the locality are noted as of high conservation value (LLS 2017) and will remain largely |

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| Direct impact | Description of impact | Assessment of impact |
|---|---|---|
| | | unimpacted by the project, and continue to provide suitable forage and movement habitat for the species. Potential collisions with operational turbines will again be managed and mitigated throughout the life of the wind farm.<br>Spotted Harrier was recorded twice by Nature Advisory and once by NHG Consulting. No nesting activity was observed but the species is considered likely to be a resident raptor in the area. Nature Advisory recorded Black Falcon twice in 2022, once within and once outside the subject land. The two observations were made during the beginning and middle of the Black Falcon breeding season (June to December), and thus the species could be breeding within the locality, although no breeding activity has been recorded. White-fronted Chat was recorded in 2021 and 2022 and is likely to a frequent visitor or resident to the study area (Nature Advisory 2023a).<br>The project will result in impact on up to 75.68 ha of foraging, roosting and potentially breeding habitat for these threatened bird species, however direct impacts to any of these species is unlikely to be substantial given the areas of commensurate and higher quality habitat within the locality and within the home ranges of these generally highly mobile species. |
| Removal of assumed habitat for threatened flora species | The project will result in the removal of the assumed habitat for:<br>• Menindee Nightshade – 2.34 ha (assumed)<br>• Mossgiel Daisy – 3.91 ha (assumed)<br>• Winged Peppercress – 3.66 ha (assumed) | Impacts to threatened flora have been assumed for these three species despite the flora survey efforts outlined in Section 4.3.1, within localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation during the October 2022 survey effort, and areas being cleared for agricultural purposes.<br>None of these species were recorded across the remainder of the development corridor during the multiple survey efforts undertaken by Biosis, and NGH Consulting, which covered a total combined survey area of approximately 228 ha.<br>Each of these species assumed present has multiple BioNet records to the north including within Yanga State Conservation Area (Mosgiel Daisy and Winger Peppercress), and all three species are noted in BioNet as occurring within NPWS areas.<br>If these species were to exist within the under-surveyed areas of the subject land, there occurrence would not be considered overly significant in the context of the species' known distribution or ecological setting. |
| Loss of hollow bearing trees | The project will result in the removal of 17 mapped hollow-bearing trees, with ≥10 cm diameter hollows | The project will also remove up to 17 mapped hollow-bearing trees, with ≥10 cm diameter hollows, from within vegetation patches mapped as vegetation zones, with more trees with smaller hollows likely to be impacted.<br>Tree hollows provide important roosting and breeding habitat for a wide range of fauna species, which in the context of the project mainly include species of birds and bats.<br>Substantial efforts have been made to avoid impacts to these important habitat resources including those outlined in Table 45 above. This included specific efforts to design the development footprint to avoid hollow-bearing trees following completion of hollow-bearing tree and scattered paddock tree mapping, based on the GIS data provided |

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| Direct impact | Description of impact | Assessment of impact |
|---|---|---|
| | | to the project design team. |
| Loss of scattered paddock trees | The project will impact upon 77 trees meeting the BAM definition of scattered paddock trees | An assessment in accordance with the BAM Streamline assessment module – Scattered tree assessment is included within Appendix 7. The project will impact upon a total of 77 scattered paddock trees, 53 of which were found to be hollow-bearing trees.<br>Like hollow-bearing trees outlined above, scattered paddock trees provide important habitat for more mobile species in fragmented landscapes such as the subject land. The project has made substantial efforts to avoid scattered paddock trees, with impacts expected to 77 out of the 269 total paddock trees mapped as part of the current assessment. Details on avoidance measures are outlined in Table 45 above. |
| Removal of planted native vegetation | The project will impact upon 0.57 hectares of planted native vegetation assessed in accordance with Appendix D of the BAM | A total of 0.57 ha of planted native vegetation will be impacted along the project's transport haul route, where impacts will occur to certain intersections where the swept path of the turbine blades need to cut the corner. An assessment in accordance with Appendix D and *Streamlined assessment module planted native vegetation Biodiversity Assessment Method operational manual* (DPE 2022c) (see Appendix 6). It was found the planted native vegetation provides negligible habitat for threatened species, and indirect and prescribed impacts and potentially SAIIs associated with the removal of this vegetation are also negligible. |

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## 8.2. Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 51 and illustrated on Figure 18.

Threatened and non-threatened species or ecological communities (entities) potentially indirectly impacted by the project include:

- All PCT / vegetation zones.
- All ecosystem credit species assumed present.
- Known threatened fauna species habitat.
- Avoided Bitter Quandong population.
- Avoided *Austrostipa metatoris* population.
- Avoided *Acacia melvillei* Shrubland and Sandhill Pine Woodland TECs.

No indirect impacts are expected to occur as a result of the proposed wind farm to the Yanga National Park Yanga Nature Reserve, or the Yanga State Conservation Area. Refer to section 8.3.3.

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**Table 51 Assessment of indirect impacts**

| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| **Inadvertent impacts on adjacent habitat or vegetation** | • All PCT / vegetation zones.<br>• All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat.<br>• Avoided Bitter Quandong population.<br>• Avoided *Austrostipa metatoris* population.<br>• Avoided *Acacia melvillei* Shrubland and Sandhill Pine Woodland TECs.<br>• 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs.<br>• Avoided hollow-bearing trees. | Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m buffer. | Ongoing in a staged manner for the life of the project (up to 30 years). | Temporary and permanent | Construction and operation | Low. Impacts to adjacent vegetation during construction and operational phase can be prevented or minimised through appropriate exclusion fencing, implementation of a Biodiversity Management Plan (BMP) and Construction Environmental Management Plan (CEMP) or similar detailing best practice environmental protection measures, strict water quality practices and stormwater controls, and by ensuring any lighting is directed towards the developed area, rather than towards adjacent retained habitat. |
| **Reduced viability of adjacent habitat due to edge effects** | • All PCT / vegetation zones.<br>• All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat.<br>• Avoided Bitter Quandong population.<br>• Avoided *Austrostipa metatoris* population.<br>• Avoided *Acacia melvillei* Shrubland and Sandhill Pine Woodland TECs. | Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m buffer. | Ongoing in a staged manner for the life of the project (up to 30 years). | Temporary and permanent | Construction and operation | Low. The majority of avoided / retained vegetation within the subject land is already subject to a high degree of edge effects due to the level of historical clearing for agricultural purposes. The project will not substantially increase edges effects due to large portions of the project's development footprint being located in existing cleared areas, and the majority of impacts to native vegetation being to existing edges and/or small and isolated patches of vegetation. Edge effects will be increased where vegetation removal is required within the larger more intact open woodland vegetation in |

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| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| | • 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs.<br>• Avoided hollow-bearing trees. | | | | | the central portion of the subject land, however the narrow liner nature of the development footprint will not result in the creation of new large / substantial edges (when compared to a wider footprint with a larger/longer perimeter). |
| **Reduced viability of adjacent habitat due to noise, dust or light spill** | • All PCT / vegetation zones<br>• All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat.<br>• Avoided Bitter Quandong population.<br>• Avoided *Austrostipa metatoris* population.<br>• Avoided *Acacia melvillei* Shrubland and Sandhill Pine Woodland TECs.<br>• 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs.<br>• Avoided hollow-bearing trees. | Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m buffer. | Ongoing for the life of the project (up to 30 years). Most substantial during construction. | Temporary and permanent | Construction and operation | Negligible. It is predicted that the adjacent habitat may be impacted in a small way by noise, dust, compaction and light spill, during construction and operation. However, this will be managed via best practices outlined in a BMP and CEMP or similar. Improve and maintain Principals will apply within the BMP to ensure retained areas of adjacent habitat do not decline or are subjected to adverse impacts.<br>It is expected that the majority of noise and dust impacts will occur during the construction phase, with a reduction to near-normal levels following completion of construction. |
| **Transport of weeds and pathogens from the site to adjacent vegetation** | • All PCT / vegetation zones<br>• All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat.<br>• Avoided Bitter Quandong population.<br>• Avoided *Austrostipa metatoris* population. | Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m buffer, and potentially along | Ongoing for the life of the project (up to 30 years). Highest potential for occurrence is during construction. | Temporary and permanent | Construction and operation | Low. Weeds occurring within the development footprint are consistent with those occurring within adjacent vegetation to be retained. Increased transport of pathogens and weeds is unlikely to occur but will be managed by biosecurity measures outlined in the CEMP or similar.<br>During both the construction and the operational phases of the project regular monitoring and management (weed control) will |

| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| | • Avoided *Acacia melvillei* Shrubland and Sandhill Pine Woodland TECs.<br>• 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs.<br>• Avoided hollow-bearing trees. | watercourses. | | | | occur within retained areas adjacent to the development footprint. |
| **Increased risk of starvation, exposure and loss of shade or shelter** | • All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat. | Within the currently vegetation areas of the development footprint and within the operational wind farm as a whole. | Ongoing for the life of the project (up to 30 years). | Temporary | Construction and operation | Negligible. The project will result in the removal of habitats that provide food and shelter to a range of fauna species, and areas currently vegetated will become areas of infrastructure and hardstands no longer suitable to support the majority of fauna species currently occupying the area. However, the level of change is minimal in the context of the subject land and broader locality and the ecosystem is unlikely to be at carrying capacity such that displaced fauna cannot continue to persist in adjacent retained areas. |
| **Loss of specialist breeding habitats** | • All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat. | Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m buffer, as well as an additional 45 m (approx. half a blade length) from | Ongoing for the life of the project (up to 30 years). | Temporary | Construction and operation | Low / Moderate. Breeding habitats supported by hollow-bearing trees and nest trees have the potential to be indirectly impacted during construction of the project via noise, dust, vibration, lights etc, and during operation by the noise, movement and potential changes to air pressure surrounding operation turbines. Where nests occur adjacent to the construction and operational footprint of the wind farm indirect impact may occur. Impacts will be managed and mitigated through monitoring and adaptive management via the |

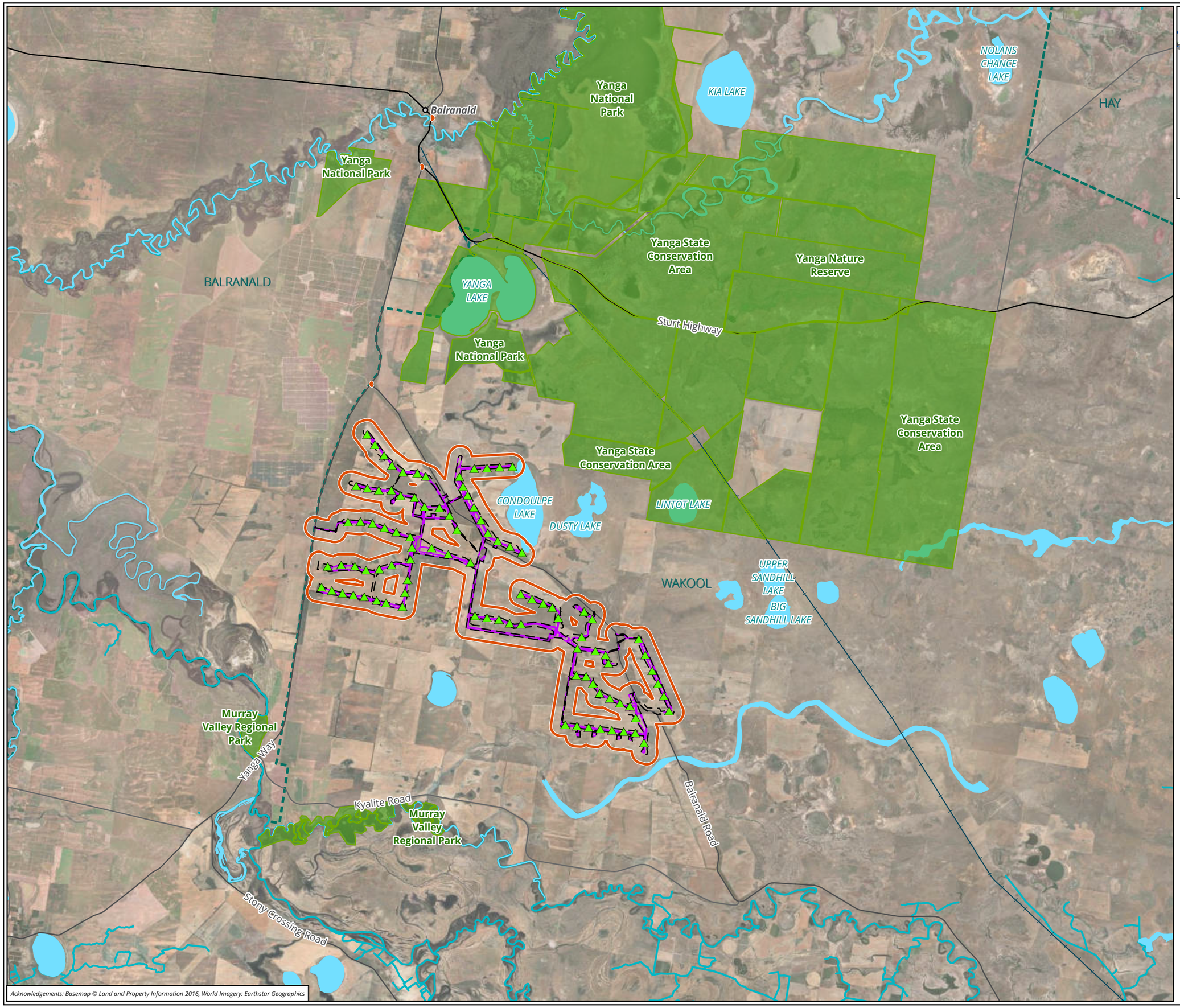
| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| | | the end of the turbine blades. | | | | BBAMP, and operational/construction restrictions may occur if breeding is confirmed. |
| **Trampling of threatened flora species** | • Population of avoided populations of Bitter Quandong, and to a lesser extant *Austrostipa metatoris* identified within the subject land. | Areas of known and potential habitat within retained vegetation. | Ongoing for the life of the project (up to 30 years). | Temporary | Construction and operation | Low. Known threatened species recorded within the subject land have been avoided. Species that occur within retained vegetation will be protected, improved and maintained. Principals will apply within the BMP to ensure retained areas of adjacent habitat and individuals do not decline or are subjected to adverse impacts. Grazing will be managed wherever possible to ensure potential trampling from livestock is minimised. |
| **Inhibition of nitrogen fixation and increased soil salinity** | • Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Negligible. Any future excavations or soil disturbance resulting from the future development of the subject land would be largely restricted to areas having undergone significant previous disturbance through grazing, cropping and vehicular traffic. As such it is not considered likely that the future development of the subject land would result in substantial changes to the level of nitrogen fixation or soil salinity in the locality. |
| **Fertiliser drift** | • Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Negligible. The site has a long history of grazing and cropping over its total extent. The project will cease these activities within the development footprint and not contribute to fertiliser drift into surrounding areas with future practices. No fertiliser is proposed to be used for the project.<br>Grazing is still active in some areas.<br>Current cropping regimes are expected to be |

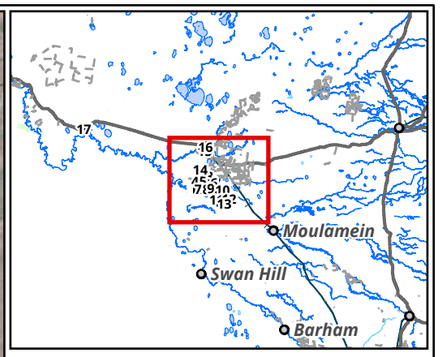
| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| | | | | | | reduced marginally through the reduction of cropping land during the construction phase. |
| **Rubbish dumping** | • Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Negligible. Standard environmental controls for the development would ensure potential impacts are minimised. Works would follow an approved Waste Management Plan.<br>Any dumped rubbish, or farm waste identified during the construction phase will be removed and transported to a licenced facility. |
| **Wood collection** | • Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Negligible. Not expected to result from the development. Future development proposed within the subject land is unlikely to increase access to any retained vegetation, beyond current access capacity. Based on the future use of the subject land, future landholders are not expected to be likely to undertake wood collection beyond existing rural approvals within the retained vegetation to a level that it will have a detrimental effect. Unauthorised access and collection of wood is expected to be negligible. |
| **Removal and disturbance of rocks** | • Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Negligible. The subject land does not support bush rock. |
| **Increase in predators and pest animal populations** | • Fauna species, including assumed ecosystem credit species and potentially Major Mitchells Cockatoo and Regent Parrot. | Adjacent to the development footprint and potential into the broader landscape. | Ongoing for the life of the project (up to 30 years). Highest potential for occurrence is during construction. | Temporary and permanent | Construction and operation | Low / Moderate. The subject land occurs in a rural landscape with known presence of introduced domestic livestock and established populations of feral species such as cats *Felis catus*, European Rabbit *Oryctolagus cuniculus*, European Hare *Lepus europaeus* and European Red Fox *Vulpes vulpes*.<br>A change in the general landscape, such that an |

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| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| | | | | | | increase in feral species occurs is not expected from the project. The project is not expected to increase numbers with required mitigation, however movement through the subject land may be considered to be exacerbated with construction and improved access roads through the subject land. The BMP and BBAMP will detail pest management regimes in order to control foxes and other predators within the subject land during construction and operations. |
| **Changed fire regimes** | • Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Unlikely to occur | Negligible. Fire mitigation systems will be implemented for the future development and the project will not result in an increased risk of fire. |
| **Fragmentation of movement corridors** | • All ecosystem credit species assumed present.<br>• Known threatened fauna species habitat.<br>• Avoided Bitter Quandong population.<br>• Avoided *Austrostipa metatoris* population. | Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m buffer. | Ongoing for the life of the project (up to 30 years). Most substantial during construction. | Temporary and permanent | Construction and operation | Low. The removal of vegetation associated with the project may impact upon movement corridors at the site scale and the landscape scale and have been addressed further under Prescribed Impacts in Section 8.3 below. |
| **Impacts to biodiversity values supported by Yanga National Park, Yanga State Conservation** | • Yanga National Park, Yanga State Conservation Area, Yanga Nature Reserve comprise a total area of 71,711 ha.<br>Supports River Red Gum forests, Black Box Woodland, Lignum, Shrubland, Nitre Goosefoot | Potential indirect impacts associated with movement of species in/out and between conservation areas. | Ongoing for the life of the project (up to 30 years). | Temporary and permanent | Construction and operation | The operational wind farm will result in infrastructure occurring in the vicinity of these conservation areas that has the potential to affect landscape-scale movements of species into, out of, and potentially between the habitats protected in these reserves. However the location of the subject land, in relation to these reverse, will not result in any substantially large |

| Indirect impact | Impacted entities | Extent | Frequency | Duration | Project phase/ timing of impact | Likelihood and consequences |
|---|---|---|---|---|---|---|
| **Area, Yanga Nature Reserve and/or Murray Valley Regional Park** | Shrubland, Sandhill Pine Woodland EEC, Acacia melvillei Shrubland EEC and Myall Woodland EEC.<br>Contain almost 14% of the Lowbidgee Floodplain, portions of which are listed on the Directory of Important Wetlands in Australia and supports some of the largest waterbird breeding colonies in Australia. (NPWS 2020)<br>• Murray Valley Regional Park comprises numerous separate precincts spread over approximately 300 km along the Murray, Wakool and Edward Rivers, with two areas along the Wakool and Edward Rivers proximal to the subject land.<br>The park supports wetland ecosystems including River Red Gum and Black Box Woodlands, terrestrial woodland EECs, as well as habitat for multiple migratory bird species and listed threatened flora and fauna. (OEH 2014) | | | | | barriers to movements at this landscape scale due to the large perimeter and areas each reserve supports. The portion of the Murray Valley Regional Park proximal to the subject land is far smaller in areas than the combined Yanga reserves, however it forms part of a large contiguous habitat corridors along the Edward / Wakool Rivers that would not be substantially impacts by potential barriers caused by operational turbines.<br>The nearest turbine to the Yanga State Conservation Area occurs within 2.7 km from the park boundary, however the size of the contiguous combined areas means that this nearest turbine occurs almost 60 km from the northern boundary of Yanga National Park. The nearest turbines occur between 7-8 km from the boundary of the Murray Valley Regional Park. Sufficient setbacks from the boundaries of the conservation reserves will ensure that no indirect impacts associated with construction such as light, noise, dust etc will occur, and operational impacts will be limited to potential effects to landscape-scale species movements. Further assessments included herein on potential impacts to species supported by the conservation areas (refer Sections 4, 5, 6, 8.3 and Appendix 5) have concluded that substantial or significant impacts are unlikely, and thus impacts to the conservation areas themselves are considered to align with these conclusions. |




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- National Park/Reserve

**Figure 18.1 Indirect impacts**

0 2,000 4,000 6,000 8,000

Meters

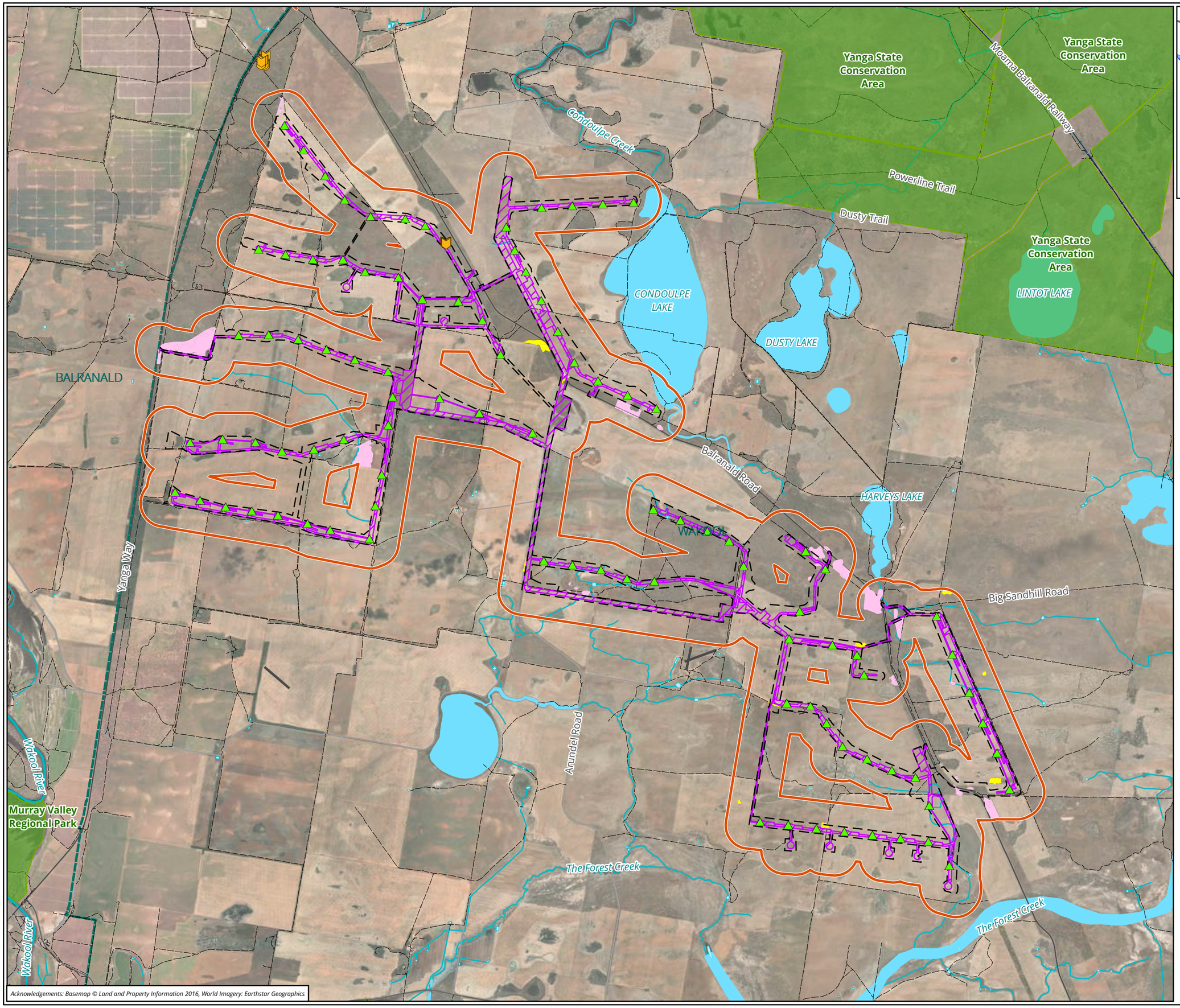
Scale: 1:180,000 @ A3

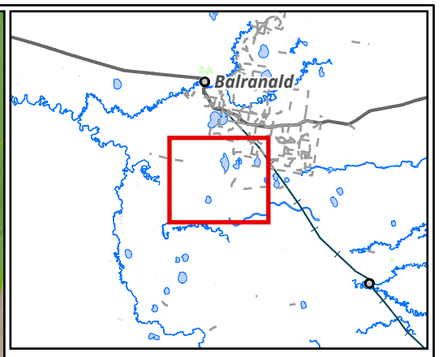
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 17 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F18.1_IndirectImpacts




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- National Park/Reserve

**Threatened ecological communities**

- *Acacia melvillei* Shrubland
- Sandhill Pine Woodland
- Threatened flora (Biosis)

**Figure 18.2 Indirect impacts**

0 750 1,500 2,250 3,000

Meters

Scale: 1:75,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F18.2_IndirectImpacts

## 8.3. Prescribed impacts

Identification and assessment of prescribed biodiversity impacts are outlined and addressed in Table 52, and the section below, and shown in Figure 19.

**Table 52 Identification of prescribed impacts**

| Prescribed impact | Description of relevant habitat features associated with prescribed impacts | Threatened species likely to utilise habitat features associated with prescribed impact | Importance of habitat feature to impacted species |
|---|---|---|---|
| **Karst, caves, crevices, cliffs, rocks and other geological features of significance** | No karst, caves, crevices, cliffs, rocks or other geological features of significance are located within the development site. | When containing water, migratory species, and fauna species have the potential to use Condoulpe Lake. | The entire lake area, including surrounding vegetation has been avoided wholly by the proposed development. |
| **Occurrences of human-made structures and non-native vegetation** | Human made structures are present within the subject land. Within the development site the following human made structure are present:<br>• Dams.<br>• Windmills.<br>• Fences.<br>• Farm tracks.<br>• Formed public roads.<br>• Water troughs.<br>• Non-native vegetation occurs, predominately In the form of cropped land, and exotic components of retained native vegetation. | Avian fauna species are known to utilise artificial and human made structures such as windmills for nesting due to historic clearing of native vegetation. Dams and water troughs are utilised by fauna species as permanent water resources throughout the year, some dams are created in areas that likely originally supported natural ephemeral billabongs.<br>Exotic vegetation, including cropped land is known to be utilised by raptor species for foraging. | Where possible, features such as dams, windmills and water troughs should be avoided during micro-siting of the project as they aid is supporting, mainly fauna, populations within the subject land.<br>These features hold a low level of biodiversity value, generally due to their degraded nature from livestock use (dams), or their lack of natural features (windmills and troughs).<br>Exotic vegetation, although utilised by many raptor species holds a low biodiversity value. |
| **Corridors or other areas of connectivity linking habitat for threatened entities** | Natural corridors in the form of native vegetation and riparian watercourses in both a project level scale and broader landscape scale occur. | All threatened fauna, flora and TECs within the landscape. | Connectivity corridors have a high biodiversity importance. |
| **Water bodies or any hydrological processes that sustain threatened entities** | Condoulpe Lake is a large wetland feature within the subject land. It is mapped as a 'natural waterbody' and is described as mainly dry, however an assessment of historic imagery shows the lake bed has been subject to grazing and cropping since at least 1961.<br>A number of watercourses occurs within the subject land. The project design as avoided the majority of riparian areas. | When containing water, migratory species, and fauna species have the potential to use Condoulpe Lake.<br>Riparian areas are utilised by fauna species as connectivity corridors. | The entire lake area, including surrounding vegetation has been avoided wholly by the proposed development.<br>The majority of riparian areas have been avoided through detailed design. Some impacts to mapped, undefined watercourses degraded through historical agricultural use are proposed. |

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| Prescribed impact | Description of relevant habitat features associated with prescribed impacts | Threatened species likely to utilise habitat features associated with prescribed impact | Importance of habitat feature to impacted species |
|---|---|---|---|
| **Protected animals that may use the proposed wind farm development site as a flyway or migration route** | See Section 8.3.5. | See Section 8.3.5. | See Section 8.3.5. |
| **Where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community** | The project has the potential to result in increased vehicle strikes during the construction and operational phase of the project as a result of increased vehicle moments, and in particular heavy vehicles. Key areas where this is expected to occur are Yanga Way, Balranald-Moulamein Road, Arundel Road and Big Sandhill Road. | All fauna. | It can reasonably be expected that the potential for vehicle strikes can be effectively managed. The project is not expected to result in any substantial or significant impacts associated with vehicle strikes. |

### 8.3.1. Human-made structures and non-native vegetation

#### Nature

Human made structures were identified within the subject land. Within the development site the following human made structure are present:

- Dams.
- Windmills.
- Fences.
- Farm tracks.
- Formed public roads.
- Water troughs.

#### Extent

Human made structures within the development site included numerous fences and farm tracks. The Subject land is bisected and/or bordered by three public roads. Windmills were not recorded. At least one water trough and approximately nine farm dams are located within the development footprint.

#### Duration

Roads, farm tracks and fences may be subject to modification and upgrade from the outset of the project. Existing windmills and dams, troughs within the final micro-siting of the development footprint are likely to be permanently removed.

#### Consequences

Avian fauna species are known to utilise artificial, and human made structures such as windmills for nesting due to historic clearing of native vegetation. No nests were recorded on manmade structures within the subject land. The consequence of the removal of these features is considered to be low.

Dams and water troughs are utilised by fauna species as permanent water resources throughout the year, some dams are created in areas that likely originally supported natural ephemeral billabongs. Where possible, features such as dams and water troughs should be avoided during micro-siting of the project as they aid is supporting, mainly fauna, populations within the subject land. The consequence of removing dams and troughs, within the broader landscape is considered low, where large water features such occur. However, at a microscale, any fauna species present in dams such as common frog, yabby or turtle species may be required to relocate to nearby areas of similar habitat. Any dams to be removed should be subject to mitigation measures, including draining several days prior to removal, and should have an appropriately qualified individual present to relocate any large fauna such as turtles.

### 8.3.2. Non-native vegetation

#### Nature

Non-native vegetation within the subject land occurred predominately in two forms, cropped land and as naturalised components in retained native vegetation areas.

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### Extent

A large portion of the subject land is comprised of cropped land, around 8,500 hectares of mapped Category 1 – Exempt land is present. Within areas mapped as native vegetation non-native species occurred as components, generally of the ground or shrub stratum. Refer to Appendix 3 for detailed list of exotic flora identified within the subject land.

### Duration

Permanent and from the outset of the project.

### Consequences

Exotic vegetation, including cropped land is known to be utilised by fauna species, such as parrots, raptors and large mammals (e.g., Kangaroo) for foraging. Exotic vegetation, although utilised by some fauna species is considered to have a low biodiversity value. Impacts to non-native vegetation will not have more than a negligible impact to threatened and non-threatened species.

## 8.3.3. Habitat connectivity

### Nature

Within the subject land, two key features form habitat connectivity, these are riparian areas and native vegetation. Watercourses, including the Forest Creek, Condoulpe Creek and a number of unnamed watercourses form a network within the subject land leading to or from larger features such as Condoulpe Lake and Lake Talbetts. Within the broader landscape, these watercourses form part of a large network of ephemeral and nonephemeral watercourses and waterbodies, including Yanga Lake and Wakool River, and further abroad, the Murray River and Lachlan River.

Native vegetation within the subject land, forms both a mosaic of small, fragmented patches, scattered trees and large areas of remnant, regenerated and disturbed native vegetation. Within the subject land, the fragmented patches of vegetation act as steppingstones between larger areas of native vegetation, which in turn, connect to important habitat corridors. The majority of Yanga Way and Balranald-Moulamein Road contain low – high condition native vegetation in a network of TSRs.

Habitat connectivity is mapped on Figure 13.

The key connectivity features relevant to the subject land are:

- The uncleared riparian corridor following Condoulpe Creek into the Yanga National Park, Yanga Nature Reserve, and Yanga State Conservation Area, Yanga Lake and Murrumbidgee River to the north of the subject land.
- The vegetated road reserves of Balranald-Moulamein Road and Yanga Way leading north through a series of TSRs to the Yanga National Park, Yanga Nature Reserve, Yanga State Conservation Area and Murrumbidgee River and south to the Murray Valley Regional Park, Edwards River and Wakool River.

The subject land occurs within the Murry Darling Depression and Riverina IBRA bioregions and the Murrumbidgee and South Olary Plain IBRA subregions. The Riverina IBRA region lies in south-west NSW, extending into central-north Victoria and the Murray Darling Depression Bioregion lies in south-west NSW and extends into Victoria and South Australia. These IBRA regions contain the Murray and Murrumbidgee

Rivers and their major tributaries, the Lachlan and Goulburn Rivers, flow from the highlands in the east, westward across the Riverina plain (*Bioregions of NSW*, 2003) and covers approximately 19,717,651 ha. The region occupies 10.03% of NSW and is bounded in the north by the Broken Hill Complex Bioregion, with the Cobar Peneplain to the north-east and the Riverina Bioregion to the east. The Murray Darling Depression Bioregion also borders the Darling Riverine Plains to the north-west and contains outlying remnants of the Darling River and tributaries as they meet the Murray River at the Victorian border (*Bioregions of NSW*, 2003).

### Extent

A total of 75.68 hectares of native vegetation to be removed. The proposed wind farm occurs across approximately 9000 hectares, with 96 turbines proposed, the design of which reduces the potential impact to habitat connectivity by allowing strategic placement of infrastructure within the landscape. This includes avoidance and minimisation of impacts to waterbodies, riparian zones, and TSRs.

Increased fragmentation within the finer scale of the subject land is expected to occur as a result of the project through direct removal of native vegetation, including removal of paddock trees, removal of small, isolated patches of vegetation, increased edge effect and reduction in the size of larger areas of native vegetation.

Barrier effect and collision risk have been minimised as a result of the proposed layout of WTGs, with substantial areas of airspace remaining available for birds and bats to move through once the wind farm becomes optional. The south-eastern potion of the wind farm encompasses the area where turbines remain closest together and RSA separation is lowest (WTGs 46 – 55), however bird and bat movement through this area are unlikely to be as common as elsewhere within the subject land due to a lack of habitat features providing or eliciting flyways compared to elsewhere within and surround the subject land (Figure 15).

Access road upgrades, and installation of internal access roads will increase the extent of barrier effect, however, measures have been taken to avoid and minimise this impact, such as:

- Use of existing tracks, roads and fence lines to delineate sections of the project and used preferentially for locating access tracks and linear infrastructure.
- Commensurate reduction in impact associated with electrical reticulation and access tracks not being required within the southern-most patch of mallee woodland (known Regent Parrot habitat).
- Access tracks from Balranald-Moulamein Road to infrastructure proposed within the adjacent paddock have been located avoid impacts to the TEC wherever possible.

### Duration

Impacts are considered long-term as they will occur over the 30-year life of the project. Following the 30-year life, impacts may be removed if the wind farm is decommissioned.

### Consequences

Connectivity within the development site will be impacted, this impact is considered minor at a large scale due to the presence of key connectivity corridors in the form of native vegetation and TSRs along Yanga Way and Balranald-Moulamein Road. At the scale of the subject land, key consequences of the development include an increase of fragmentation and edge effect.  All threatened species and ecological communities rely on habitat connectivity to some degree to maintain genetic diversity and to allow for adaption to threatening processes.

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The proposal is expected to reduce the width of habitat connectivity areas, but will not remove any key areas of connectivity. Key connectivity through the subject land, to important wildlife corridors will be maintained. The proposed development will not result in the loss of, or substantial impacts to key functional corridors within the landscape. It is expected that fauna species will continue to utilise the existing corridors within the subject land and broader landscape, with minor or negligible impact to movement patterns and/or population viability.

In addition to the threat of direct loss of habitat from windfarm construction, wind farm impacts on birds and bats can arise from three potential pathways listed below:

- Direct collision of birds and bats with towers and/or operating wind turbine blades at RSA heights.
- Disturbance effects that exclude birds and bats from habitat within the wind farm.
- Barrier effects that limit bird and bat movements between essential resources, such as foraging and roosting areas (Nature Advisory 2023f).

An assessment against the collision and barrier effect risk was completed by Nature Advisory (refer to section 5.2 and 6). This assessment did not find any birds to be at more than a 'Negligible' risk of indirect disturbance from barrier effects (Nature Advisory 2023f).

Additional to this, a 'nearest neighbour analysis' undertaken in GIS has determined that the average gap between RSAs along strings of turbines throughout the subject land is approximately 450 metres. There is evidence that birds are known to fly through gaps in turbine less than half this size (see Section 8.3.5), thus the current separation is considered to minimise potential barrier effects along turbine strings.

Habitat connectivity will be maintained, where:

- The proposed design was sited, where possible within areas of non-native vegetation to avoid and minimise impacts to native vegetation.
- Impacts to key movement corridors and TSRs have been avoided and minimised to the fullest extent possible. This includes avoidance of impacts through redesign and setbacks from 10 Mile TSR along the project's western boundary, and minimisation of the size and number of crossings of Balranald-Moulamein Road impacting upon higher condition native vegetation within the Lillas Dam and Yards and the 19 Mile Balranald-Moulamein Road TSRs.
- As outlined above, substantial efforts have been made to maximise separation distances between WTG RSAs for the proposes of maintaining habitat connectivity for birds and bats through and within the wind farm.
- Habitat connectivity was considered, the proposed design was sited to reduce edge effect by avoiding and minimising large areas of native vegetation where possible.
- Existing tracks and disturbed areas were used to avoid and minimise impacts to less disturbed areas.
- Key waterbodies and sources within the subject land have been avoided, including, Condulpe Lake, Condulpe Creek, The Forest Creek and majority of the watercourses feeding into Lake Talbetts directly west of the subject land.
- Where impacts to mapped watercourses are expected to occur, this has been limited to watercourses modified and disturbed from historic agricultural use and clearing.

Additional to the above, two locations within 2.5 kilometres of the subject land are under assessment for feasibility of establishment as Biodiversity Stewardship Sites to offset the impacts of the project. Once active management has commended, a management plan will be implemented ensuring ongoing restoration and

management of the lands proximal to the subject land, helping to compensate and minimise the impact of habitat loss for local populations of biodiversity values. Management actions will prevent indirect degradation of the vegetation within areas connected to the subject land via natural corridors.

### 8.3.4. Water bodies, water quality and hydrological processes

#### Nature

Waterbodies and hydrological process occur within the subject land. Impact associated with groundwater are assessed within Section 8.4 below. Impacts associated with the alteration to surface water, water quality and direct removal of dams are detailed here, these are:

- Discharges from the construction and operational site, especially into waterways.
- Dewatering and removal of dams.
- Further modification of watercourses.

#### Extent

Five Strahler Stream Order (SSO) one and two SSO two watercourses bisect the development footprint. These watercourses are undefined, unnamed and non-perennial. In general, these watercourses likely formed part of a mosaic of creeks, wetlands and billabongs within the landscape, however the watercourses to be impacted are significantly modified from historical agricultural use and clearing of the landscape, with a number of human made features, such as tracks, cropped paddocks and fences segmenting them.

Nine farm dams are currently located within the proposed development footprint.

Condoulpe Lake occurs within the subject land. This lake is mapped as a natural waterbody that is 'mainly dry'. An assessment of historical and aerial imagery notes that seasonal cropping of the lakebed has occurred since at least 1961 (NSW Spatial Services 2024). To ensure impacts to Condoulpe Lake were accurately assessed, the lake area was mapped as native vegetation.

There is Key Fish Habitat as mapped by the NSW Department of Primary Industries (DPI) within the subject land and within the adjacent area (DPI 2013). The Key Fish Habitat runs from Lake Talbetts (west of the subject land), through an unnamed ephemeral watercourse within the subject land and into The Forest Creek where it exits the subject land.

No watercourses within the subject land are identified within the NSW DPI Freshwater Fish Community map (DPI 2023). The nearest mapped freshwater fish community is the Eward River south of the subject land, which is identified as occurring in 'Poor' condition. Given this, it is unlikely any watercourses within the subject land would be considered higher than 'very poor' condition. The subject land falls within the polygon of potential habitat for the Murray Hardhead *Craterocephalus fluviatilis*, a small freshwater fish listed as Endangered under the EPBC Act and Critically Endangered under the FM Act.

#### Duration

From the outset of the project.

#### Consequences

Water management will be covered within the CEMP to ensure:

- Minimisation of discharge from the construction and operational site.
- Maintaining current water flow regimes within the landscape of the subject land.
- Providing industry best practice erosion and sedimentation controls.

It is unlikely that the proposed construction would alter the surface drainage, or flow regimes of watercourses within the landscape such that, any more than negligible changes to the water regime would be observed. Watercourses bisecting the development footprint are degraded, and heavily segmented and modified from historical agricultural activities, including cropping, grazing, clearing and construction of fences, farm tracks, channels and dams.

Given the disturbed, modified and non-perennial nature of the watercourses within the subject land, it is considered unlikely that threatened fish species occur. Such species occur in lakes and billabongs, and may occur within Condoulpe Lake. Condoulpe Lake within the subject land is identified as a dryland lake, filling only during above average rainfall events and is utilised for agricultural cropping and grazing.

The proposed wind farm does not include works within key areas of aquatic habitat. No works are proposed within at least 600 metres of Condoulpe Lake, The Forest Creek (and associated tributaries within the subject land) and the associated areas of Key Fish Habitat.

The proposed wind farm is not considered an action that would alter the surface drainage, natural drainage systems or flow of watercourses within or adjacent to the subject land. No instream woody debris removed and no modification to key areas of aquatic habitat is proposed. As such, a permit under Part 7 of the FM Act is not required.

Consequence of farm dam removal is discussed within Section 8.3.1 above.

### 8.3.5. Wind farm developments

As outlined in Section 6.2 a numerical collision risk model (CRM) has not been run for the project. As such predictions made relating to the rate and timing of impact per turbine per year for species likely to be affected are based on the qualitative assessments completed for the project, outlined in Section 6.1, and attached as Appendix 9.

Table 53 below provides a summary of the predicted impacts (BAM s.8.3.5.1 (a)i), rate and timing of impacts (BAM s.8.3.5.1 (a)ii), and potential consequence of impacts (BAM s.8.3.5.1 (a)iii) associated with wind farm developments, focussed on potential turbine collisions, with more detailed assessment of these impacts provided in the following sections. These predictions are based on the risk assessments completed/summarised in Sections 6.1 and 6.3 above, and Appendix 9 below).

**Table 53 Prescribed impact assessment – wind farm developments**

| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| **Australasian Bittern** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Australasian Darter (Arrgarrg)** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Australasian Shoveler** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Australian Pelican** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Black Falcon** | No | Turbine strike | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines) | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collision more likely to occur between spring and autumn | | | | |
| **Black Kite** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Black Swan** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | Addressed below |
| **Black-and-white Shag (Pied Cormorant)** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Black-shouldered Kite** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Blue-billed Duck** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines). | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collisions more likely to occur between spring and autumn. | | | | |
| **Brown Falcon** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Brown Goshawk** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Caspian Tern** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | Addressed below |
| **Fork-tailed Swift** | No | Turbine strike | • 50% likelihood of a strike occurring in a given year<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur between spring and early autumn | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | Addressed below |
| **Gould's Wattled Bat** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines) | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collision more likely to occur over spring and summer | | | | |
| **Great Cormorant** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Grey (Oceanic) Teal** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Gull-billed Tern** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | Addressed below |
| **Little Black Cormorant** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Little Eagle** | No | Turbine strike | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines) | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collision more likely to occur at any time of year | | | | |
| **Little Pied Cormorant** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Major Mitchell's Cockatoo** | No | Turbine strike | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Maned Duck (Australian Wood Duck)** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx.2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Nankeen Kestrel** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year. | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Pacific Black Duck** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines). | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collisions more likely to occur between spring and autumn. | | | | |
| **Peregrine Falcon** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year. | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Pink-eared Duck** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Regent Parrot (eastern subspecies)** | No | Turbine strike | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines).<br>• Collision more likely to occur at any time of year. | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Straw-necked Ibis** | No | Turbine strike | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines)<br>• Collision more likely to occur at any time of year. | Collisions are not expected to be high in number and given the apparently low presence of the species in the study area, would likely be relatively infrequent, and unlikely to significantly impact even the local population. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Wedge-tailed Eagle** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines) | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collision more likely to occur at any time of year | | | | |
| **Whiskered Tern** | No | Turbine strike | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx. 2% of turbines).<br>• Collisions more likely to occur between spring and autumn. | Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Whistling Kite** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines).<br>• Collision more likely to occur at any time of year. | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **White-bellied Sea-Eagle** | No | Turbine strike | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines).<br>• Collision more likely to occur at any time of year. | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **White-striped Freetail-bat** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines).<br>• Collision more likely to occur over spring and summer. | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |
| **Yellow-bellied Sheathtail-bat** | No | Turbine strike | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx. 6% of turbines) | Repeated loss of small number of individuals but no reduction in population viability. | Likely – further addressed below | Addressed below | N/A – Not a migratory species |

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| Protected / threatened species | SAII entity | Predicted impact | Rate & timing of impact per turbine per year | Consequences | Cumulative impact | Likelihood and nature of impacts | Impact of avoidance behaviour |
|---|---|---|---|---|---|---|---|
| | | | • Collision more likely to occur over spring and summer | | | | |

### a) Predict the impact on species living in, or likely to fly over, the proposed development site, including bat or bird strike and barotrauma.

Impacts that have the potential to occur to bird and bat species within the subject land during the operational phase of the project are associated with turbine strike, as outlined in Table 53 above.

Whilst impacts to microbat species may occur as a result of turbine strike, it is considered unlikely that additional impacts will occur as a result of barotrauma. A paper published in December 2020 in the journal PLOS One, by Lawson et al, describes how mortality as a result of barotrauma is unlikely to occur due to the areas where exposure to the level of pressure variation required to cause mortality are present only in the immediately vicinity of the turbine blades, and that flight paths required for bats to be exposed to these areas are highly improbable. As such, even a small change in flight path would result in the bat being hit by the blade or experiencing a much smaller pressure change. Furthermore, the magnitude of the low-pressures bats could experience when flying near wind turbines is approximately 8 times smaller than the pressure that causes mortality in rats, the smallest mammal for which data are available. The magnitude of the high-pressures that bats may experience are approximately 80 times smaller than the exposure level that causes 50% mortality in mice, which have a body mass similar to several bat species that are killed by wind turbines in the United States (Lawson et al 2020).

The study concludes that, if bats have a physiological response to rapid low- and high-pressure exposure similar to that of other mammals, that it is unlikely that barotrauma is responsible for a significant number of turbine-related bat fatalities, and that impact trauma is the likely cause of the majority of wind-turbine-related bat fatalities. (Lawson et al. 2020).

The level at which turbine strike is likely to occur is difficult to predict prior to commissioning of turbines, and as such impacts are considered uncertain. A monitoring and adaptive management approach has been developed to ensure any impacts that may occur are realised as early as possible, mitigation is implemented (where possible) to minimise the potential for the impact to reoccur, and where relevant calculate an offset requirement for the impacted entity.

As outlined in Table 53 above:

- For 11 at risk bird and bat species it is considered more probable than not that a strike event could occur in any year (>50%).
- For 1 at risk bird species it is considered equally probable that a strike event could or could not occur in any year (50%).
- For 6 at risk bird species it is considered less probable than not that a strike event could occur in any year (< 50%).
- For 19 at risk bird species it is considered that an event may occur only in unusual circumstances (less than 5 %).

When the consequence of predicted strike events is considered, all of the above at risk species are predicted to be subject to:

- Repeated loss of small number of individuals but no reduction in population viability.
- Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years.

Those species considered most sensitive to the predicted impacts are assessed further below.

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**Table 54 Potential impacts to identified 'more sensitive' at risk species**

| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| **Australasian Bittern** | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx.2% of turbines).<br>• Collisions more likely to occur between spring and autumn.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | As outlined in Section 6.1.4 above, a detailed literature review of the potential use of the subject land by Australasian Bittern has been completed by Nature Advisory (refer Appendix 9 for full report). Key findings of this review included:<br>• The species may occur within wetland habitats present in the subject land during flood years, which are predicted to occur around once over the estimated 20-year lifespan of the operational wind farm.<br>• The species is known to fly at RSA height, most likely to occur on approach into, and exit out of, wetlands within the subject land during the start and end of breeding.<br>• Three two-way flight long-distance routes (six routes in total) have been determined which may result in the species occurring within the operational wind farm during regular (yearly) nomadic movements.<br>• The species is known to make long-distance flights at night and in low-light conditions, however these flights are likely to be well above RSA height.<br>Based on the above there are potential for impacts to Australasian Bittern during the operational phase of the project during the (predicted) infrequent flood years when habitats in areas such as Condoulpe Lake may be used as breeding habitat, and more temporally frequent but of lower likelihood during yearly nomadic movement between coastal and inland habitats.<br>As with other water birds, a 400 m operational turbine exclusion buffer from wetland habitats is expected to be sufficient to prevent collisions during flights into / out of breeding habitats (Nature Advisory 2023e), and this will be employed via turbine curtailments during time when wetland habitats exist within the subject land. Further detail around triggers for the implementation of these operational curtailment will be developed in the finalisation of the BBAMP.<br>The potential for impacts to the species during yearly nomadic flights between coastal and inland habitats is considered possible but low. Flights at night and during low light condition increase the potential for collisions, however as flights are generally above RSA height the frequency of collisions is not expected to be high. The BBAMP includes specific monitoring requirements timed to coincide with these nomadic movement for Australasian Bitterns (September to early-December and February to early-April), to ensure that any potential impacts that may occur are captured and suitable mitigation and adaptive management strategies are employed, to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Black Falcon** | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines) | Black Falcon was recorded twice within the subject land in 2022 during BUS undertaken by Nature Advisory. The two observations were made during the beginning and middle of the species' breeding season (June to December), however the species has not been considered 'resident' due to the low number of total observations. The species is highly mobile, moving in response to food availability and seasonal conditions(Marchant & Higgins 1993, Nature Advisory 2023a). |

| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| | • Collision more likely to occur between spring and autumn.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | The species is known to fly at RSA height and potential collisions could occur between spring and autumn when the species is searching for prey, and potentially breeding within the vicinity of the subject land. The species is considered to be at risk of collision with a relatively high number of turbines throughout the subject land, 6 high risk turbines in total, however the spacing between RSAs (as detailed in Section 7.1) is considered to provide adequate blade-free areas in/around the subject land to minimise the risk of collision.<br>Should the species be subject to collision, a worst-case scenario would be that a moderate loss in numbers of individuals could lead to minor reduction in population viability for between one and five years. This could be potentially more significant if impacts were to occur to either breeding pairs, leaving chicks unable to be raised by one or both parents reducing the likelihood of the chick survival, or to fledged juveniles leading to impacts to the next generation of birds placing increased stress of future generations of the local population.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Blue-billed Duck** | • 5% likelihood of a strike occurring in a given year.<br>• 2 relevant high-risk turbines (approx.2% of turbines).<br>• Collisions more likely to occur between spring and autumn.<br>• Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. | Nature Advisory completed a review of the ecological literature and previous records concerning waterbirds in the Riverina region, surrounding the proposed Junction Rivers Wind Project. This assessment considered Blue-billed Duck, and found the following (Nature Advisory 2023e):<br>• Adults are considered likely to be confined to their preferred deep-water habitat within Yanga Lake and are considered unlikely to enter the airspace of the wind farm.<br>• Fledglings have the potential of entering the proposed wind farm airspace when dispersing from Yanga Lake.<br>• A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions.<br>Potential collisions with turbines are considered likely to be rare for this species and are only likely to occur during the (predicted) infrequent flood years when habitats are present in areas such as Condoulpe Lake. During these times a 400 m operational turbine exclusion buffer from wetland habitats will be implemented to minimise the potential for collision. Further detail around triggers for the implementation of these operational curtailment will be developed in the finalisation of the BBAMP.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |

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| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| **Fork-tailed Swift** | • 50% likelihood of a strike occurring in a given year<br>• 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur between spring and early autumn.<br>• Repeated loss of small number of individuals but no reduction in population viability. | Fork-tailed Swift was not recorded within the subject land during 24 months of BUS completed by Nature Advisory. The species is known to fly regularly at RSA height and has been known to collide with turbines wind farms elsewhere in NSW and eastern Australia (Nature Advisory 2023f).<br>The potential for occurrence of the species within the subject land is considered relatively low, with a paucity of the species' records in the broader region, however if present the potential for turbine strike is relatively high. It is considered unlikely, but possible, that repeated loss of small number of individuals may occur, however no reduction in population viability would be expected.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Little Eagle** | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur at any time of year.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Little Eagle was not recorded within the subject land during 24 months of BUS completed by Nature Advisory. The species is known to be in a state of decline in NSW, and the subject land is considered to be potential habitat, albeit likely utilised on an infrequent basis (Nature Advisory 2023f).<br>The potential for occurrence of the species within the subject land is considered relatively low, with a paucity of the species' records in the broader region, however as with other raptor species it is likely to fly at RSA height and collision is possible. Collisions could occur when the species is searching for prey, and potentially during breeding season. The species is considered to be at risk of collision with a relatively high number of turbines throughout the subject land, 6 high risk turbines in total, however the spacing between RSAs (as detailed in Section 7.1) is considered to provide adequate blade-free areas in/around the subject land to minimise the risk of collision.<br>Should the species be subject to collision, a worst-case scenario would be that a moderate loss in numbers of individuals could lead to minor reduction in population viability for between one and five years. This could be potentially more significant if impacts were to occur to either breeding pairs, leaving chicks unable to be raised by one or both parents reducing the likelihood of the chick survival, or to fledged juveniles leading to impacts to the next generation of birds placing increased stress of future generations of the local population.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Major Mitchell's Cockatoo** | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines) | As outlined in the previous section of this BDAR, Major Mitchell's Cockatoo has been recorded numerous times throughout biodiversity surveys undertaken for the project and is considered resident and likely to be breeding within the subject land. As such, the relatively high numbers of individuals and associated activity mean the species is at relatively high risk of turbine collision during the operational phase of the project. |

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| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| | • Collision more likely to occur at any time of year.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | However, the species was not recorded flying at RSA height during the 24 months of BUS completed by Nature Advisory, which included 93 BUS observations, and a further 114 observations incidentally, which illustrates the rarity of potential collisions.<br>Collisions could however occur at any time of year when the species is foraging or dispersing within/from the subject land, including during breeding season. The species is considered to be at risk of collision with a relatively high number of turbines throughout the subject land, 6 high risk turbines in total, however the spacing between RSAs (as detailed in Section 7.1) is considered to provide adequate blade-free areas in/around the subject land to minimise the risk of collision.<br>Should the species be subject to collision, a worst-case scenario would be that a moderate loss in numbers of individuals could lead to minor reduction in population viability for between one and five years. This could be potentially more significant if impacts were to occur to either breeding pairs, leaving chicks unable to be raised by one or both parents reducing the likelihood of the chick survival, or to fledged juveniles leading to impacts to the next generation of birds placing increased stress of future generations of the local population.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Regent Parrot (eastern subspecies)** | • <50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur at any time of year.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | As outlined in Section 6.1.5, Nature Advisory completed a targeted assessment of Regent Parrot for the proposed Junction Rivers Wind Project, to provide detailed information on the utilisation of the subject land by the species. A total of 117 Regent Parrots were observed during the 24 moths of BUS completed by Nature Advisory, including 102 records during formal BUS, and 15 incidental records. No observations were made of the birds within RSA height (Nature Advisory 2023d).<br>Further to the above, a total of 216 Regent Parrots were recorded during the targeted assessment, along the western and northern regions of the study area. The "Yanga Corridor" (referring to the 8 Mile TSR along Yanga Way) is considered important habitat for the species, and provides foraging resources and a movement corridor where the parrots can safely travel to and from breeding sites along the Edward and Murrumbidgee Rivers. Mallee woodland habitats that adjoin the Yanga corridor provide foraging and roosting opportunities. Approximately 97% of observations of Regent Parrot were within 100 metres of suitable habitat (Nature Advisory 2023d).<br>One key recommendation made by Nature Advisory was to ensure a 100 metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable foraging and roosting habitat and along known movement corridors. This buffer has been implemented during design stages, and includes setbacks relevant to WTGs 1, 8, 31, 41, 48, minimising the risk of turbine collision for the species. A slight overlap still remains adjacent to WTG 48, however the proponent is committed to micro-siting this turbine outside the recommended setback. |

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| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| | | Should the species be subject to collision, a worst-case scenario would be that a moderate loss in numbers of individuals could lead to minor reduction in population viability for between one and five years. This could be potentially more significant if impacts were to occur to either breeding pairs, leaving chicks unable to be raised by one or both parents reducing the likelihood of the chick survival, or to fledged juveniles leading to impacts to the next generation of birds placing increased stress of future generations of the local population.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Wedge-tailed Eagle** | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur at any time of year.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Wedge-tailed Eagle was recorded during formal survey 23 times over the 24 months BUS completed by Nature Advisory, during which 47.8% of their flights were observed at RSA height. The Wedge-tailed Eagle is considered one of the most vulnerable species to collision with operating turbines because of their soaring habits while hunting (Nature Advisory 2023a), and collisions are known to be occurring at operational wind farms around NSW.<br>Wedge-tailed Eagle is considered likely to have resident pairs within or close to the subject land, and the species is considered to be at risk of collision with a relatively high number of turbines throughout the subject land, 6 high risk turbines in total. Spacing between RSAs (as detailed in Section 7.1) is considered to provide adequate blade-free areas in/around the subject land to minimise the risk of collision.<br>Should the species be subject to collision, a worst-case scenario would be that a moderate loss in numbers of individuals could lead to minor reduction in population viability for between one and five years. This could be potentially more significant if impacts were to occur to either breeding pairs, leaving chicks unable to be raised by one or both parents reducing the likelihood of the chick survival, or to fledged juveniles leading to impacts to the next generation of birds placing increased stress of future generations of the local population. As the species is known to be subject to collision the overall risk to the local population is considered 'moderate' (whilst risk to the species as a whole remains 'low').<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Such mitigation would likely include installation of evolving technologies such as automated avian detection systems that allow for detection of bird species and the triggering of curtailment of select turbines. The "IdentiFlight" avian detection system is one such technology, where testing has suggested that use of the system has achieved an 85 % reduction in Golden Eagle *Aquila chrysaetos* fatalities at a wind farm site in Wyoming, USA (McClure et al. 2022). Offsets would also be required for any impacts to the species. |
| **White-bellied Sea-Eagle** | • <50% likelihood of a strike occurring in a given year. | White-bellied Sea Eagle has been subject to detailed assessment by Nature Advisory as part of both the bird utilisation and associated risk assessments (Nature Advisory 2023f) and as part of the regional analysis of |

| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| | • 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur at any time of year.<br>• Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | waterbird activity (Nature Advisory 2023e). The species was not recorded within the subject land during 24 months of BUS, however it is known to occur in the surrounding locality including Yanga Lake, the Murrumbidgee River, and the Wakool River.<br>The spatial distribution of records within 20 km of the subject land suggests that between two and four pairs could occur within the locality. The species is known to make a high proportion of flights at RSA height, 70 % of flights have been documented as occurring between 30 -120 m high, which puts them at relatively high risk of collision with turbines ((Smales 2005), Nature Advisory 2023).<br>Resident pairs are typically relatively sedentary and do not move far from the large waterbodies around which their territories are based. Therefore, the potential presence of adult individuals within the operational wind farm is relatively low. However, immature birds are highly dispersive and could occur within the wind farm during searches for unoccupied habitat, putting them at higher risk of collision risk based due to their known occurrence at RSA height (Nature Advisory 2023e).<br>Nature Advisory conclude that it is conceivable that one or two mortalities could occur each year (although collisions every few years instead are perhaps more likely), which could have a small but detrimental impact on the local population.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Such mitigation would likely include installation of evolving technologies such as automated avian detection systems that allow for detection of bird species and the triggering of curtailment of select turbines, such as the "IdentiFlight" system, outlined above. Offsets would also be required for any impacts to the species. |
| **White-striped Freetail-bat** | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur over spring and summer.<br>• Repeated loss of small number of individuals but no reduction in population viability. | White-striped Freetail-bat is known to be fast-flying species (not considered particularly manoeuvrable) intercepting their prey 50 m or more above the ground (Churchill 2008). The species was recorded during both the summer and spring 2021 bat utilisation surveys; however it was one of the two species with the lowest detection rate (average 2.8 % of detectors nights) in summer 2021, and the fourth lowest (from 12 total species) recorded (average 35.7 % of detector nights) during spring 2021.<br>The species is known to be at risk of collisions, which have been occurring at operational wind farms across the species' range. Should collisions be recorded during the operation phase of the project, operational mitigation measures such as low-wind speed curtailments or implementation of evolving technologies such as the SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics (further discussed in Section 9.1.2 below), may be implemented to minimise the potential for ongoing impacts.<br>Curtailment of turbine operations during low wind speeds is recognised as an effective tool for reducing bat deaths at wind energy facilities (Arnett 2017, Arnett et al. 2013, Rodrigues et al. 2015, Smallwood and Bell 2020, Adams et al. 2021, Bennet 2022). Bat activity is known to be highest during low wind speeds and progressively tapers off as wind |

| Protected / threatened species | Rate, timing & consequence | Significance of potential impacts |
|---|---|---|
| | | speeds increase. In contrast, power generation increases as wind speed increases meaning there is a window of wind speeds during which collisions occur and power generation is not optimal (Bennet 2022). So if an unacceptable level of collisions is recorded it would be expected that adaptive management would be able to enact sufficient mitigation to substantially reduce the potential operational impacts(Nature Advisory 2023)<br><br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |
| **Yellow-bellied Sheathtail-bat** | • >50% likelihood of a strike occurring in a given year.<br>• 6 relevant high-risk turbines (approx.6% of turbines)<br>• Collision more likely to occur over spring and summer<br>• Repeated loss of small number of individuals but no reduction in population viability. | Yellow-bellied Sheathtail-bat is known to be fast and high flying migratory species (likely to be present between January and April), not considered particularly manoeuvrable, and as such has the potential for turbine collision. The species was not recorded during Nature Advisory's bat utilisation surveys, but a handful of records occur within 40 km north of the subject land, and the species is known to occur at other proposed development sites in the broader locality / region.<br>The species is considered to be at risk of collisions which if recorded during the operation phase of the project, may result in the implementation of operational mitigation measures such as low-wind speed curtailments or implementation of evolving technologies such as the SMART system by Wildlife Acoustics to minimise the potential for ongoing impacts.<br>Curtailment of turbine operations during low wind speeds is recognised as an effective tool for reducing bat deaths at wind energy facilities (Arnett 2017, Arnett et al. 2013, Rodrigues et al. 2015, Smallwood and Bell 2020, Adams et al. 2021, Bennet 2022). So if an unacceptable level of collisions is recorded it would be expected that adaptive management would be able to enact sufficient mitigation to substantially reduce the potential operational impacts.<br>Ongoing BUS monitoring, as outlined in BBAMP, will continue to collect data on the use of the subject land by the species, and regular carcass monitoring will ensure that any potential impacts that may occur are captured, and suitable mitigation and adaptive management strategies are employed to prevent reoccurrence of the event (as far as is possible). Offsets would also be required for any impacts to the species. |

### b) Predict the rate and timing of impact per turbine per year for species likely to be affected.

The predicted rate and timing of potential impacts from turbine strike to at risk bird and bat species per turbine per year are outlined in Table 53 above. These predictions are based on the risk assessments completed/summarised in Sections 6.1 and 6.3 above, and Appendix 9.

### c) Predict the consequences of impacts for the persistence of populations.

The predicted consequences of potential impacts from turbine strike to populations of at-risk bird and bat are outlined in Table 53 above. These predictions are based on the risk assessments completed/summarised in Sections 6.1 and 6.3 above, and Appendix 9.

### d) Predict the cumulative impacts of the proposed development alongside existing wind farms, on species mortality, movement patterns and use of adjacent habitat.

As wind farms developments increase in NSW, and in particular the South West REZ, bird and bat species with the potential to move over larger distances can be subject to impacts at multiple wind farms (Biosis, 2006). Six additional windfarms are proposed within 100 kilometres of the proposed Junction Rivers Windfarm. These are:

- Keri Keri Wind Farm – 20 kilometres east of the subject land.
  - Up to 170 wind turbines.
- Wilan Wind Farm – 25 kilometres north-east of the subject land.
  - Up to 138 wind turbines.
- Baldon Wind Farm – 30 kilometres east of the subject land.
  - Up to 162 wind turbines.
- Tchelery Wind Farm – 50 kilometres east of the subject land.
  - Up to 120 wind turbines.
- Euston Wind Farm – 80 kilometres north-west of the subject land.
  - Up to 96 wind turbines.
- The Plains Wind Farm – 90 kilometres east of the subject land.
  - Up to 226 wind turbines.

All six wind farms are yet to be approved and are currently at the same stage of environment assessment, being 'Prepare EIS'.

Within around 150 kilometres of the proposed Junction Rivers Wind Project, an additional three wind farms are proposed, also at the 'Prepare EIS' phase, these are:

- Pottinger Wind Farm – 115 kilometres east of the subject land.
  - Up to 108 wind turbines.
- Mallee Wind Farm – 125 kilometres north-west of the subject land.
  - Up to 150 wind turbines.
- Bullawah Wind Farm – 140 kilometres east of the subject land.
  - Up to 170 wind turbines.

Each of these wind farms are considered to have the potential to result in some level of mortality to wide ranging aerial species, however there would be limited overlap in species populations for more sedentary species between these wind farm due to their distant locations in the landscape. There is however likely to be a somewhat substantial loss of species' habitats within the region if the numerous large-scale projects are constructed. This cumulative habitat loss will affect all species to some degree, although those most affected (i.e. those with habitat spanning all, or the majority of, the proposed development) are also those species better able to adapt and utilise a wide range of unimpacted habitats across a region where native dominated habitats are prevalent, albeit in a historically generally degraded state.

The Junction River Wind Farm will operate 96 turbines, over an area of approximately 9000 hectares. If the above wind farms are approved and operate at their proposed capacities (i.e. numbers of turbines) and are built at similar densities, Junction Rivers would contribute approximately 7 % of the numbers of operational turbines and area covered by operation wind farm within approximately 150 kilometres. The project could therefore be considered to contribute a similar percentage to the potential cumulative impacts to bird and bat species in the region.

Species considered more at risk as a result of the current project, which may also be at risk from cumulative impacts from the numerous proposed wind farms in the region include nomadic and migratory species, such as:

- Australian Pelican *Pelecanus conspicillatus.*
- Australasian Darter *Anhinga novaehollandiae.*
- Australasian Bittern *Botaurus poiciloptilus.*
- Australasian Shoveler *Spatula rhynchotis.*
- Black Falcon *Falco berigora.*
- Black Swan *Cygnus atratus.*
- Caspian Tern *Hydroprogne caspia.*
- Fork-tailed Swift *Apus pacificus.*
- Freckled Duck *Stictonetta nervosa.*
- Great Cormorant *Phalacrocorax carbo.*
- Grey Teal *Anas gracilis.*
- Gull-billed Tern *Gelochelidon nilotica.*
- Little Black Cormorant *Phalacrocorax sulcirostris.*
- Magpie Goose *Anseranas semipalmata.*
- Pacific Black Duck *Anas superciliosa.*
- Pink-eared Duck *Malacorhynchus membranaceus.*
- Straw-Necked Ibis *Threskiornis spinicollis.*
- Whiskered Tern *Chlidonias hybrida.*

The majority of the above species are considered common, widespread and secure species and cumulative impacts would be unlikely to result in substantial impacts to local, regional or national populations. However, Australasian Bittern, Black Falcon and Magpie Goose are listed as threatened in NSW and/or federally and cumulative impacts to these species could be more substantial.

Regular nomadic movements of Australasian Bittern and Black Falcon are likely to put populations at relatively frequent risk of cumulative impacts associated with turbine strike and avoidance of habitat adjacent to operational turbines across multiple operational wind farms. It could reasonably be expected that this risk would be greatest during the initial years of operation before birds have been able to habituate to the turbines in the landscape. Magpie Geese would be at risk of interacting with multiple operational wind farms less frequently due to their less regular nomadic movement patterns, however when interactions did occur larger flocks of birds would likely be affected.

Detailed and adaptive management plans, such as Operational Bird and Bat Adaptive Management Plan, will be required to be developed and implemented consistently to provide an effective monitoring program and strategy to manage and mitigate operational issues relating to the potential cumulative impacts from multiple sites. A coordinated effort will be required to ensure issues that may occur at one wind farm site, and which could be prevented at another, are consistently reported upon and mitigation strategies consistently applied.

### e) Predict the likelihood and nature of impacts on aerial species living in, or likely to fly over, the proposed development site, including barriers to migratory pathways, and breeding, feeding and resting resources.

An assessment was completed by Nature Advisory on the potential for barrier effect impacts on aerial species living in, or likely to fly over, the proposed development site. All species included in the risk assessment were concluded to be subject to no more than a 'Negligible' risk of impact from barrier effect (Nature Advisory 2023f).

Where turbine spacing occurs in close proximity to each other this represents areas or turbine clusters that may have a slight increase in an inherent risk associated with barrier effects or altered flight behaviour. Some evidence suggests from studies at wind farms abroad that turbines too closely spaced (i.e., <200 metres between RSA) had an effect of flight behaviour, with a preference for flight routes taken between turbines spaced between 200 – 400 metres apart (Tulp et al. 1999, Percival 2001). It should be noted that these studies were based on seabirds and offshore wind farms, however directly comparable data is lacking (i.e. Australian studies). It does however illustrate that birds will fly between turbines where sufficient space exists.

Avoidance behaviour, potentially induced by barrier effect, is displayed by birds and bats at different scales at wind farms. Macro-scale avoidance comprises avoidance of the entire wind farm, where animals adjust their flightpaths substantially to fly around (or possibly over) the site, meso-scale avoidance where birds and bats are flying within the wind farm but are able to avoid individual turbine and rotor-swept areas by flying through the space in between, and micro-scale avoidance where highly manoeuvrable species are able to avoid turbine blades (potentially including operational rotating blades). Plate 2 illustrates these differences in scales.

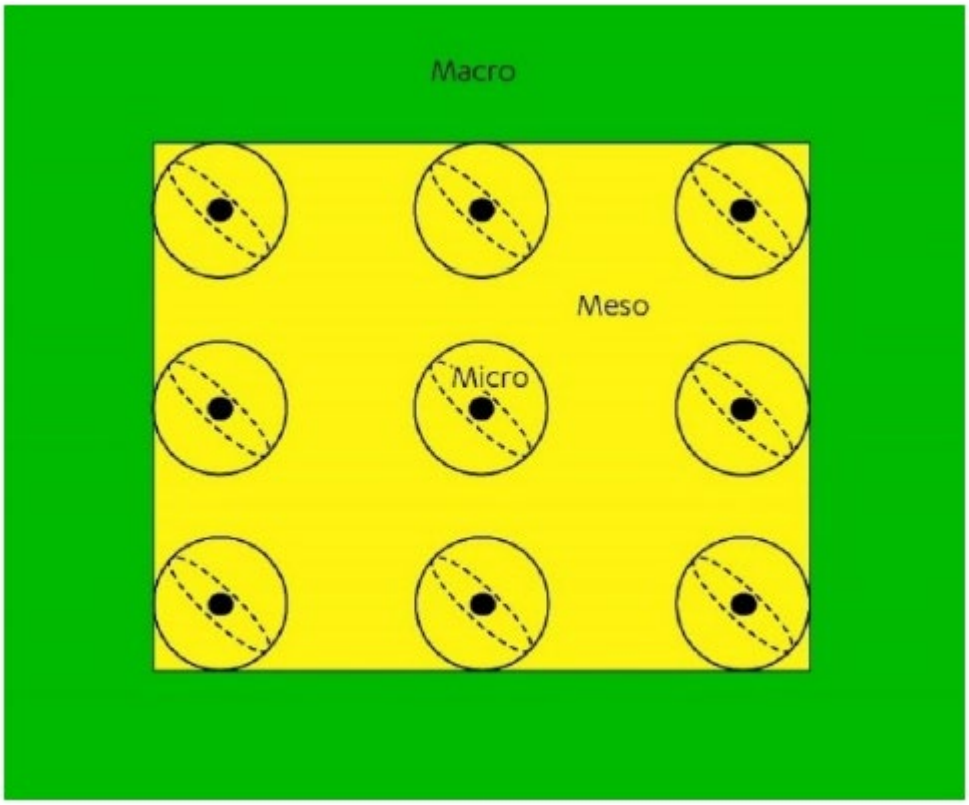



**Plate 2** **Schematic illustrating the spatial scales over which micro-avoidance, meso- and macro-responses operate. Dots refer to turbine tower locations, circles are rotor-swept areas and ellipses (dotted) to a hypothetical rotor position (not to scale, from (Cook et al. 2014)).**

As outlined in Section 7.1 (refer Figure 15 and Table 46), pinch points, with an inherently increased risk of barrier effect, have separation distances between RSAs of no less than 520 meters between rows of turbines, and approximately 70 % of the locations analysed have RSA separation gaps are greater than 1 kilometre. Averages RSA separation along the nominal flight paths though pinch points, range from approximately 700 metres to 2.7 kilometres, with three of the six areas analysed comprising gaps of over 1 kilometre. This separation is considered sufficient to allow for meso-scale avoidance and therefore movement through the wind farm, for species less likely (or less able) to fly around/over the wind farm to access habitats on either side.

Barrier effect and collision risk have been minimised as a result of the proposed layout of WTGs, with substantial areas of airspace remaining available for birds and bats to move through once the wind farm becomes optional. The south-eastern potion of the wind farm encompasses the area where turbines remain closest together and RSA separation is lowest (WTGs 46 – 55), however bird and bat movement through this area are unlikely to be as common as elsewhere within the subject land due to a lack of habitat features providing or eliciting flyways compared to elsewhere within and surround the subject land (Figure 15).

Furthermore, the overarching conclusion from Nature Advisory's analysis of regional waterbird activity (including EPBC Act listed migratory shorebirds) is that longer distance migratory / nomadic movements are made above RSA height, and thus are unlikely to be substantially impacted by barrier effect (Nature Advisory 2023e).

### f) Predict the impact of avoidance behaviour for migratory species relative to migration distances, and the availability of suitable habitat for breeding, feeding and resting over the migration route.

Analysis of nomadic and migratory species' flight paths relevant to the subject land is provided in Section 5.2.3 above, and illustrated on Figure 12.

As outlined above, the overarching conclusion from Nature Advisory's analysis of regional waterbird activity (which includes EPBC Act listed migratory species) is that longer distance migratory / nomadic movements are made above RSA height, and thus are unlikely to be substantially impacted by barrier effect (Nature Advisory 2023e). The full review is attached as Appendix 9.

The project is not expected to result in substantial avoidance behaviour in species undertaking longer distance nomadic or migratory flights due to these flights generally occurring over RSA height, or to species undertaking local-scale movements due to the layout of the project allowing sufficient blade-free areas allowing movement corridors through the operational wind farm.

### g) Map the disturbance zone around wind turbines, and the significant landscape and habitat features within that zone, for species likely to be affected, e.g. hollow bearing trees and important habitat for migratory species.

The project's development corridor was assessed and mapped as the potential disturbance zone around operational wind turbines. Refer to Section 8.1 for direct impacts to landscape and habitat features. Flight paths and discussion of disturbance to migratory species is location within Section 5.2.3 and Section 6.

The zone of disturbance can be considered to comprise two separate parts, those being the RSA, and an area of air disturbance extending past the blade tip. Potential impacts to aerial species within the RSA are largely associated with blade strike and possibly barotrauma, the risk and likelihood of which has been assessed for bird and bat species in Section 5.2.1, Section 6, earlier in the current section, and in Appendix 9 of this BDAR.

Impacts associated with the area of air disturbance, past the end of the blade tips, are less clear but are likely associated with avoidance behaviour and barrier effect due to alteration of forces acting on aerial species, potentially leading additional indirect habitat loss due to expected avoidance behaviour. It is expected that smaller species would be more likely to experience disturbance from smaller changes in air pressure (etc), and therefore experience disturbance further from the blade tips, when compared to larger species likely to be more tolerant of smaller changes, and thus experiencing disturbance closer to the tips of the blades.

Within the combined zone of disturbance, equating to the RSA and the additional area of air disturbance, habitat features likely to be utilised by aerial fauna include open grassy areas, scattered trees and intact saltbush and mallee vegetation supporting hollows, small dams and watercourses. All of these features are potentially utilised for foraging, roosting and breeding habitat (for some species).

As outlined above, the project has limited potential to result in impacts to habitat connectivity for some species potentially flying through the wind farm to access habitats as part of migratory movements or long-range foraging. However as noted, habitat connectivity is maintained surrounding the development footprint and the likelihood of regular migratory movements through the wind farm at RSA height is considered unlikely.

Migratory flight paths are discussed and mapped within Section 5.2.3, earlier in the current section, Figure 12 and Figure 13.

### 8.3.6. Vehicle strikes

#### Nature

The project has the potential to result in increased vehicle strikes during the construction and operational phase of the project as a result of increased vehicle moments, and in particular heavy vehicles. Key areas where this is expected to occur are Yanga Way, Balranald-Moulamein Road, Arundel Road and Big Sandhill Road.

#### Extent

Increased heavy vehicle movements will occur and be ongoing for the life of the project, however, the main increase in vehicular movement will occur during the construction phase of the project.

#### Duration

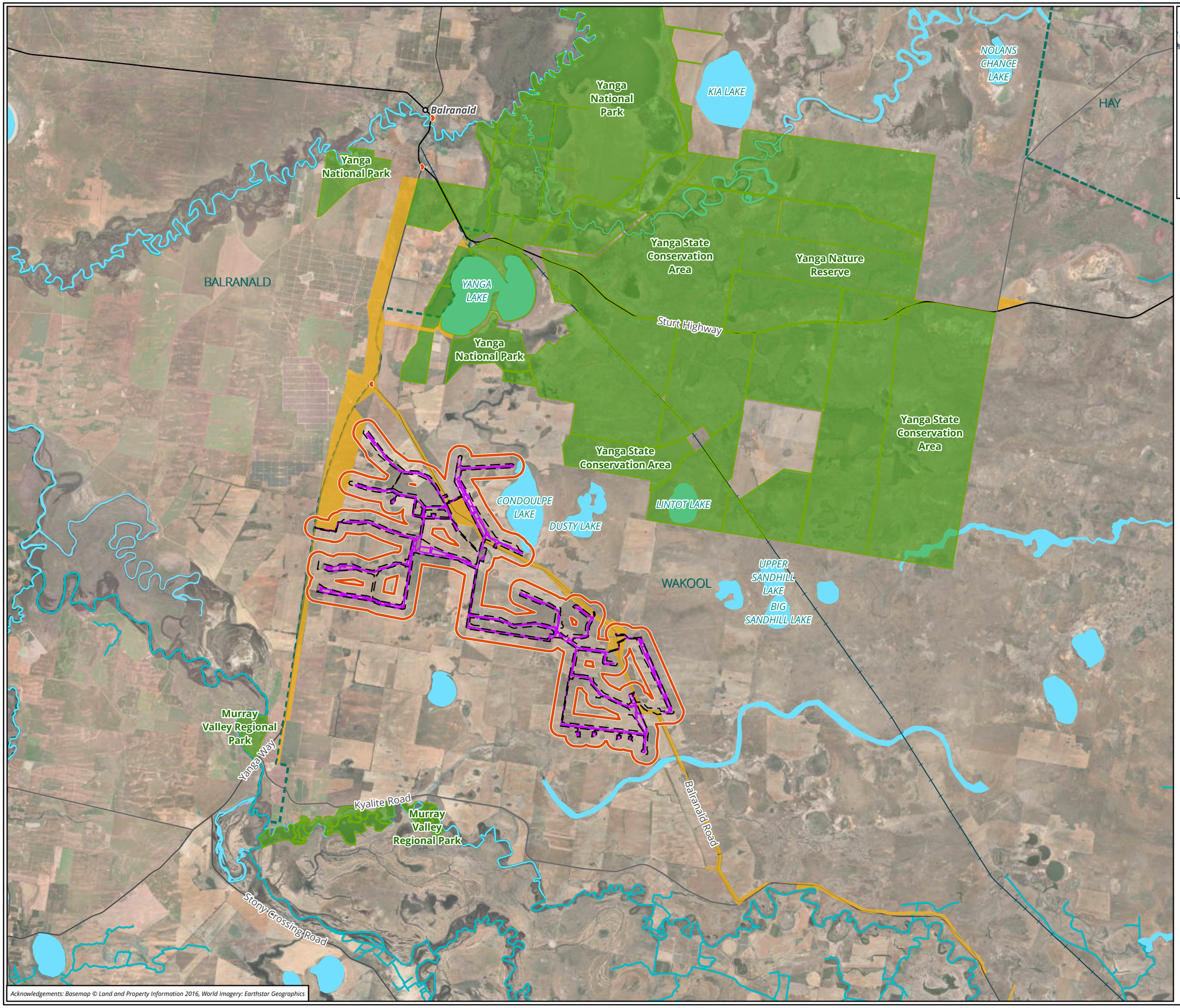
The potential for increased vehicle strikes will occur and be ongoing for the life of the project.

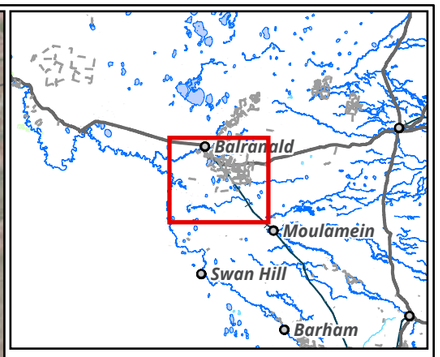
#### Consequences

It can reasonably be expected that the potential for vehicle strikes can be effectively managed though:

- Reduced speed limits during the construction phase on Balranald-Moulamein Road, Arundel Road and Big Sandhill Road.
- Minimise driving from construction or operational related vehicles between dusk – dawn.
- Driver awareness training of potential fauna to occur.
- On site measures including reduced speed limits and signage.
- Vehicle strike protocols, including contact numbers (e.g. WIRES) and steps to be undertaken in the event of a vehicle strike with an animal.

The project is not expected to result in any substantial or significant impacts associated with vehicle strikes.




**Legend**

- Subject land
- Development corridor
- Development footprint
- National Park/Reserve
- Travelling stock reserves

**Figure 19.1 Prescribed impacts**

0 2,000 4,000 6,000 8,000

Meters

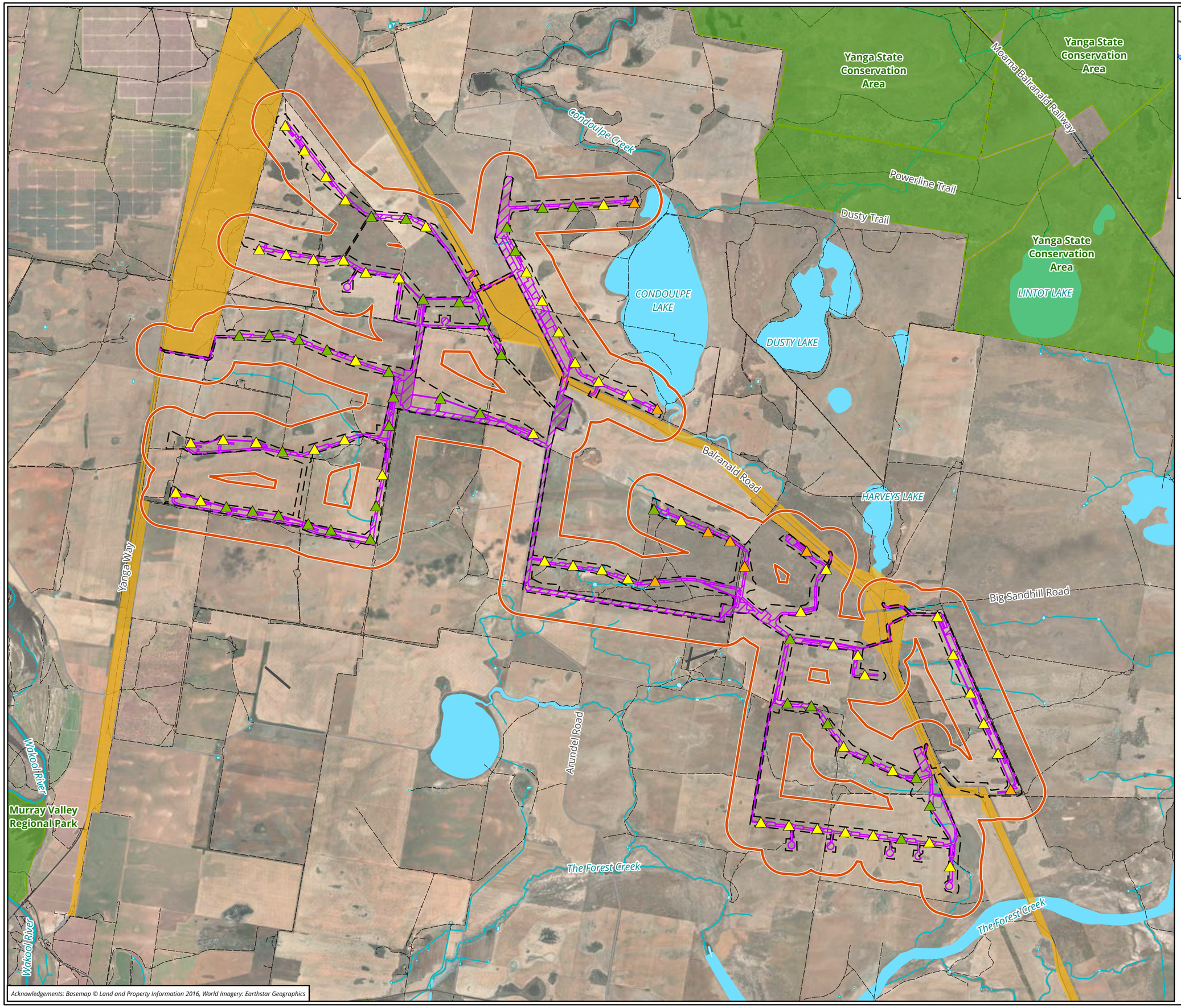
Scale: 1:180,000 @ A3

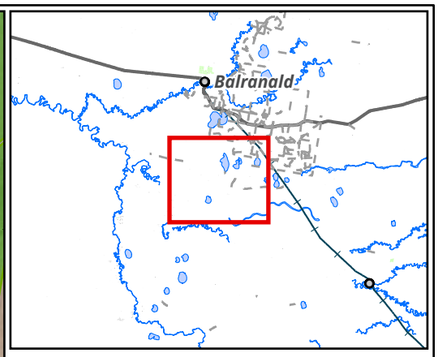
*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F19.1_PresImpacts




**Legend**

- Subject land
- Development corridor
- Development footprint
- National Park/Reserve
- Travelling stock reserves

**Turbine risk**

- High
- Moderate
- Low

**Figure 19.2 Prescribed impacts**

0 750 1,500 2,250 3,000

Meters

Scale: 1:75,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F19.2_PresImpacts

## 8.4. Impacts to Groundwater Dependent Ecosystems (GDE)

Groundwater Dependent Ecosystems (GDEs) are ecosystems that are partially or completely dependent on underground water, or the surface expression of this water, for their existence or health. These ecosystems include flora and fauna species and communities that are dependent on water discharge to the surface at a level where they can access, to persist in permanently wet environments, or to persist during times of extended low rainfall via the access to subsurface water reserves.

Assessment of the potential for the subject land to support groundwater dependant ecosystems (GDEs) was undertaken using the Australian Government's Bureau of Meteorology Groundwater Dependent Ecosystems Atlas (BOM 2019). The subject land is not mapped as supporting GDEs associated with an aquifer as outlined in the Risk Assessment Guidelines for Groundwater Dependent Ecosystems (DPI 2012). Harveys Lake, located 600 metres north-east of the subject land and (800 metres north of Big Sandhill Road) is an area of mapped 'Low potential' aquatic GDE, this area is a mapped wetland. No areas of Groundwater Vulnerability are mapped within the Wakool LEP 2013, however Condoulpe Lake and a watercourse in the south-east of the subject land are identified as areas of Wetland under the Wakool LEP 2013.

Wetlands identified as being groundwater dependent can be either ephemeral or permanent systems that have a continuous or seasonal connection with groundwater (Howe et al. 2007). Although rainfall is the dominant source of water for nearly all wetland systems, groundwater plays a role in many of Australia's wetlands (Hatton and Evans 1998; Kuginis et al 2016).

An undefined watercourse runs through the subject land and feeds into Harveys Lake . This watercourse is undefined and non-perennial, and has been subject to modification due to historical grazing, cropping, clearing and construction of fences, roads and farm tracks. In the south-east of the subject land The Forest Creek is present and connected directly to the MVRP, Edward River and associated wetlands. This watercourse is defined but non-perennial with aerial imagery and connectivity to the Edward River indicating larger seasonal flows. The Forest Creek within the subject land has been subject to clearing for the purpose of grazing activities and occurs in a modified state, including the presence of a dam. The proposed development is unlikely to result in major change to the surface drainage, groundwater recharge or discharge of the subject land or surrounding areas. Water management will be included as part of the CEMP.

## 8.5. Impacts considered uncertain

Operational impacts to bird and bat species associated primarily with collision risk and to a lesser potential barrier effect are considered uncertain at this stage. As such, a monitoring and adaptive management strategy has been developed for the project to ensure any negative effects are realised early, mitigated where possible, and offset if required. The monitoring and adaptive management strategy is summarised in Section 9.1, and detailed in the project's draft BBAMP (Biosis 2023 in prep.).

## 8.6. Cumulative impacts

An assessment of proposed and current renewable and other projects within similar PCTs, habitats and sited in the South West REZ has been carried out to provide a summary of potential cumulative impacts to biodiversity in Section 8.3.5.

It is important to recognise that the South West REZ is currently a highly competitive landscape for renewable energy development and project outcomes will largely be determined by the NSW

Government allocation of access rights to the limited transmission infrastructure present. For example, the NSW Government registration of interest for the South West REZ received 49 registrations, representing 34 gigawatts of electricity (more than 13 times the intended 2.5 gigawatts capacity) from potential generation and storage projects. Access to the South West REZ transmission lines will be managed by the NSW Government in accordance with the *NSW Electricity Infrastructure Investment Act 2020* (EII Act). A competitive tender process for transmission "access rights" will be administered by AEMO Services (ASL). The mix of technologies and size of projects that will be built in the South West REZ will, to a large extent, be determined by the outcomes of this competitive auction process. This process would limit the scale of development within the South West REZ and means that the cumulative impacts required to build the South West REZ to its maximum capacity would be less than that predicted for the full extent of all projects currently proposed.

Impacts resulting from the project are largely consistent with impacts that are considered to occur at other nearby proposals, more so with those occurring within 50 kilometres or less.

The summary of biodiversity impacts from publicly available information was reviewed to gain an understanding of the main biodiversity impacts and how these may contribute to cumulative impacts when considering the development of the project.

**Table 55 Cumulative impact summary**

| Project | Distance | Overview | Potential biodiversity impacts |
|---|---|---|---|
| **Project EnergyConnect (Approved project)** | 0 km | Includes construction and operation of 330 kV and 500 kV transmission line and Dinawan Substation. | 38 PCTs directly impacted<br>1,615.20 ha of native vegetation<br>232.16 ha of TECs, including 101 ha of Weeping Myall<br>Loss of habitat of 74 ecosystem species<br>20 candidate species impacted |
| **Sunraysia Solar Farm (Approved)** | 2 km west | Construction of a 200 MW solar farm. | 12.11 hectares of native vegetation, including 1.2 ha of Acacia melvillei shrubland TEC. |
| **Limondale Solar Farm (approved)** | 2 km west | Construction of a 250 MW solar farm. | Removal of 5.32 ha of native vegetation, and 18 scattered trees. |
| **Keri Keri Wind Farm (EIS)** | 20 km east | Includes construction and operation of 1 GW wind farm, including approximately 176 WTGs and 200 MW BESS. | Potential impacts to 2625 ha of native vegetation including 9 PCTs and one TEC, and one threatened flora species |
| **Keri Keri Solar Farm (EIS)** | 20 km east | Includes the construction of a 400 MW solar farm. | Potential impacts to eight PCTs, 1,741.2 ha of native vegetation project area including potential impacts to Natural Grasslands of the Murray Valley plains TEC. |
| **Wilan Wind Farm (EIS stage)** | 25 km north-east | Includes construction and operation of 800 MW wind farm, including approximately 138 WTGs | Potential impacts to 607 ha of native vegetation, including 12 PCTs. Potential impacts to two threatened flora species |
| **Baldon Wind Farm (Prepare EIS)** | 30 km east | Includes construction and operation of 1 GW wind farm, including approximately 162 WTGs across approximately 42,000 | Potential impacts to 17 PCTs including Natural grassland TECs<br>Potential impacts to 3 threatened |

| Project | Distance | Overview | Potential biodiversity impacts |
|---|---|---|---|
| | | ha. | species, including the Plains-wanderer |
| **Tchelery Wind Farm (EIS)** | 50 km east | Includes construction and operation of 800 MW wind farm, including approximately 120 WTGs | Potential impacts to 16 PCTs, 4 TECs including Weeping Myall Woodland. Potential impacts to seven flora species and five fauna species known to occur. |
| **Euston Wind Farm (Prepare EIS)** | 80km north-west | Construction of a wind farm with up to 96 WTGs. | Impacts uncertain, sic PCTs and with potential occurrence of Acacia loderi shrublands, Acacia melvillei shrublands, Plains mallee box woodlands, Porcupine Grass – red Mallee – Gum Coolabah and Mallee Bird community TECs. |
| **The Plains Solar Farm** | 90 km east | Includes 900,900 PV panels, 500 MW capacity, and BESS | 15 PCTs identified in the project area, 4 TECs considered likely to occur including Myall Woodland. Numerous threatened species consider likely to occur. |
| **The Plains Wind Farm** | 90 km east | Includes up to 226 wind turbines and approximately 1,800 MW capacity | 15 PCTs identified in the project area, 2 TECs confirmed as present - Myall Woodland and Sandhill Pine Woodland. Numerous threatened species consider likely to occur. |
| **Romani Solar Farm (Scoping stage)** | 90 km east | Construction of a 250 MW solar farm with 150MW/300MWh BESS. | Potential impacts to an estimated 900 ha, however an estimated 60% occur on Category 1 Exempt land. Nine PCTs noted a potentially present and range of threatened species. |
| **Pottinger Wind Farm and Solar Farm (EIS stage)** | 115 km east | Includes construction and operation of 750 GW wind farm, 300 solar farm and 500 MW BESS., including approximately 108 WTGs across approximately 15,160 ha. | Impacts to 470 ha of native vegetation for the wind farm and 630 ha for the solar farm, including potential impacts to Weeping Myall Woodland and Natural Grasslands TECs |
| **Mallee Wind Farm (EIS)** | 125km north-west | Construction of a wind farm with up to 150 WTGs. | Potential impact of 489.9 hectares of native vegetation, including Acacia loderi shrublands, Acacia melvillei shrubland, and Mallee Bird Community TECs. |
| **Bullawah Wind Farm** | 140 km east | Includes up to 170 wind turbines and approximately 1,000 MW capacity | 20 PCTs identified in the project area, 4 TECs considered highly likely to occur including Myall Woodland and Sandhill Pine Woodland. Estimated impacts to 1012.6 ha of native vegetation Numerous threatened species consider likely to occur. |

# 9. Mitigation and management of impacts

Residual impacts occur once all efforts have been made to avoid and minimise impacts through the design phase of the project. Mitigation of unavoidable impacts is the next step in the impact reduction hierarchy and includes commitments made by the proponent to further minimise impacts to biodiversity.

Identification of measures to mitigate or manage impacts has been undertaken in accordance with the BAM (DPIE 2020a), including considerations such as:

- Techniques, timing, frequency and responsibility.
- Identification of measures for which there is risk of failure.
- Evaluation of the risk and consequence of any residual impacts.
- Documentation of any adaptive management strategy proposed.

Identification of measures for mitigating impacts related to:

- Displacement of resident fauna.
- Indirect impacts on native vegetation and habitat.
- Mitigating prescribed biodiversity impacts.
- Protecting threatened flora and fauna habitat, especially threatened flora populations identified within the subject land, but outside the development footprint.
- Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain.

Table 56 below provides the mitigation measures proposed to be implemented during the construction, operation and decommissioning of the project to ensure the principles of avoidance and minimisation of impact continue to be implemented.

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**Table 56 Measures to mitigate and manage impacts**

| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| **Direct and indirect impacts** | | | |
| **Removal of native vegetation and TECs** | • Wherever possible the project will look to avoid impacts to native vegetation and TECs through minimisation of clearing footprint during detailed design and preferentially locating infrastructure/plant/materials etc in areas of existing disturbance.<br>• Prescriptions for mitigation of potential impacts of construction activities on retained native vegetation and habitat will be addressed in a site-specific CEMP and BMP sub-plan. The plan will include all measures outlined below:<br>o Minimise vegetation clearance and disturbance, including impacts to standing dead trees and riparian zones.<br>o Where possible, limit clearing to trimming rather than the removal of whole plants.<br>o Micro-siting of all construction related access roads, stockpiles, vehicle parking and site compounds should occur and where possible these should be located in areas that do not contain native vegetation or fauna habitat.<br>o Physically delineate vegetation to be cleared and/or protected on site and install appropriate signage prior to works commencing.<br>o No-Go Zones should be erected during the construction phase at the extent of clearing works in patches of vegetation to ensure clearing limit is not exceeded and no vehicle or plant equipment movement occurs outside the clearing limit. These areas should be checked as part of the pre-clearing survey.<br>o Protect trees in accordance with the requirements of Australian Standard 4970-2009 for the Protection of Trees on Development Sites.<br>o Do not damage tree roots unless absolutely necessary, and engage a qualified arborist where roots >50 mm are impacted within the Tree Protection Zone.<br>o Retain dead tree trunks, bush rock or logs in-situ unless they are in the development footprint and moving is unavoidable. Reposition material elsewhere on the site or approved adjacent sites. Dead wood and Coarse Woody Debris (CWD) should be lifted and placed into adjacent vegetation, not pushed.<br>o Undertake pre-clearance inspections by a licenced ecologist of vegetation to ensure all no-go areas are appropriately fenced.<br>o If any threatened species (flora or fauna) is discovered during the works, stop work immediately at the site of species identification and notify the onsite Manager. Work will | Prior to construction – construction | Proponent / Principal contractor |

| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| | only recommence once the impact on the species has been assessed and appropriate control measures provided.<br>○ If any damage occurs to vegetation outside of the impact area (as shown in the CEMP), notify the onsite Manager and Environmental Representative so that appropriate remediation strategies can be developed.<br>• A biosecurity management plan prepared as part of the project's CEMP and will prevent the spread of weeds and pathogens, and other biosecurity items into or out of the impact area upon implementation.<br>• Secure biodiversity offsets in accordance with the NSW BOS. | | |
| **Removal of fauna and flora habitat** | • Wherever possible the project will look to avoid removal of hollow-bearing trees and trees supporting nests during detailed design.<br>• The CEMP will include a plan for pre-clearance surveys. Pre-clearance surveys will include:<br>○ Fauna general:<br>▪ Survey of all areas to be cleared prior to construction to identify and mark all fauna habitat to be impacted including hollow-bearing trees (HBTs)<br>▪ All HBTs to be removed will follow a two-stage removal process, including knocking of the tree to be removed 24 hours prior to removal.<br>▪ All fauna habitat to be removed will be surveyed by a suitably qualified ecologist, prior, during and after removal.<br>▪ Active nests will be avoided by clearing.<br>▪ If native fauna is likely to be present, a licenced ecologist should inspect the removal and undertake fauna relocation.<br>○ Flora general:<br>▪ All vegetation to be removed is to be clearly marked for removal.<br>▪ No-Go fencing is to be erected along the clearing extent where partial clearing of a patch it to occur. No-Go fencing is to be retained until the completion of the construction phase.<br>• If native fauna is encountered on site, stop work and allow the fauna to move away un-harassed. Engage a licenced ecologist if assistance is required to move fauna. | Prior to construction | Proponent / Principal contractor |

| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| **Removal of threatened fauna habitat** | **Major Mitchells Cockatoo**<br>• Once final development footprint is determined undertake a HBT survey to create an inventory of potential Major Mitchell's Cockatoo nest trees, at least one month prior to scheduled vegetation removal.<br>• Removal of potential nest trees will not occur during breeding season (September – December) unless the tree has been confirmed as not being used for breeding.<br>• Pre-clearance survey of potential nest trees is to be undertaken within one week of scheduled vegetation removal to determine whether hollows are being used by the species.<br>• Removal of potential nest trees could occur as early works, outside breeding season, and prior to the main vegetation clearing program. It would be ensured that this would not result in the removal of potential nest trees more than one breeding season prior to the main vegetation clearing program.<br>• Two-staged tree removal under ecologist supervision is required for the removal of all potential Major Mitchell's Cockatoo nest trees. This would include a method such as:<br>  ○ Remove all non-habitat vegetation (e.g., non-habitat trees) prior to the removal of habitat trees (e.g., hollow-bearing tree).<br>  ○ Leave habitat trees standing for at least one night after other clearing to allow any fauna the opportunity to remove themselves after site disturbance.<br>  ○ Actively shake habitat trees immediately prior to removal.<br>  ○ Non-habitat branches are removed before the habitat branches,<br>  ○ Ecologist inspects habitat trees before and after felling to rescue any trapped / injured fauna.<br>  ○ Wildlife carers (or vets) are available to treat any injured fauna. | Prior to construction – construction | Proponent / Principal contractor |
| | **Regent Parrot**<br>• Area of expected high use for Regent Parrot are to be mapped once final development footprint has been determined at least one month prior to scheduled vegetation removal.<br>• Pre-clearance surveys are to be undertaken to determine if these areas of habitat are being used by the species 24-48 hours before vegetation removal.<br>• Two-staged tree removal under ecologist supervision is required for the removal of all potential Regent Parrot high use areas. | | |

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| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| | **Threatened raptor species (incl. non-threatened at risk species)**<br>• All potential raptor nests within 200 m of the finalised development footprint are to be mapped at least one month prior to vegetation removal.<br>• Pre-clearance surveys are to be undertaken within one week of scheduled vegetation removal to determine whether nests are in use by threatened raptors, **or** non-threatened at risk raptors (see Section 6.1.6).<br>• Clearing of raptor nests with juveniles present will not be undertaken.<br>• Removal of potential nest trees could occur as early works, outside breeding season, and prior to the main vegetation clearing program. It would be ensured that this would not result in the removal of potential nest trees more than one breeding season prior to the main vegetation clearing program.<br>• Clearing of vegetation within 200 m of raptor nests with juveniles present will be avoided wherever possible<br>• Two-staged tree removal under ecologist supervision is required for the removal of all raptor nests.<br>**Other threatened species**<br>• Pre-clearance surveys will be undertaken when vegetation removal is proposed during the breeding season of threatened species (for example between July – October for Southern Whiteface).<br>• Survey results will trigger the implementation of mitigation measures to minimise impacts to breeding individuals, to be further detailed in the BMP. | | |
| **Construction adjacent to identified threatened flora populations** | **Bitter Quandong - *Santalum murrayanum***<br>• A No-Go fence is to be created around the entire patch of native vegetation where the population of *Santalum murrayanum* was identified (allowing for approved vegetation removal).<br>• Ensure No-Go Zones are established early and maintained throughout the life of the construction phase of the project.<br>• Regular monitoring of the health of the population will be undertaken throughout the life of the project as guided by the BMP, negative pressures acting on the population will be subject to management.<br>• To the fullest extent feasible no grazing is to occur within the patch of vegetation supporting the population. | Prior to construction – construction | Proponent / Principal contractor |

| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| | ***Austrostipa metatoris***<br>• Any future works associated with the project proposed within the road reserve of Yanga Way (and associated 8 Mile TSR) must complete targeted surveys for this species.<br>• If future works are required in the vicinity of the population, no-go zones and ongoing monitoring will be established as per the recommendations associated with Bitter Quandong above. | Any future works associated with the project | Proponent / Principal contractor |
| **Indirect impacts on retained native vegetation, habitat and native species** | • Project fencing will be designed so as not to create barriers to fauna movement, nor to funnel fauna species into dead ends. Egress points will be provided for fauna that do enter the project site (both construction and operational).<br>• Ensure all works areas and access routes are clearly delineated and sign-posted from the outset of the project construction phase to avoid unauthorised/accidental access to retained areas.<br>• Develop and implement specific erosion and sediment controls described in a CEMP, such as:<br>  ○ Minimising the area and duration of soil disturbance.<br>  ○ Progressively rehabilitate disturbed areas.<br>  ○ Temporary or permanent earth banks and silt fences. Trench blocks (i.e. trench/sack breakers) and compaction of backfilled soils to be used to prevent subsurface erosion.<br>  ○ Specific Erosion and Sediment Control Plans for waterway crossings.<br>• All material stockpiles, vehicle parking and machinery storage, and other ancillary works are to be located within areas considered within the current assessment and not be located within retained vegetation outside the development footprint.<br>• As waste management plan will be developed to ensure rubbish and construction waste are properly managed, and do not attract pest species.<br>• Cleared vegetation, which may be mulched or stored for re-use on site, should be:<br>  ○ Stockpiled separately from topsoil in a manner which facilitates respreading or salvaging, avoids damage to adjacent live vegetation and does not impede wildlife.<br>  ○ Where possible, mulch produced from native vegetation should be reused for landscaping and site rehabilitation and spread <10 cm deep to aid in retention of native seed bank.<br>• Commit to undertaking ongoing pest animal control in conjunction with a local/regional pest control program (or providing a monetary contribution towards) to ensure a strategic approach can be achieved. | Prior to construction – construction | Proponent / Principal contractor |

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| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| **Reduced viability of adjacent habitat due to edge effects** | • The CEMP will include a landscaping and rehabilitation management plan that will ensure areas of temporary disturbance are rehabilitated via best practice ecological restoration techniques.<br>• Re-use felled vegetation (logs and tree-hollows) and other habitat features such as rocks/boulders to increase the habitat values of any retained and adjacent vegetation.<br>• Any revegetation / rehabilitation or vegetation screening works within and/or contiguous with areas of native vegetation are to use locally sourced (local provenance) seed stock only. All species installed are to be locally indigenous and suitable and characteristic of the surrounding PCTs (noting that plantings should not increase bird and bat collision risk). | Prior to construction – construction | Proponent / Principal contractor |
| **Reduced viability of adjacent habitat due to noise, dust or light spill** | • The CEMP will include a plan to ensure:<br>  ○ Minimisation of the amount of time that noise, light and vibration impacts are occurring.<br>  ○ Ensure the smallest machinery that can complete the required works are used to reduce potential noise and vibration impacts.<br>  ○ Regularly train workers and contractors to use equipment in ways to minimise noise.<br>  ○ Site managers periodically check the site and nearby residences for noise problems so that solutions can be quickly applied.<br>  ○ All plant and equipment will be turned off when not in use.<br>  ○ Breeding habitat such as tree hollows and nests adjacent to works areas will be considered in noise management strategies.<br>• The CEMP will include dust suppression to be undertaken as required using water sprays, water carts or other media on:<br>  ○ Unpaved work areas subject to traffic or wind.<br>  ○ Sand, spoil and aggregate stockpiles.<br>  ○ During the loading and unloading of dust generating materials.<br>• Lighting will be designed in general accordance with Australian Standard 4282-1997 Control of the obtrusive effects of outdoor lighting and the good lighting design Principals documented in Dark Sky Planning Guideline.<br>• Lighting will be designed so as not to shine onto adjacent retained vegetation and habitats as much as is possible. | Prior to construction – construction | Proponent / Principal contractor |
| **Transport of weeds and pathogens to/from the site to/from adjacent vegetation** | • A biosecurity management plan prepared as part of the project's CEMP is recommended and will prevent the spread of weeds and pathogens, and other biosecurity items into or out of the impact area upon implementation.<br>• The plan will include prescriptions for regular monitoring and control of weeds. | Prior to construction – construction | Proponent / Principal contractor |

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| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| **Adaptive management strategies proposed to monitor and respond to impacts on biodiversity values that are uncertain** | • All plans will be progressively reviewed and updated through the life of the operations.<br>• All adaptive management strategy plans, including the BMP, will form part of an overarching Environmental Management Strategy (EMS). | Prior to construction – construction | Proponent / Principal contractor |
| | • Preparation of a BMP will ensure mitigation strategies are properly implemented during construction and operation of the project.<br>  ○ The BMP will be prepared by a qualified ecologist or consulting company in consultation with NSW DCCEEW (BCS).<br>  ○ The BMP will be implemented for all stages of the project (pre-construction, construction, operation and decommissioning).<br>  ○ Mitigation strategies included in the plan will include (but are not limited to):<br>  ▪ Permit system for the clearing of native vegetation.<br>  ▪ Installation of no-go zones and delineation of vegetation to be removed/retained.<br>  ▪ Pre-clearance procedures for vegetation to be removed.<br>  ▪ Unexpected finds procedure that includes strategies to minimise, mitigate and potentially offset unexpected impacts to threatened species not recorded during the preparation of the BDAR.<br>  ▪ Details of protection procedures for directly impacts threatened flora.<br>  ▪ Requirements for revegetation or screening works including suitable species and requirements around local provenance and seed sources, and the re-use of felled vegetation and salvaged habitat features.<br>  ▪ Fencing requirements for No-Go Zones.<br>  ▪ Management requirements for stockpiles, vehicle parking, machinery storage, other ancillary works.<br>  ▪ Pest management requirements.<br>  ▪ An adaptive management strategy and timing of regular review/updates.<br>  ▪ Further detail as provided in Section 9.1.1 below.<br>• The BMP will also provide detail on survey requirements prior to micro-siting of infrastructure components within the development corridor and provide criteria that must be met to ensure there are no increase to biodiversity impacts as a result of micro-siting during detailed design. | Prior to construction – construction – operation. | Proponent / Principal contractor |
| | • A BBAMP will be prepared to measure any operational impacts on bird and bats species, and ensure suitable mitigation and adaptive management strategies are implemented. The plan will: | Prior to construction – | Proponent / Principal contractor |

| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| | ○ Address the prescribed impacts associated with blade strike impacts, and include development of trigger levels to manage impacts during operation of the project.<br>○ Provide guidance and develop a framework for monitoring of impacts, including baseline and ongoing monitoring requirements, including for nesting sites on man-made structures.<br>○ Utilise survey data and complete statistical analysis of species, and develop triggers for number of species incidents.<br>○ Develop strategies on consultation with BCS for reducing bird and bat collision risk.<br>○ Identify additional mitigation measures, further detailed in Section 9.1.2 below. | construction – operation. | |
| | • Preparation of a Groundwater and Soil and Water Management Plan (or similar) that will:<br>○ Describe measures that will be employed to minimise soil erosion and the discharge of sediment and other pollutants from the site during construction and operation of the project.<br>○ Describe how water will be managed to achieve compliance with consent and EPL licence conditions.<br>○ Establish responsibilities and reporting requirements.<br>○ Establish surface water quantity and quality monitoring requirements.<br>○ Establish trigger action response plans to enable progressive improvement. | Prior to construction – construction – operation. | Proponent / Principal contractor |
| **Prescribed impacts** | | | |
| **Turbine strike and barriers to movements** | • A minimum 400 m buffer between the blade tip of operational turbines and suitable wetland habitats determined to provide suitable habitat for "At-risk" species will be maintained.<br>○ During rare flood events it is possible that habitat provided by larger ephemeral waterbodies such as Condoulpe Lake may increase in area such that suitable habitat for At-risk waterbirds occurs in close proximity to operational turbines.<br>○ Turbines will be curtailed to reduce the risk of turbine collision when suitable habitat occurs within 400 m of a blade tip of a turbine.<br>○ End of curtailment would be determined via field survey confirmation that birdlife and habitat value had reduced significantly enough back to pre-flood conditions for operation of the turbines to not increase collision risk for at risk species. Further information is provided in Section 9.1.2.<br>• A 100 m turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable Regent Parrot foraging and roosting habitat and along the | Construction - operation | Proponent / Principal contractor |

| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| | known movement corridor along the western boundary of the subject land. A slight overlap remains adjacent to WTG 48, however the proponent is committed to micro-siting this turbine outside the recommended setback.<br>• Investigation of feasibility and suitability of automated avian detection system(s) to allow for detection of bird species and the triggering of mitigation at high risk turbines, as a means of pre-emptively reducing any potential mortality events. Further information is provided in Section 9.1.2.<br>• Where blade strike impacts are found to occur implement adaptive management strategies as outlined in Section 9.1.2 below. | | |
| **Vehicle strikes** | • Speed limit on Balranald-Moulamein Road for construction vehicles, including trucks should be reduced to minimise increased risk of vehicle strike on fauna.<br>• Speed limits within the subject land should be enforced for the life of the project.<br>• Fauna species (particularly threatened species) susceptible to vehicle strike will be included in project inductions to increase knowledge of the wildlife occurring within the subject land.<br>• A vehicle strike protocol, including details of local WIRES contacts will be created and made available to all staff.<br>• Suitable speed limit reductions will be determined during preparation of the BMP. | Prior to construction – construction – operation. | Proponent / Principal contractor |
| **Construction in waterways & removal of dams** | • Construction within waterbodies will be preferentially undertaken when dry.<br>• During the micro siting process, where possible, construction in wet areas including dams, drainage lines and creek lines should be avoided.<br>• Where avoidance or undertaking works when waterbodies are dry is not possible, all areas containing water, e.g. dams, must be surveyed as part of the pre-clearance and clearing survey outlined in the CEMP including:<br>• Engaging a qualified and licensed ecologist to be present during dewatering of farm dams, to undertake fauna relocation (e.g. turtles, frogs, etc.) into an appropriate nearby habitat.<br>• Once dewatering is complete, dams are to be left for a minimum of 48 hours to allow species such as frogs and yabbies to naturally relocate. Where possible, dewatered dams should be left dry for a minimum of 1 week. | Prior to construction – construction. | Proponent / Principal contractor |
| **Fragmentation of movement corridors** | • Establish local Biodiversity Stewardship Sites to ensure local habitats outside the development corridor are improved and conserved in perpetuity.<br>• Ensure indirect impacts to TSRs are prevented through implementation of the BMP.<br>• The following opportunities will be fully explored as a part of the detailed design: | Prior to construction – construction. | Proponent / Principal contractor |

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| Measures to mitigate and manage impacts | Action | Timing | Responsibility |
|---|---|---|---|
| | ○ Opportunities to further minimise the disturbance footprint and clearing within important movement corridors for fauna.<br>○ Opportunities for post-works restoration of habitat connectivity within important movement corridors for fauna.<br>○ Areas subject to temporary disturbance will be rehabilitated using a native species planting schedule as much as practical considering any operational and safety constraints.<br>○ The total area exposed and cleared at any one time will be minimised and planned to allow for fauna movement during construction and periods of temporary disturbance | | |

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## 9.1. Adaptive management strategy

Construction and operational management plans will all contain an adaptive management component. Adaptive management strategies will be receptive to any new and relevant data that may arise through ongoing assessment and monitoring and are key to the successful implementation of crucial objectives yet also allow flexibility to changing dynamics and ongoing feedback and results. This includes measures to monitor predicted and uncertain impacts which will trigger adaptive management actions and allow for effective and quick responses.

It is expected that an overall EMS would be developed with specific sub-management plans that will entail an adaptive management strategy component. Those sub-management plans in relation to biodiversity include but are not limited to a:

- Biodiversity Management Plan.
- Bird and Bat Adaptive Management Plan.

Adaptive management plans (or components of plans) will include the following key components:

- Framework and objectives.
- Baseline information.
- Monitoring methods, frequency and Before After Control Impact (BACI) design.
- Trigger-level and unacceptable impacts for further investigation and responsive adaptive management.
- Monitor and report on the effectiveness of impacts and trigger levels.
- Operational mitigation measures.
- Residual prescribed impacts, compensatory measures and additional offset calculation framework.
- Compliance management and summary.

### 9.1.1. Biodiversity Management Plan (BMP)

A BMP would be implemented demonstrating adaptive management strategies to ensure key milestones are achieved including the following project commitments:

- Protecting vegetation and fauna habitat outside the approved disturbance areas and managing the remaining remnant vegetation and fauna habitat within or surrounding the development site toward a benchmark state, minimising indirect impacts, especially to Major Mitchell's Cockatoo and Regent Parrot (refer Table 56 above).
- Fauna monitoring and management protocol including identification and reporting of fauna mortalities to the relevant BCS office.
- Collection of detailed baseline weed data and ensuring no increase of key emerging weeds or invasive pests.
- Commit to ongoing consultation vertebrate pest control baiting programs working cooperatively with local landholders.
- Mapping and identification of individual tree hollows and stick nest and developing measures to minimise impacts to these features.

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- Pre-clearing protocols, including pre-clearing inspections, establishment of exclusion zones and on-ground identification of specific habitat features to be retained and/ or relocated.
- Monitoring of soil and water controls to prevent indirect impacts associated with water pollution to all waterways.
- Clear performance targets and monitoring criteria.
- Corrective actions.
- Timing and responsibilities.
- Reporting, review and evaluation periods.

A recommended outline of the BMP is provided below with further details demonstrated within the mitigation measures listed in Table 56.

- Introduction
  - Background
  - Management scope and objectives
- Planning requirements
- Construction and operational activities
- Habitat management
  - Flora and fauna values
  - Soils
  - Weeds and pests (i.e. key emerging weeds and priority weeds)
  - Baseline data
- Environmental mitigation measure
- Site specifics
  - Inductions
  - Erosion /sediment control
  - Retained vegetation and rehabilitation works
- Adaptive management
  - Performance criteria, triggers, and responses
- Compliance management
- Reporting, Review and Improvement

The BMP will also provide detail on survey requirements prior to micro-siting of infrastructure components within the development corridor and provide criteria that must be met to ensure there are no increase to biodiversity impacts as a result of micro-siting during detailed design.

### 9.1.2. Bird and Bat Adaptive Management Plan (BBAMP)

#### Framework and objectives

The overall objectives of the BBAMP are to provide an effective monitoring program and strategy to manage and mitigate operational issues relating to bird and bat impacts for the wind farm, to monitor and assess for impacts considered uncertain at the time of approval, and prescribe additional compensatory measures for residual prescribed impacts, if required. Targets will be set which outline the maximum acceptable numbers of trigger alerts, impacts, mitigation interventions, turbine shutdown hours etc., to allow for monitoring of the effectiveness of the mitigation strategies. Additionally, the framework aims to provide certainty to the consent authority and stakeholders prior to approval that measures for minimising biodiversity impacts during operation have been clearly defined that address potential prescribed impacts that cannot be quantified prior to approval.

Guided by the collision risk assessment and turbine risk assessment, and baseline data collected from within the subject land, a detailed BBAMP will be developed prior to operation of the wind farm, in conjunction with relevant stakeholders, to confirm adaptive management measures around the potential for collision mortality, barrier effects and behavioural displacement of resident, nomadic and migratory bird and bat species. A draft BBAMP is provided as Appendix 9.

The Proponent will commit to mitigation measures that must be underpinned by a rigorous monitoring program involving at least five years of carcass searches by conservation detection dogs (where available and allowed onto farmland) and a robust Trigger Action Response Plan (TARP). Therefore, a detailed BBAMP will be finalised in consultation with DPE and BCS prior to commissioning of any turbines, however a framework of the key elements of the BBAMP is provided below, with some known specifics detailed within the mitigation measures listed in Section 9 above.

#### Baseline information

The BBAMP will include baseline data on threatened bird and bat species as well as any non-threatened species considered to be at risk of collision impacts ('at-risk' species) from the project. One of the key objectives for the collection of detailed baseline data is to gather adequate replicable information on the existing bird and bat species abundance and activity (site utilisation) prior to commencement of operation of the wind farm. This includes the setup of impact zones and control zones that would be monitored pre commissioning of turbines, during construction and during operation for an agreed period of time. The data collected is utilised to detect changes in the species use of the site (including changes in activity patterns such as avoidance) post-commissioning and during operation of the wind farm, and allow for stringent mitigation measures to be implemented as, and when, they are required.

Investigations of the site utilisation patterns of bird and bat species within the subject land have been established as a Before-After-Control-Impact (BACI) assessment design. It is important that bird and bat surveys continue once the wind farm becomes operational and that the survey methods used prior to construction are replicated such that results from before and after operation are appropriately comparable. As such the bird and bat utilisation survey points established, and monitored to date, by Nature Advisory will continue to be used through the implementation phase of the BBAMP.

Following commissioning of turbines, ongoing monitoring would mirror the baseline surveys, within spring and summer/autumn, when activity of both birds and bats are likely to be at their highest, for three to five years following commissioning of the wind farm.

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### Trigger-level and unacceptable impacts for further investigation and responsive adaptive management

In order to effectively measure impacts to any at-risk populations or species during the operation phase of the project, and to actively re-assess the suitability of mitigation measures and potential turbine curtailment strategies, the development of alerts, trigger levels and adaptive mitigation response to a potential event is required.

Triggers for responsive management actions will apply where the number of collisions per annum represents a low, but uncertain potential to result in a negative effect on the local population of a species. This is a precautionary objective, as it will be implemented at levels substantially below numbers of collision mortality events that are considered likely to represent a significant impact on the viability of the overall population of any species.

The following definitions (Table 57) are considered a trigger-level alert, and if realised would warrant an increased focus on areas of concern if they were to occur.

**Table 57 General investigation and monitoring triggers for bird and bat strike**

| Tier | Type | Trigger | Mitigation |
|---|---|---|---|
| **Tier 1 alert** | Threatened species | • Where any carcass; feather spot; or injured individual (likely caused as a result of turbine collision) is found under or close to (<120 m from) a wind turbine during any single mortality search or incidentally by wind farm personnel. | Tier 1 mitigation instigated |
| | Non threatened 'at-risk' species | • Where three or more carcasses; feather spots; or injured individuals (likely caused as a result of turbine collision) of a single species are found under or close to (<120m from) a wind turbine during any single mortality search or incidentally by wind farm personnel. | |
| | Other protected species | • Where ten or more carcasses; feather spots; or injured individuals (likely caused as a result of turbine collision) of a single species are found under or close to (<120m from) a wind turbine during any single mortality search or incidentally by wind farm personnel. | |
| | Other | • An at-risk or threatened species is recorded nesting within 200 m of an operational turbine blade tip | |

The following definitions (Table 58) are considered an unacceptable impact and require detailed investigation and stringent temporary or permanent mitigation should they occur.

**Table 58 General investigation and monitoring triggers for bird and bat strike**

| Tier | Type | Trigger | Mitigation |
|---|---|---|---|
| **Tier 2 impact** | Non threatened 'at-risk' species | • Where population* numbers are known:<br>  ○ Any impact that is likely to reduce the total species' population by more than 1% over a two-year period; or<br>• Where population numbers are not known:<br>  ○ Where five or more carcasses, feather spots; or injured individuals (likely caused as a result of turbine collision) of one non-threatened at-risk species (identified in the tables in BDAR Section 6.1.6) are found under or close to (<120 m from) a wind turbine within a two month cycle** or during incidental searches.<br>• Where three or more Tier 1 alerts for non-threatened 'at-risk' species are triggered in a six month period. | Tier 2 and 3 mitigation instigated |
| **Tier 3 impact** | Threatened species | • Where population* numbers are known:<br>  ○ Any impact that is likely to reduce the total species' population by more than 1% over a five-year period; or<br>• Where population numbers are not known:<br>  ○ Where three or more carcasses, feather spots; or injured individuals (likely caused as a result of turbine collision) of a single species are found under or close to (<120 m from) a wind turbine within a two-month cycle** or during incidental searches.<br>• Where three or more Tier 1 for threatened alerts are triggered in a six month period. | |

*'Population relevant to the operation of the wind farm will be determined (where possible) in consultation with BCS via a detailed monitoring plan, and based on baseline and ongoing utilisation survey data and dependent on species by species basis.

**A two month cycle is the search of all turbines split across a two month period i.e. 48 turbines in one month, the remaining 48 the following month.

A detailed decision framework will be included for triggers and mitigation (in conjunction with the below mitigation framework) associated with both the threatened and non-threatened at-risk species during the development of the BBAMP, finalised prior to commissioning of turbines.

### Monitor and report on the effectiveness of impacts and trigger levels

Purpose-trained dogs have been shown to be highly efficient at detecting carcasses (Mathews *et al.* 2013) and have been used for this purpose at a number of wind farms in Australia and internationally. Using purpose-trained dogs obviates the need for formal transects to be established in the search zones as dogs use scent to detect carcasses and are permitted to roam to do so. Every dog is fitted with a GPS tracking device while undertaking searches. GPS tracks will be downloaded and maintained for future reference and used for analyses of search effort and coverage. GIS maps showing routes taken by dogs will be made available to DPHI on request. The use of trained dogs is the preferred method for searches and will be used, provided appropriately trained dogs and handlers are available and landholders allow access by dogs. Dog handler(s) must have demonstrated capacity to identify bird and bat species of NSW.

However, if the use of dogs is not practicable or are unavailable for the project, the alternative is to engage suitably trained ecologists or environmental officers. Observers will search by walking transects through the search zones, generally a 120 metre radius, and a repeated 60 metre pulse search. Searches will be

undertaken by persons with demonstrated capacity to identify bird and bat species of NSW and relevant to the subject land. Transects will be spaced 6 metres apart, or as near to 6 metres as is practical, and observers will thus search the ground for 3 metres either side of each transect. Each observer will carry a hand-held GPS unit (or similar) and record transects they walk. GPS tracks will be downloaded and maintained for future reference and used for analyses of search effort and coverage. GIS maps showing transects walked will be made available to BSC on request.

It is proposed carcass searches be undertaken in accordance with the schedule in Table 59, pending adaptive management, triggers and introduction or amendments to mitigation measures.

**Table 59 Monitoring requirements for carcass searches**

| Turbines | Monitoring schedule |
|---|---|
| **All** | • Monthly for the first six months following commissioning of turbines, however, must include the first spring/summer season following commissioning of turbines, and therefore may be extended in duration, including follow up pulse searches*. |
| **Low and Moderate risk** | • Over a two month cycle**, from six months up to five years following commissioning of relevant turbines, monthly searches in a randomised order including:<br>  ○ 120 m search area around relevant turbines, with a follow up 60 m pulse search from October to March (6 in total).<br>  ○ 120 m search area around relevant turbines, with no pulse searches required from April to September (6 in total).<br>• Following three years following commissioning of relevant turbines, a review of sampling frequency will be undertaken to inform adaptive management. |
| **High-risk** | • Over a two month cycle**, from six months to a minimum of five years following commissioning of relevant turbines, monthly searches in a randomised order including:<br>  ○ 120 m search area around relevant turbines, with 60 m pulse searches throughout.<br>• From five years following commissioning of relevant turbines, sampling frequency thereafter will be informed by a series of scavenger surveys and adaptive management. |

*A 'pulse search' is a secondary search undertaken from three to seven days following the primary search to detect additional mortality of bats and birds.

**A two month cycle is the search of all turbines split across a two month period i.e. 44 low/moderate risk turbines in one month, the remaining 44 low/moderate risk turbines the following month.

It is likely (but uncertain at present) that any carcasses of bats and small birds will be scavenged quickly within the subject land. Carcass persistence trials will be undertaken during the course of the operational monitoring, and prior to its commencement, particularly to inform analyses required to extrapolate from numbers of carcasses detected to estimate total number of collisions. In order for the search regime to accommodate the likelihood of rapid scavenging, a relatively short period between initial searches is important. Trials to determine persistence time of carcasses are required to derive correction factors necessary to estimate total fatalities from the results of the carcass searches. Two persistence trials will be undertaken in each year of the monitoring regime (minimum of three years), one in each of spring and summer/autumn.

Further details on carcass searches/monitoring, persistence trials, incidental finds and data analysis are included in the detailed BBAMP.

## Operational mitigation measures

It is not feasible to foresee what potential factors might lead to an unexpectedly high level of collisions by any species, and therefore appropriate mitigation measures can be prepared only if a cause, or causes, of ecologically significant impacts on the relevant species is known. Additionally, flexibility in mitigation shall be designed to encourage innovative and new technologies to be implemented over the operational life of the wind farm where appropriate.

If a cause is not readily apparent, then investigation of the reason(s) for the impact must be undertaken prior to proposal of a mitigation strategy. Advice from BCS will be sought with regard to design and implementation of any such investigations and of an ultimate mitigation strategy, if required. BCS will be notified within an agreed timeframe from determination by the wind farm operator or the contracted qualified ecologist that a trigger level or unacceptable impact for any species of concern is detected.

The BBAMP will detail considerations of mitigation measures to reduce the number of tier 1 alerts, and tier 2 and tier 3 impacts. Broadly, these will include general mitigation measures and specific trigger related mitigation, including but not limited to, those presented in Table 60 below.

**Table 60 Consideration of likely required mitigation measures**

| Type | Mitigation considerations and response |
|---|---|
| **General** | • Ongoing reassessment of species risk levels and thus relevant trigger-levels.<br>• Periodic review of the turbine mitigation strategy and monitoring program every two years.<br>• Incorporate any operational mitigation measures developed during the preparation and implementation of the BMP relating to active nests / nest trees.<br>• Minimising availability of raptor perches on infrastructure within close proximity to turbines and overhead powerlines.<br>• Installation of marker balls, flags or rotating markers on transmission lines to prevent collisions and deter perching.<br>• Prompt animal carcass removal within the 200 m of a turbine (within 24 hrs of discovery) to minimise raptor scavenging opportunities and reviewed annually.<br>• Changes to land use practices such as stubble burning that might attract raptors.<br>• Participation on local (site based) and co-ordinated (LLS and NPWS) feral animal control programs, i.e., rabbits, wild dogs and foxes, and in line with carcass removal protocols.<br>• Investigation of feasibility and suitability of potential deterrents or evolving technologies, such as:<br>  ○ Ultrasonic technologies, such as the SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics (see further detail below).<br>  ○ Radar (or optical sensor) or live camera technologies for automatic, reactive and temporary curtailment of turbines at high risk turbines (see further detail below).<br>  ○ Avoiding or limiting the use of artificial lighting (synchronising flashing red light if required) on turbines and other infrastructure within close proximity to turbines, unless required for avian safety (or other similar) purposes.<br>  ○ Consider novel deterrent techniques related to blade visibility (i.e., painting one blade a different colour).<br>  ○ Use of 'acoustic lighthouse' to deter avian activity by broadcasting, for example, audible frequencies of 4 – 6 kHz in front of turbine towers to encourage avoidance behaviour (as detailed in (Boycott et al. 2021)).<br>• Maintenance of a minimum 400 m setback buffer between the blade tip of operational turbines and suitable wetland habitats determined to provide suitable habitat for certain "At-risk" species. |

| Type | Mitigation considerations and response |
|---|---|
| | • Annual reporting to include triggers relating to the re-assessment of the mitigation strategies to be implemented over the following year of operation where tier 1 and/or tier 2 and 3 triggers have occurred.<br>  ○ Additional triggers will be developed that consider the actual/extrapolated impacts to bird and bat species calculated across the preceding year, and include associated mitigation measures and potential additional offsets for the following year of operation. |
| **Tier 1 Alert mitigation and response** | Initiate rapid assessment framework for Tier 1 alerts within the BBAMP to identify the most effective mitigation measures to be implemented, including but not limited to:<br>• Increased monitoring of a relevant turbine(s) for a seven day period following a tier 1 alert to determine a one off event, or a potential ongoing event.<br>• Increased frequency of carcass removal, or increased use of other methods of deterrence (where relevant).<br>• Consideration of mobile radar installation or use of 'acoustic lighthouses' for a minimum seven day period for automatic, reactive and temporary curtailment of turbines relating to a Tier 1 alert for medium to large threatened or at-risk bird species.<br>• In the case of at-risk or threatened species nesting within 200 m of an operational turbine blade tip, the nesting event will be allowed to occur, with increased monitoring, potential for temporary curtailment in line with Tier 2 and Tier 3 recommendations until removal of the nest following the breeding event can be undertaken. Any mitigation is to be consistent with project approval conditions.<br>• The assessment is to determine possible causes of alert and identify if additional mitigation is required. |
| **Tier 2 and 3 Impact mitigation and response** | Initiate rapid assessment framework for Tier 2 and Tier 3 triggers within the BBAMP to identify the most effective mitigation measures to be implemented.<br>• Consider temporarily ceasing operation of a turbine(s) relevant to the impact trigger event during the rapid investigation.<br>• Increased daily carcass searches for 14 days following discovery of a Tier 2 or Tier 3 trigger, to be undertaken within the subsequent four weeks of the trigger event by suitable trained ecologist, environmental advisor and/or detector dog services.<br>• The assessment is to determine possible causes of the impact and identify the additional mitigation measures required to be implemented to minimise recurrence of the impact (as far as is practicable).<br>Pending an investigation into Tier 2 and Tier 3 impacts being detected, the following (but not limited to) mitigation options may be required in consultation with the Proponent, suitably qualified ecologists, wind farm subject matter experts and BCS;<br>• Implementation, increase, or re-location of collision risk reduction technologies such as SMART curtailment (microbats) or avian detection systems (birds).<br>• Implementation of low-wind speed, nocturnal curtailments to reduce the potential for microbat collision during periods of highest activity.<br>• Temporary turbine shut down during periods of low visibility (i.e. fog), if suspected as the cause of collision(s).<br>• Consider novel deterrent techniques related to blade visibility (i.e., painting one blade a different colour).<br>• Use of 'acoustic lighthouse' to deter avian activity by broadcasting, for example, audible frequencies of 4 – 6 kHz in front of turbine towers to encourage avoidance behaviour (as detailed in Boycott et al 2021).<br>• Short-term seasonal shutdowns (e.g. based on migratory periods, ephemeral wetland flood events, or nesting events). For example in the case of an at-risk species or threatened species |

| Type | Mitigation considerations and response |
|---|---|
| | nesting within 200m of a turbine, the nesting event will be allowed to occur, with increased monitoring and/or temporary curtailment.<br>• Short-term shutdowns where there is a delay in getting the necessary personnel to site to undertake increased turbine monitoring and relevant assessments.<br>• Immediate reassessment of current mitigation strategy being implemented and if required adjustment (or inclusion if not being implemented for the specific turbine) to reduce the potential for reoccurrence of the unacceptable impact. This reassessment may be required on a temporary or permanent basis. |

The need for adjustments to the mitigation strategy, including specific trigger levels relating to the recording of carcasses or other impacts, will be determined through regular monitoring on the efficacy of the current strategy (as prescribed in the BBAMP). Adjustments may include additional mitigation measures if an unacceptable number of strikes are found to occur, however the option to reduce the level of mitigation will also be prescribed, if sufficient evidence can be provided that it is safe to do so. Such evidence may include few, to no, recorded bird/bat strikes at a given turbine, combined with a comparison to the results of a trial period of reduced mitigation. As such, turbines currently assessed as low risk of impact may be subject to mitigation in the future, or those turbines currently considered to present a moderate risk of impacts may have mitigation measures reduced. All such changes would be guided by the monitoring and adaptive management processes outlined in the BBAMP.

Detailed monitoring on the efficacy of the mitigation strategies, including proactive mitigation and responsive management triggers, has been committed to by the Proponent, as is detailed herein. This includes a schedule of proposed carcass searches utilising trained sniffer dogs (when available/appropriate) focusing on an intensive search period over the initial six months of operation (must include the first spring/summer season) whilst animals habituate to the presence of the turbines. This is then followed by regular ongoing searches of all turbines for a period of three to five years, and then ongoing based on the results of the searches. Triggers have been developed and committed to, which based on the results of the carcass searches, will ensure that mitigation strategies (scaled based on the severity of the trigger) are promptly implemented and will arrest the occurrence of any unacceptable events (i.e. strikes). Mitigation strategies include the ongoing opportunities for alternative actions to turbine curtailment such as audible and ultrasonic noise broadcasting to create avoidance behaviour, or the use of radar to induce turbine shutdowns, with such technologies expected to develop greatly over the life of the project.

**Automated avian detection systems**

Automated detections system are being used in Australia and around thew world as new and innovative technology available to operational wind farms to reduce potential bird and bat collisions. A recent peer-reviewed paper published by Orsted (an offshore wind energy developer) and DHI (a water software development and engineering firm) provides a catalogue and assessment of available monitoring technologies for birds and bats at offshore wind farms, with a focus on managing the risk of collision (Skov et al. 2023). Whilst the focus of the paper relates to offshore wind farms, the technologies reviewed have application potential onshore, and at the Junction Rivers site. The assessment includes a comparison of the multiple applications for the following technologies:

- Radar (2D and 3D)
- Digital camera
- Accelerometer
- Acoustic equipment

- Large-scale survey platform and large-scale telemetry.

Plate 3 below provides an overview of the results of the comparison and provides insight into the suitability of the various technologies available depending on the desired application and mitigation requirements.

| | | Implementation | | | Density | | Species | | | | Avoidance | | | Collision | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Equipment | Retrofit | Installation Complexity | Cost of equipment | Flux outside OWF[1] | Flux inside OWF[1] | Distribution and behaviour | Species id | Flight speed | Flight height | Macro avoidance | Meso avoidance | Micro avoidance | Collision rate | Shutdown |
| Radar | 3D Radar[2] | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▼ | ▼ | ▲ |
| | 2D Radar[2] | ● | ▼ | ● | ▲▲ | ▲▲ | ▲ | ▼ | ▲▲ | - | ▲▲ | ▲▲ | ▼ | ▼ | ▲ |
| | Radar coupled to camera[2] | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ |
| | Radar with fixed antenna[2] | ● | ● | ● | ● | ● | ▼ | ▲ | ● | - | ▲ | ▲ | ▼ | ▼ | ● |
| Camera | Fixed camera[2] | ▲ | ▲ | ▲ | - | - | ▼ | ▲ | ▼ | - | ▼ | ▼ | ▲▲ | ▲▲ | ● |
| | Dome with multiple fixed cameras | ● | ● | ▼ | - | - | ▲▲ | ▲▲ | ▼ | - | ▼ | ▼ | ▲▲ | ▲▲ | ● |
| | Moving camera | ▲ | ▲ | ● | - | - | ▲▲ | ▲▲ | ▼ | - | ▼ | ▼ | ▲▲ | ▲▲ | ● |
| Other | Accelerometer as single sensor | ▼ | ▼ | ▼ | - | - | - | - | - | - | - | - | - | ● | - |
| | Accelerometer coupled to camera | ▼ | ▼ | ▼ | - | - | - | - | - | - | - | - | - | ▲ | - |
| | Microphone[2] | ▲ | ▲ | ▲▲ | - | - | - | ▲▲ | - | - | - | - | - | - | ● |
| Survey Platform | Ship-based surveys | - | - | ▼ | ● | ● | ▲ | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Aerial visual surveys | - | - | ▼ | ▼ | ▼ | ● | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Aerial digital surveys | - | - | ▼ | ▼ | ▼ | ● | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | UAV/drone surveys | - | - | ▼ | ▼ | ▼ | ● | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| Telemetry | Radio transmitters | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Satellite transmitters | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Archival tags | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▼ | ▼ | ▼ | ▼ |
| | Acoustic telemetry | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | - | ● | ▼ | ▼ | ▼ | ▼ |

| | |
|---|---|
| Very good | ▲▲ |
| Good | ▲ |
| Average | ● |
| Bad | ▼ |
| Not Available | - |

**Plate 3 Scoring system applied in the assessment of monitoring technologies (Skov et al. 2023)**

The paper goes on to recommend the combination of technologies considered to best met the aims of the mitigation. For example, if the mitigation objective was to remotely shut down a turbine to prevent collision with a certain highly at-risk species, Skov et al (2023) recommend the following combination of technologies (Plate 4).

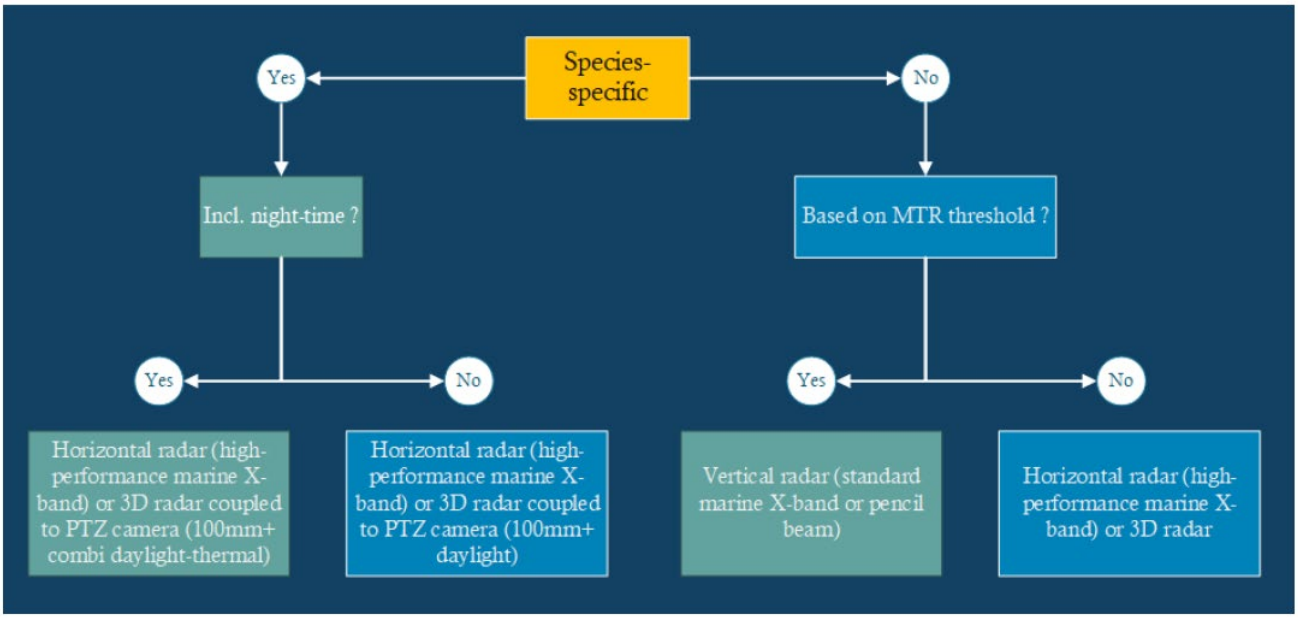



**Plate 4 Recommended solution for turbine shutdowns (MTR is migration traffic rate, and relates to birds flying per hour, per kilometre).**

The applicability and use of automated detection systems at the Junction Rivers Wind Project requires further critical assessment, which will be undertaken during the finalisation of the BBAMP. However, assuming the site is suitable for installation of such technologies, automated detection systems may be a valuable method

to avoid potential collisions for at-risk species. The effectiveness of any installed automated system would be monitored using carcass search methods as detailed above.

Further effective mitigation strategies include pest animal control to reduce the occurrence of foxes, cats and dogs, likely to scavenge microbat carcasses, potentially skewing the results or searches, establishment of lighting systems that reduce insect (prey) attraction, and annual reporting requiring accounting for all events over the preceding 12 months and reinvestigation the effectiveness of the current mitigation strategy. In the event of trigger level investigations being required increased carcass searches would be implemented to determine the actual severity of the event, potential temporary turbine shutdowns (while the investigation is underway), re-assessment of existing mitigation strategy, and ultimately greater mitigation of turbines if unacceptable events are found to be re-occurring.

The Proponent is prepared to work with regulators to share data and continue to contribute to the growing body of literature around bird and bat collisions at operational wind farms. Operational monitoring and adaptive management will ensure that any unacceptable events that may occur are captured and mitigated, thus providing an ongoing feedback loop to further reduce the potential for the project to result in substantial operational impacts to bird and bat species and populations.

**Maintenance of 400 metre minimum setbacks from wetland habitat**

As outlined in Section 6 above, a key strategy to minimise the potential for at-risk waterbird species, such as Australasian Bittern, Australian Pelican and Blue-billed Duck, to collide with operational turbine blades is the implementation and maintenance of a minimum 400 metre buffer between suitable large wetland habitats and operational blade tips. Suitably large ephemeral wetlands, in proximity to the operational wind farm, with the potential to increase sufficiently in the area of suitable habitat available during flood years are considered to be restricted to Condoulpe Lake. Other waterbodies such as Dusty Lake, Harveys Lake, Lake Talbetts and The Forrest Creek occur too far from the wind farm to pose an increased collision risk, and Condoulpe Creek is also unlikely to provide sufficient habitat value, in close enough proximity to operational turbines.

The frequency with which Condoulpe Lake could flood and result in the presence of wetland habitat for at-risk species within 400 metres of an operational turbine is not expected to be high. Condoulpe Lake flooded in summer 2022 / 2023, towards the end of the triple La Niña event that brought increased rainfall to south-eastern Australia between September 2020 and February 2023. Water in the lake was at its highest levels between January and February 2023, after flooding in the upper reaches of the broader catchments reached the local area. However, water levels and thus any associated wetland habitats did not occur within approximately 1 kilometre of proposed turbine (blade) locations. Plate 5 below displays Normalized Difference Water Index (NDWI) multi-spectral imagery from the online Copernicus Data Space Ecosystem browser (Copernicus 2024) of Condoulpe Lake from 10 January 2023, when the lake was near maximum inundation over the summer 2022 / 2023 period. NDWI is most appropriate for viewing and mapping of waterbodies (Copernicus 2024), with blue areas representing water in the landscape, ranging through white to green areas that do not represent standing water. It can be seen from the 1075 metre diameter buffer rings (refer Section 6.3) overlaying the NDWI imagery, that the water was no closer than approximately 1 kilometre from the proposed locations of the blade tips during maximum inundation.

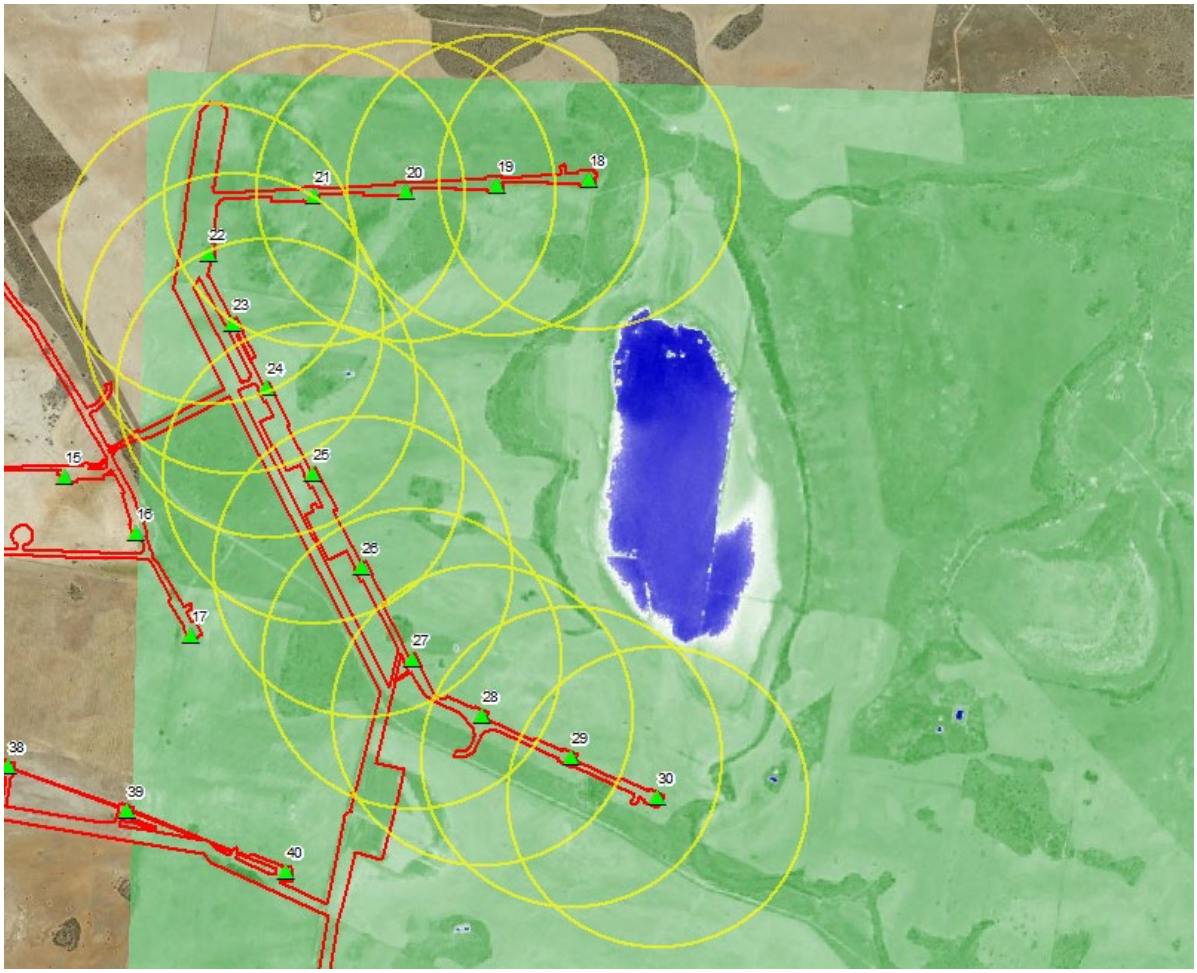



**Plate 5** **NDWI imagery of Condoulpe Lake from January 2023 illustrating wetland habitat during flooding (blue colour) remains approximately 1 km from operational turbine blades.**

For water and associated wetland habitats to reach within 400 metres of the blade tips, a significant weather event would need to occur, the frequency of which would be unlikely to occur multiple times in the expected 30 year lifetime of the project. La Niña conditions over three consecutive summers, as contributed to the water levels observed in summer 2022/2023, are rare and have only occurred three times since 1950 (in 1973-76, 1998-2001, and 2020-2023) (ARC 2022).

Finalisation of the BBAMP will include details of catchment-scale flood event monitoring requirements that would trigger additional monitoring of habitats in proximity to the operational wind farm (i.e. Condoulpe Lake). Threshold triggers will also be included for further investigation and potential implementation of seasonal event-based mitigation strategies to maintain the minimum 400 metre setbacks. Mitigation strategies may include; increased monitoring of turbines and habitats to detect the presence of target at-risk species, installation of deterrent measures such as acoustic lighthouses, installation of mobile (or fixed from commissioning) automatic detection systems to monitor for the species presence and implement temporary turbine shutdowns, or longer-term turbine shutdowns until such time as floodwaters and habitat have receded back to >400 metres from the blade tips. Thresholds for the end of increased mitigation would also be developed to determine when suitable wetland habitats were no long present within the critical 400 metre setbacks.

**SMART curtailment**

'Blanket curtailment' approaches although often successful in reducing bat fatalities, also result in a reduced energy generation capacity and often coincide with periods of high electrical demand thus rendering them potentially unsustainable in the long-term for many wind generation operations.

In an attempt to reduce bat fatalities while optimising energy production, more tailored strategies can be developed to increase the time during which turbines can continue operation and power production relative to blanket operational mitigation approaches. 'Smart curtailment' approaches are being developed that use and combine information about real-time bat activity and environmental information, such as weather conditions, in order to guide curtailment decisions based on real-time risks to bats. Smart curtailment provides wind energy facilities with a pathway for reducing bat fatalities whilst also reducing curtailment time when compared to blanket curtailment techniques thereby maximising energy production whilst minimising impacts to bats.

Studies trialling the approach overseas have achieved significant reductions in bat mortality without the need for blanket curtailment of turbines at lower wind speeds (Hayes et al. 2019). However, there are no comparable studies available for Australian wind farms. Furthermore, overseas studies have often been used in conjunction with automated bat call identification software, which is not currently available for Australian bat species. Automated identification allows bat calls to be identified to species level in real-time and in a consistent, repeatable and time-efficient way.

Recent technological advances have seen the release of smart curtailment systems that are considered applicable to the Junction Rivers Wind Project. For example, the SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics, allows ultrasonic detectors to be mounted to the nacelles of turbines and files containing probable bat call information to be transmitted in real-time via modems and the cellular network to a database system where the information can then be analysed. The SMART system allows for user defined alarms which match bat call parameters that can be directly input into curtailment decision-making processes in real-time.

Technology such as the SMART system provides real potential for a tailored curtailment approach for the project that would provide operational flexibility in allowing turbines to continue producing energy when they might otherwise be curtailed based only on wind speed information.

When the smart curtailment acoustic monitoring system is engaged, real-time monitoring of microbat activity would allow turbines to be curtailed when bat activity reaches a pre-determined threshold. The SMART curtailment acoustic monitoring system can also be switched off when wind speeds reach thresholds above which bat activity (and therefore collision risk) are considered to be negligible. Under these circumstances, electricity generation would proceed without intervention until wind speeds fall below the pre-determined threshold. This approach has been the subject of a study by Hayes et al (2019) that found implementing a similar acoustic monitoring and remote curtailment system when wind speeds were below 7.9 m/s reduced bat fatalities by 85 %, without the use of blanket low wind speed curtailments.

Technologies such as the SMART system are included in the BBAMP as possible mitigation strategies available to the operational project if a trigger alerts or an unacceptable level of impacts to bats was found to be occurring.

### Residual prescribed impacts and compensatory measures

Following implementation of required mitigation, additional offset requirements for prescribed impacts may be required to offset residual impacts in accordance with the BAM. This may be achieved via the retiring of credits or payment to the Biodiversity Conservation Fund. The amount of credits required to be offset would be calculated by the number of actual and modelled impacts, accounting for scavenger impacts, to individual species in a given year, multiplied by the biodiversity risk weighting (BRW) for the relevant species. This method is commensurate with the Equation 3 (Section 10.1.3) of the BAM for calculating species credit requirements for flora species assessed by a count of the number of individuals, which is aligned with the calculation of offsets required for impacts to individual bird and bat strikes. This method also captures the relevance of a current threatened listing for a species, and is in accordance with the expectations of BAM implementation for prescribed impacts (Section 8.6 of the BAM).

Where an unacceptable impact to a non-threatened 'at risk' species be encountered or estimated, following mitigation, then a like for like risk weighting may be applied from a similar threatened species i.e. – Wedge-tailed Eagle to Little Eagle, following consultation with BCS. Any credit generation required to offset residual prescribed impacts would be calculated during the annual reporting, which will also demonstrate that credits required for the preceding 12 months have been retired under the BOS.

### Monitoring and adaptive management triggers for barrier effect impacts

Whilst the focus of the above section is on mitigation of the impacts associated with collision risk, it is acknowledged that there remains some potential for impacts associated with barrier effects for threatened and/or at-risk species. During operational monitoring, if there is a noted discernible statistical reduction or anomaly in abundance of an at-risk or threatened species, additional investigations into possible causes would occur. If it is determined that the operational wind farm was a key factor, additional assessments against key relevant Test of Significance criteria or Significant Impact Criteria would be used to quantify or measure the level of impact. If these assessments determined that an event resulting from barrier effects warranted additional mitigation, compensatory measures or species specific offsetting, these would be employed. This detail and decision framework is provided within the BBAMP.

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# 10. Impact summary

## 10.1. Direct and indirect impact to biodiversity values

The project is expected to impact upon the following biodiversity values:

- Seven native PCTs mapped as 15 separate vegetation zones, and 77 scattered paddock trees.
- Two BC Act listed TECs - *Acacia melvillei* Shrubland and Sandhill Pine Woodland.
- Assumed habitat for three threatened flora species credit species – Menindee Nightshade, Mossgiel Daisy and Winged Peppercress.
- Known foraging and assumed breeding habitat for one fauna species credit species – Major Mitchell's Cockatoo.
- Known and predicted habitat for a range of fauna ecosystem credit species.
- Thirty-five species of bird and bat considered at risk of operational impact mainly associated with turbine strike.

As detailed in the above section of this BDAR the proponent has undertaken significant efforts to avoid and minimise impacts to all biodiversity values present within the subject land, and the residual impacts to the above listed biodiversity values will continue to be minimised, mitigated and offset through the duration of the project.

No direct or indirect impacts are expected to occur as a result of the proposed wind farm to the Yanga National Park, Yanga Nature Reserve or the Yanga State Conservation Area. Refer to section 8.3.3.

## 10.2. Serious and irreversible impacts

In accordance with Clause 6.7 of the BC Regulation an impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

(a) Principle 1: It will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.
(b) Principle 2: It will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.
(c) Principle 3: It is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.
(d) Principal 4: The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

No species recorded or assumed present within the subject land are considered to meet the above principles, and as such no serious and irreversible impacts are expected to occur as a result of the project.

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## 10.3. Identification of impacts requiring offset, not requiring offset and areas not requiring assessment

The following section provide information on the project's impacts requiring offset, not requiring offset and areas not requiring assessment. Each category is displayed on Figure 20.

### 10.3.1. Impact requiring offset

#### Impacts to native vegetation (ecosystem credits)

As outlined in Section 9.2.1 of the BAM, the assessor must determine an offset for all impacts of proposals on PCTs that are associated with a vegetation zone that has a vegetation integrity score of:

- ≥15, where the PCT is representative of an EEC or a CEEC.
- ≥17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community.
- ≥20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

The offset requirement for the proposal was calculated using the BAM Calculator. Table 61 provides a summary of the ecosystem credit offsets required for impacts from proposed development at the subject land.

**Table 61 Offsets required (ecosystem credits)**

| Vegetation zone | Impact (ha) | VI score | TEC | HBTs | Credit requirement |
|---|---|---|---|---|---|
| **16_Moderate** | 3.8 | 53.4 | No | Yes | 89 |
| **16_Low** | 0.36 | 28.6 | No | Yes | 5 |
| **21_Moderate** | 1.17 | 64.6 | Sandhill Pine Woodland | Yes | 38 |
| **23_Moderate** | 2.03 | 62.7 | Acacia melvillei Shrubland | No | 64 |
| **57_Moderate** | 0.19 | 61.1 | No | No | 4 |
| **58_High** | 0.85 | 91 | No | Yes | 34 |
| **58_Moderate** | 20.91 | 74.8 | No | Yes | 685 |
| **58_DNG** | 31.01 | 17.7 | No | No | 241 |
| **58_Paddock_trees** | 0.07 | 46.6 | No | Yes | 1 |
| **163_Moderate** | 3.58 | 59.5 | No | No | 80 |
| **170_Moderate** | 4.67 | 59.5 | No | Yes | 104 |
| **170_Low** | 0.56 | 29.7 | No | Yes | 6 |
| **Total** | | | | | 1351 |

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## Impacts to threatened species and their habitat

As outlined in Section 9.2.2 of the BAM an offset is also required for the impacts of the proposals on the habitat of species credit species. Table 62 provides a summary of the species credit offsets required for impacts from proposed development at the subject land.

**Table 62 Offsets required (species credits)**

| Vegetation zone | Species | Habitat condition (vegetation integrity score) loss | Area (ha) | Credit requirement |
|---|---|---|---|---|
| **16_Moderate** | Mossgiel Daisy *Brachyscome papillosa* | 53.4 | 2.3 | 62 |
| **163_Moderate** | | 59.5 | 1.6 | 47 |
| **Subtotal** | | | | **109** |
| **16_Moderate** | Winged Peppercress *Lepidium monoplocoides* | 53.4 | 2.2 | 58 |
| **163_Moderate** | | 59.5 | 1.5 | 45 |
| **Subtotal** | | | | **103** |
| **16_Moderate** | Menindee Nightshade *Solanum karsense* | 53.4 | 2.3 | 47 |
| **Subtotal** | | | | **47** |
| **16_Moderate** | Major Mitchell's Cockatoo *Lophochroa leadbeateri* | 53.4 | 2.3 | 60 |
| **16_Low** | | 28.6 | 2.3 | 5 |
| **16_DNG** | | 14.7 | 2.6 | 19 |
| **16_Paddock_trees** | | 10.7 | 0.21 | 1 |
| **21_Moderate** | | 64.6 | 0.85 | 27 |
| **23_Moderate** | | 62.7 | 1.7 | 52 |
| **57_Moderate** | | 61.1 | 0.19 | 6 |
| **58_High** | | 91.0 | 0.85 | 39 |
| **58_Moderate** | | 74.8 | 9.1 | 340 |
| **58_DNG** | | 17.7 | 11 | 97 |
| **58_Paddock_trees** | | 46.6 | 0.07 | 2 |
| **163_Moderate** | | 59.5 | 1.4 | 43 |
| **170_Moderate** | | 59.5 | 4.3 | 43 |
| **170_Low** | | 29.7 | 0.48 | 7 |
| **170_DNG** | | 15.0 | 2.1 | 15 |
| **Subtotal** | | | | **840** |
| **Grand total** | | | | **1099** |

Species polygons for the above four species credit species impacted by the project are illustrated in Figure 20 below.

## Impacts to scattered trees

Offsets are required for the clearing of Class 2 and Class 3 paddock trees.

**Table 63 Offsets required (scattered trees)**

| Class | Contains hollows | Number of trees | Ecosystem credits |
|---|---|---|---|
| **16-Black Box grassy open woodland wetland** | | | |
| **3** | Yes | 4.0 | 4 |
| **2** | Yes | 3.0 | 2 |
| **Subtotal** | | | **6** |
| **58-Black Oak - Western Rosewood open woodland** | | | |
| **3** | Yes | 14.0 | 14 |
| **3** | No | 8.0 | 6 |
| **2** | Yes | 2.0 | 2 |
| **2** | No | 1.0 | 1 |
| **3** | Yes | 10.0 | 10 |
| **3** | No | 4.0 | 3 |
| **Subtotal** | | | **36** |
| **170-Chenopod sandplain mallee** | | | |
| **3** | Yes | 3.0 | 3 |
| **2** | Yes | 2.0 | 2 |
| **2** | No | 1.0 | 1 |
| **2** | No | 1.0 | 1 |
| **2** | No | 1.0 | 1 |
| **Subtotal** | | | **8** |
| **21-Slender Cypress Pine - Sugarwood - Western Rosewood open woodland** | | | |
| **3** | Yes | 14.0 | 14 |
| **Subtotal** | | | **14** |
| **23-Yarran tall open shrubland** | | | |
| **3** | Yes | 1.0 | 1 |
| **3** | No | 1.0 | 1 |
| **Subtotal** | | | **2** |
| **Grand total** | | | **66** |

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### 10.3.2. Impacts not requiring offset

As outlined in Section 9.2.1 of the BAM, offsets are not required for impacts to vegetation zones that have a vegetation integrity score of ≥17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community.

Three vegetation zones impacted by the project fit the above criteria and are outlined in Table 64 below.

**Table 64 Offsets not required (ecosystem credits)**

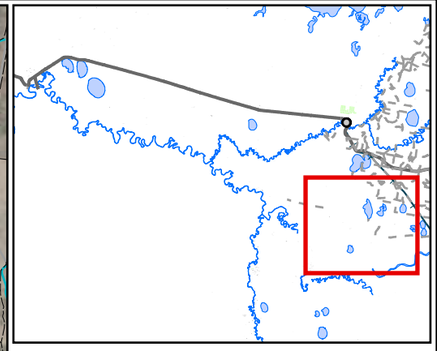
| Vegetation zone | Impact (ha) | VI score | TEC | HBTs | Credit requirement |
|---|---|---|---|---|---|
| **16_DNG** | 2.78 | 14.7 | No | No | 0 |
| **16_Paddock_trees** | 0.21 | 10.7 | No | Yes | 0 |
| **170_DNG** | 3.50 | 15 | No | No | 0 |

### 10.3.3. Impacts not requiring assessment

As outlined in Section 9.3 of the BAM, areas within the subject land that do not contain native vegetation do not need to be assessed for ecosystem credits. Areas of land mapped as Category 1 Exempt land under the LLS Act also do not require assessment under the BAM.

Areas of land that do not contain native vegetation must still be assessed for threatened species habitat and prescribed biodiversity impacts in accordance with the BAM.

The project will impact upon approximately 691 hectares of land that does not contain native vegetation, and approximately 3.48 hectares on native vegetation that occurs on Category 1 – Exempt land.



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring assessment
- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Winged Peppercress
- Mosgiel Daisy
- Menindee Nightshade
- Major Mitchell's Cockatoo

**Figure 20.1 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 900 1,800 2,700 3,600

Meters

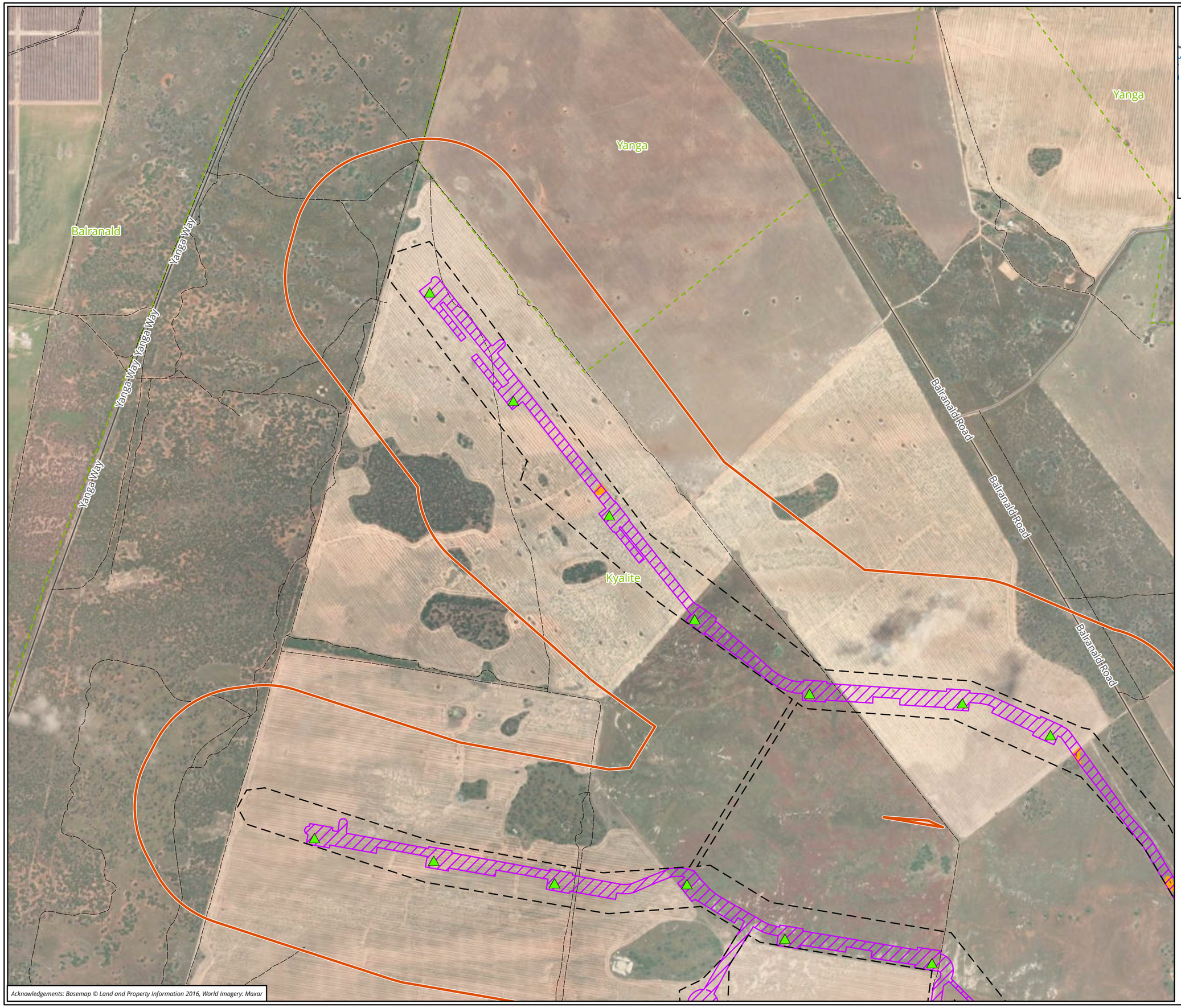
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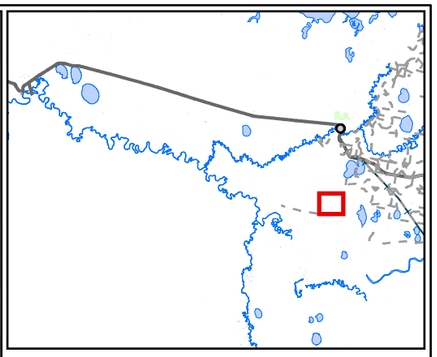
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics*



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.2 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800 N

Meters

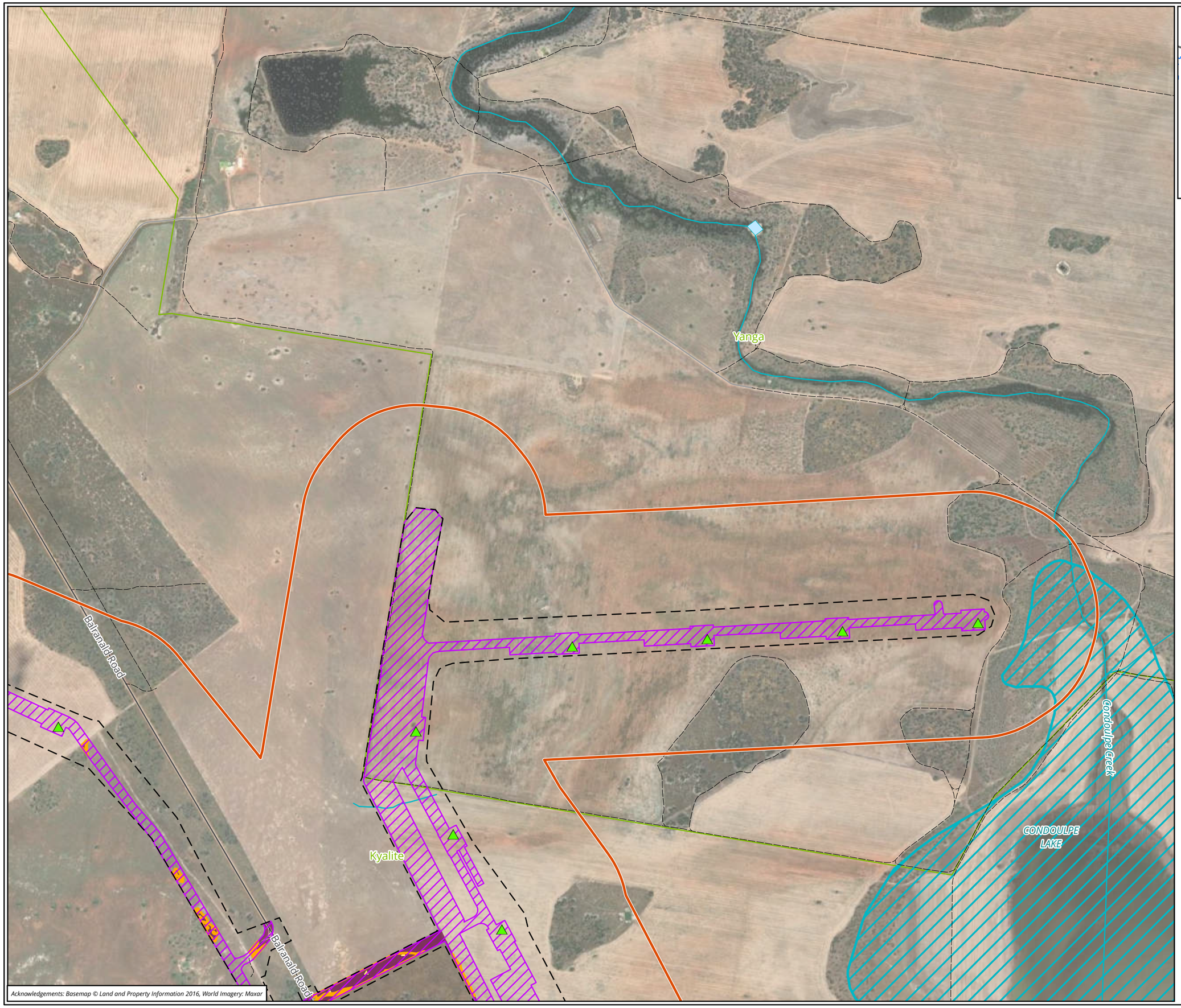
Scale: 1:17,000 @ A3

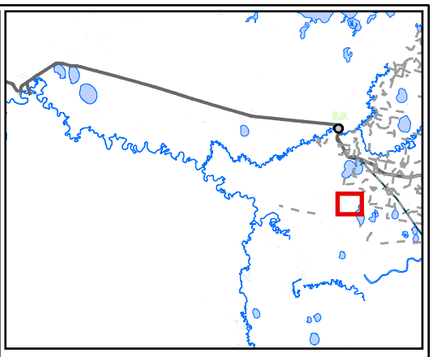
*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.3 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

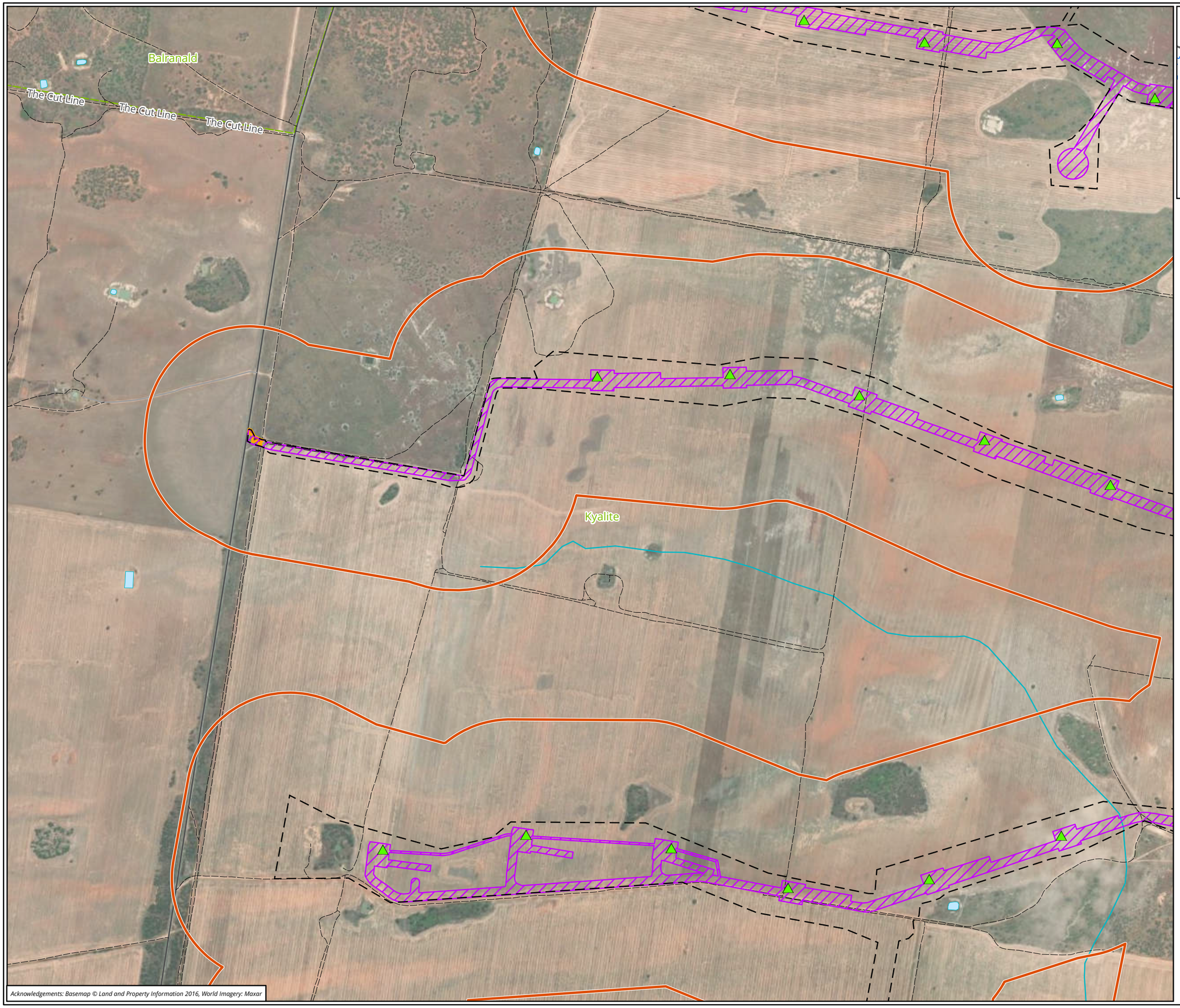
Meters

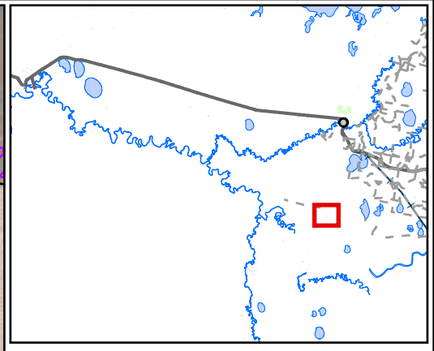
Scale: 1:17,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.4 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

Scale: 1:17,000 @ A3

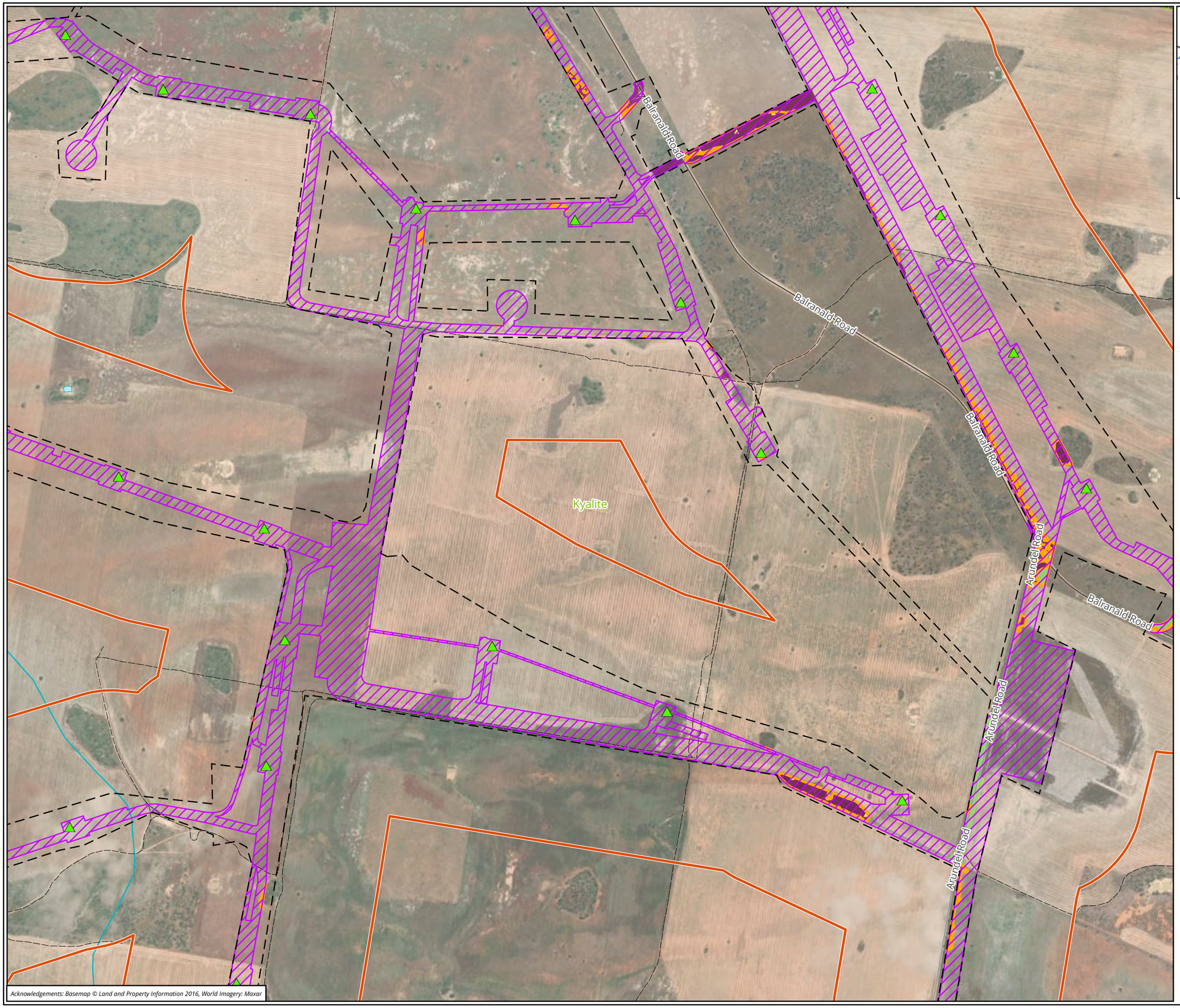
*Coordinate System: GDA2020 MGA Zone 54*

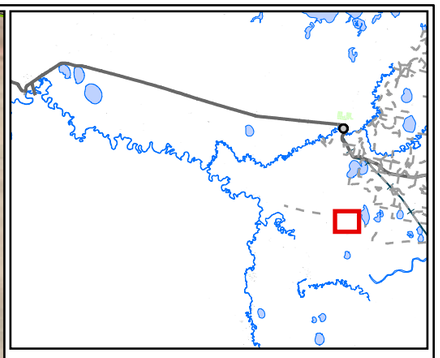
N

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring assessment
- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.5 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

Scale: 1:17,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

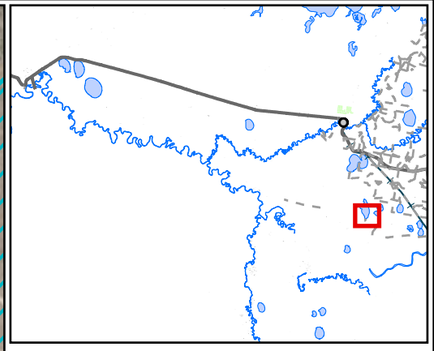
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Matter: 37502, Date: 19 April 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring assessment
- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.6 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

Scale: 1:17,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

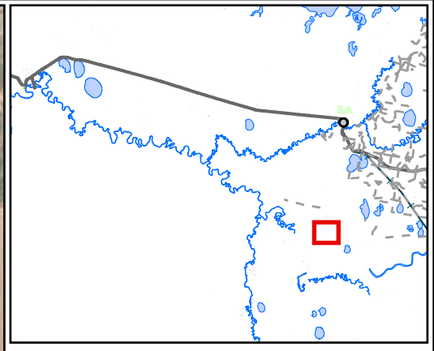
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biosis

Matter: 37502, Date: 19 April 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Requiring offsets

**Threatened species requiring offsets**

- Winged Peppercress
- Mosgiel Daisy
- Menindee Nightshade
- Major Mitchell's Cockatoo

**Figure 20.7 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

N

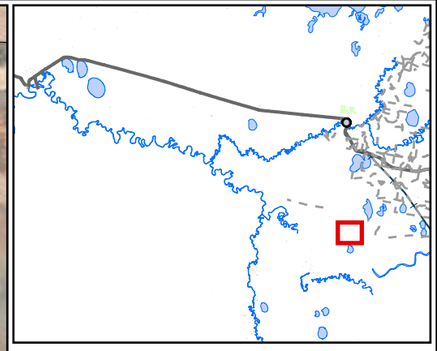
Scale: 1:17,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Winged Peppercress
- Mosgiel Daisy
- Menindee Nightshade
- Major Mitchell's Cockatoo

Kyalite

Arundel Road

Arundel Road

Arundel Road

Arundel Road

**Figure 20.8 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

Scale: 1:17,000 @ A3

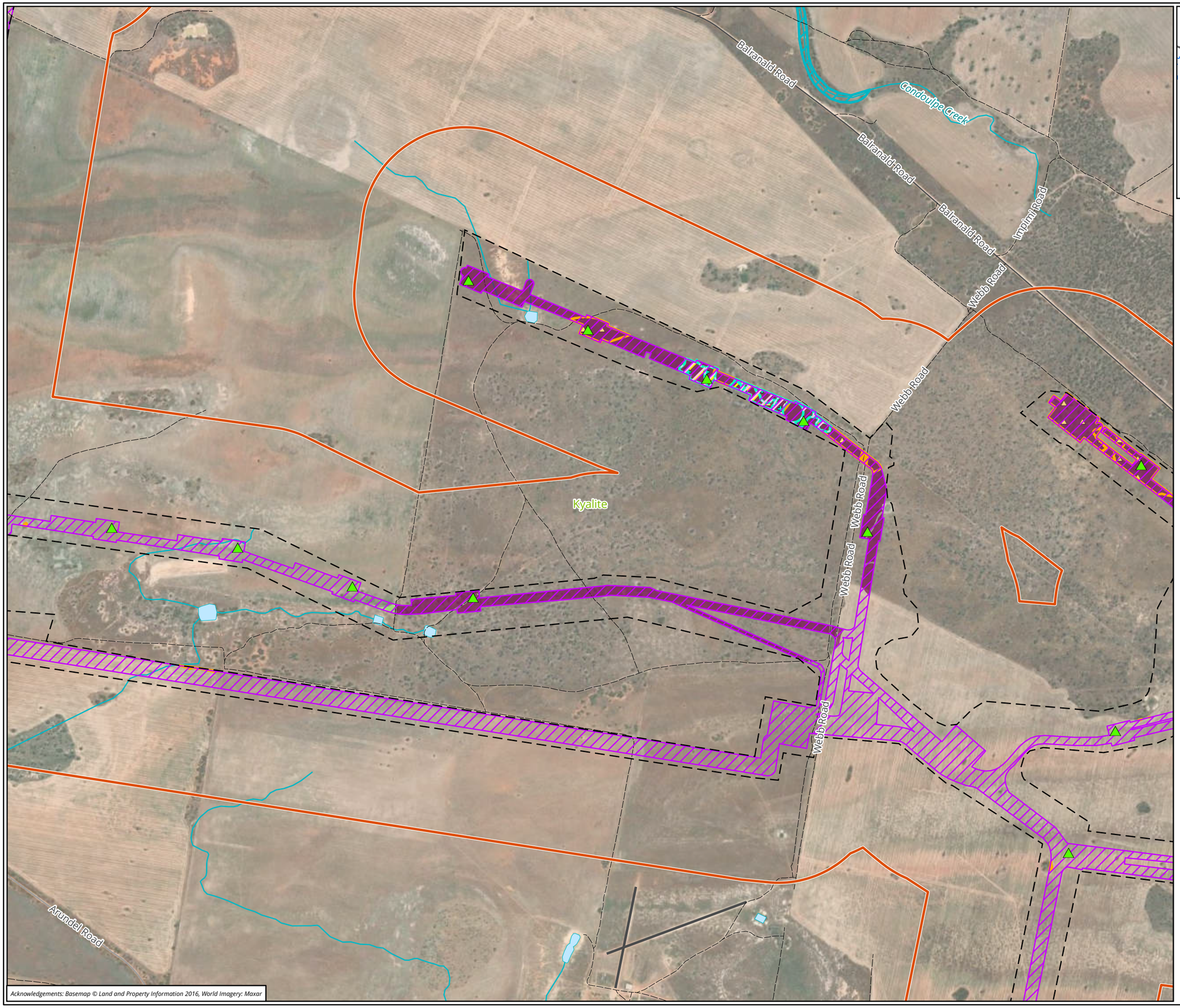
*Coordinate System: GDA2020 MGA Zone 54*

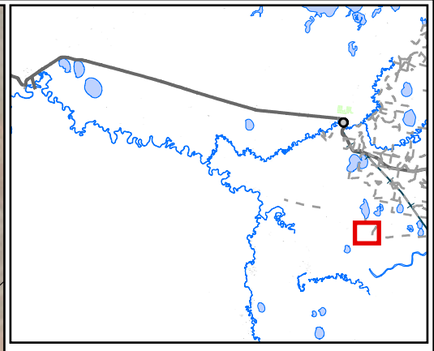
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Winged Peppercress
- Mosgiel Daisy
- Menindee Nightshade
- Major Mitchell's Cockatoo

**Figure 20.9 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

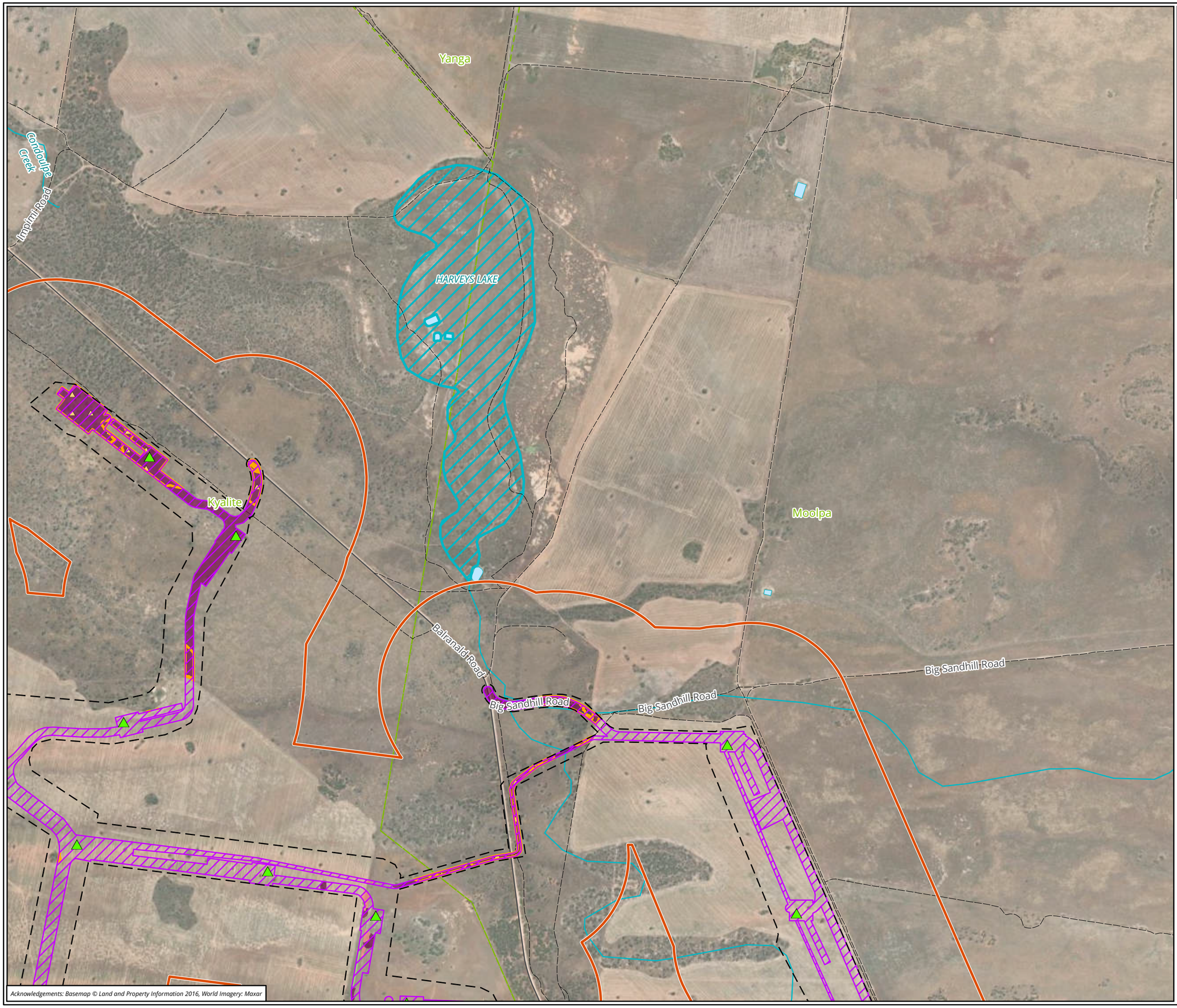
Scale: 1:17,000 @ A3

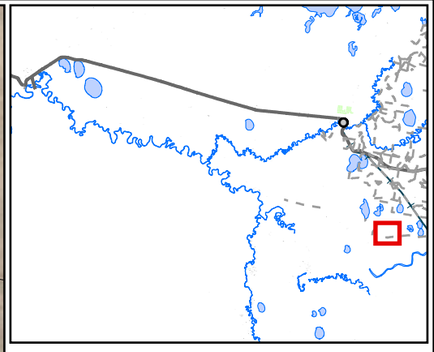
*Coordinate System: GDA2020 MGA Zone 54*

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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring assessment
- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.10 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

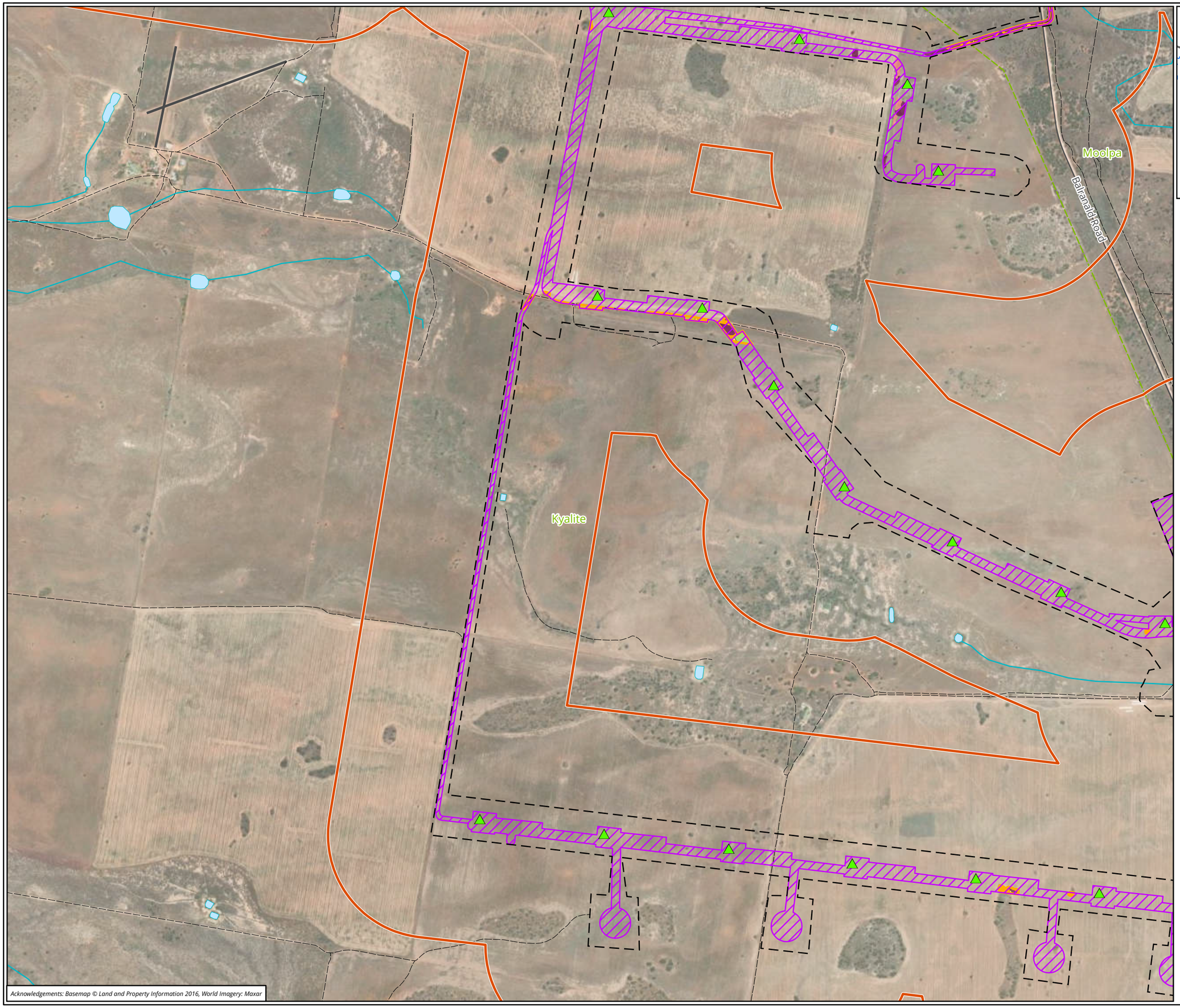
Scale: 1:17,000 @ A3

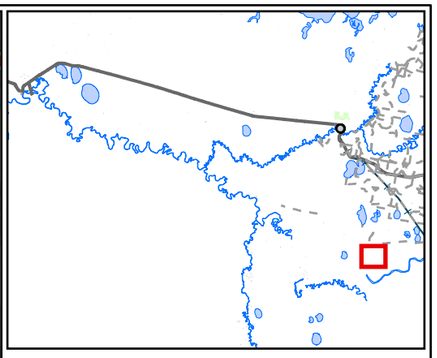
*Coordinate System: GDA2020 MGA Zone 54*

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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring assessment
- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.11 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

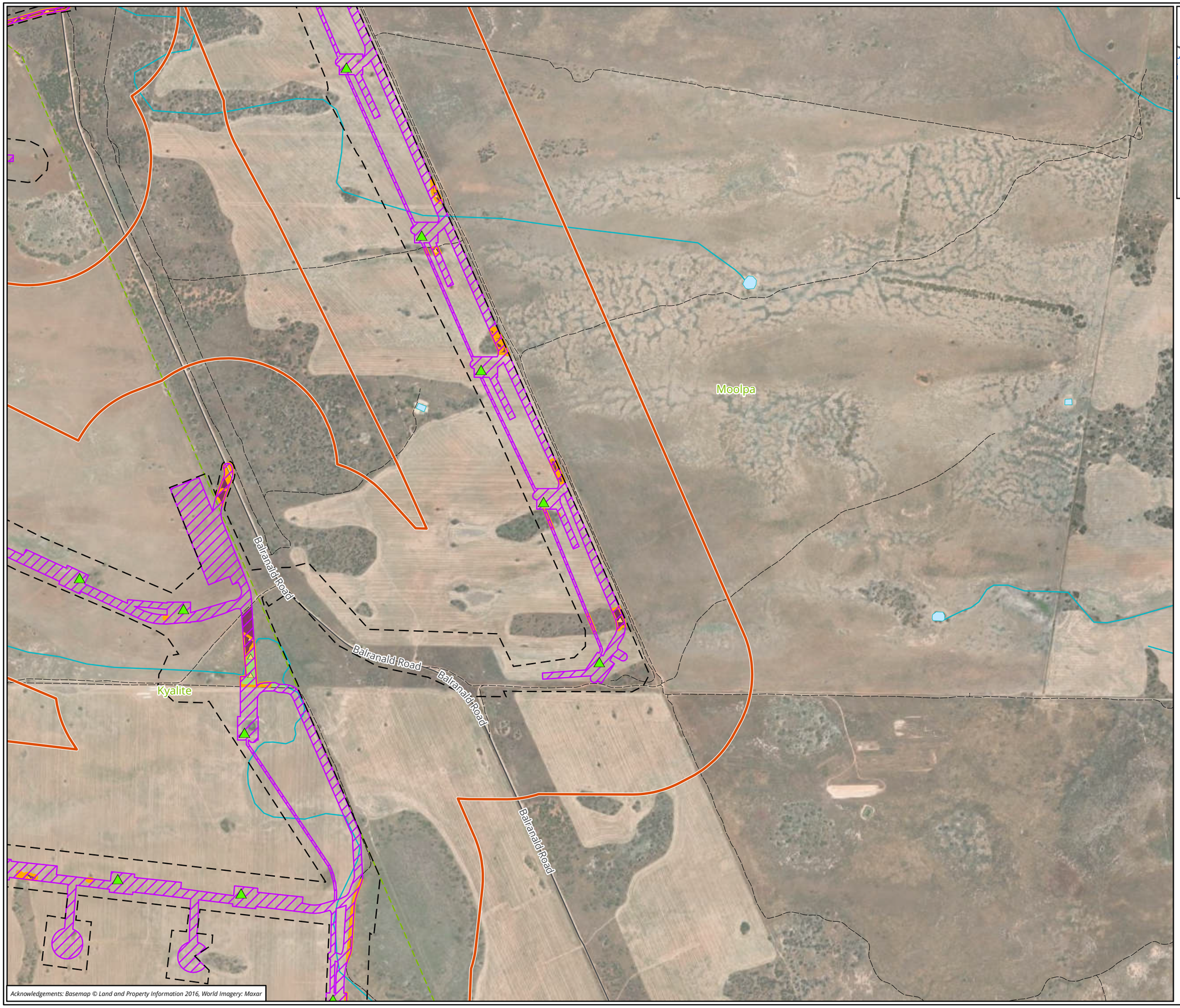
Scale: 1:17,000 @ A3

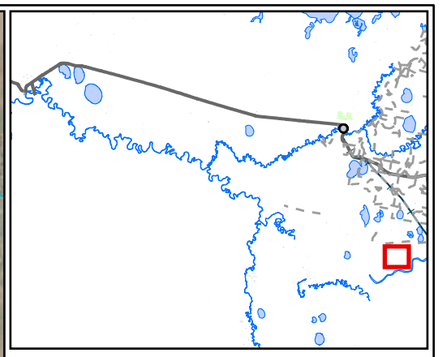
*Coordinate System: GDA2020 MGA Zone 54*

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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.12 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

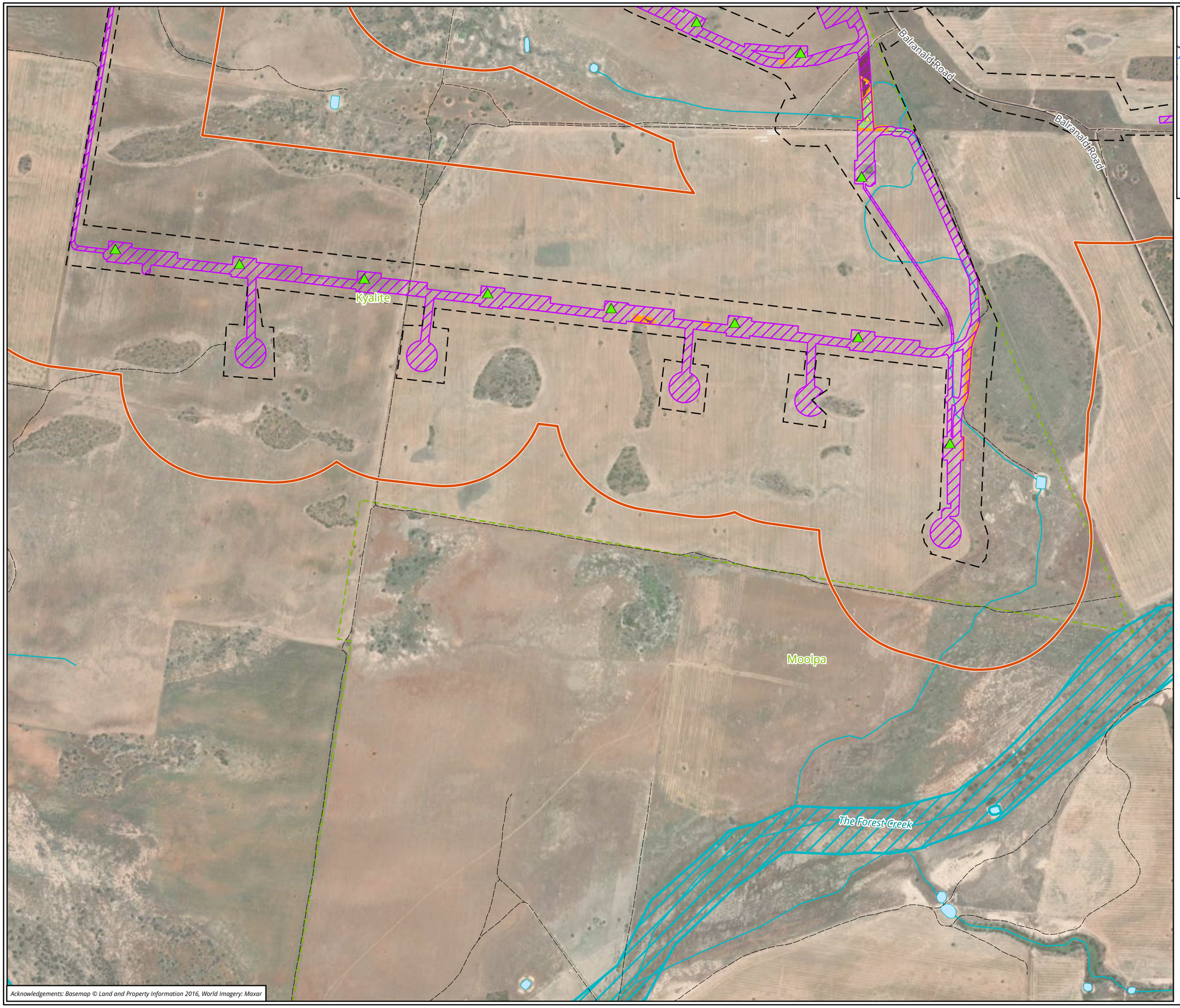
Scale: 1:17,000 @ A3

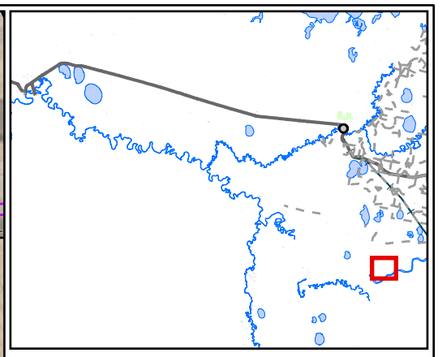
*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 19 April 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Threatened species requiring offsets**

- Major Mitchell's Cockatoo

**Figure 20.13 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 200 400 600 800

Meters

Scale: 1:17,000 @ A3

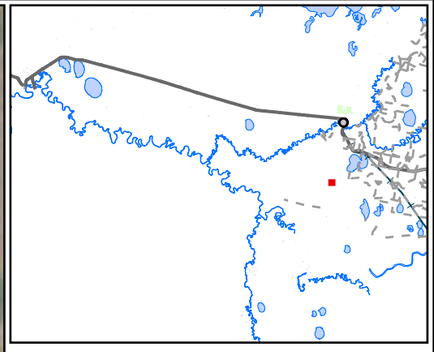
*Coordinate System:*
*GDA2020 MGA Zone 54*

N

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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets



**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Offsets**

- Not requiring offsets
- Requiring offsets

**Figure 20.14 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

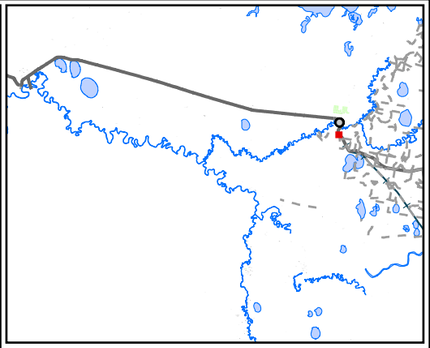
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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 20.15 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

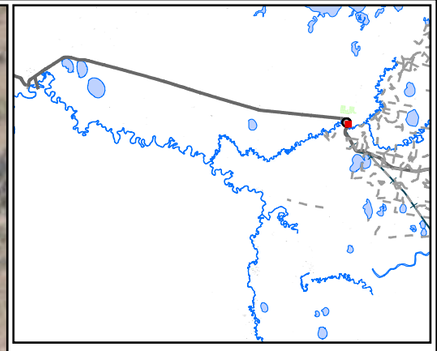
N

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Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F20_Offsets

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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 20.16 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

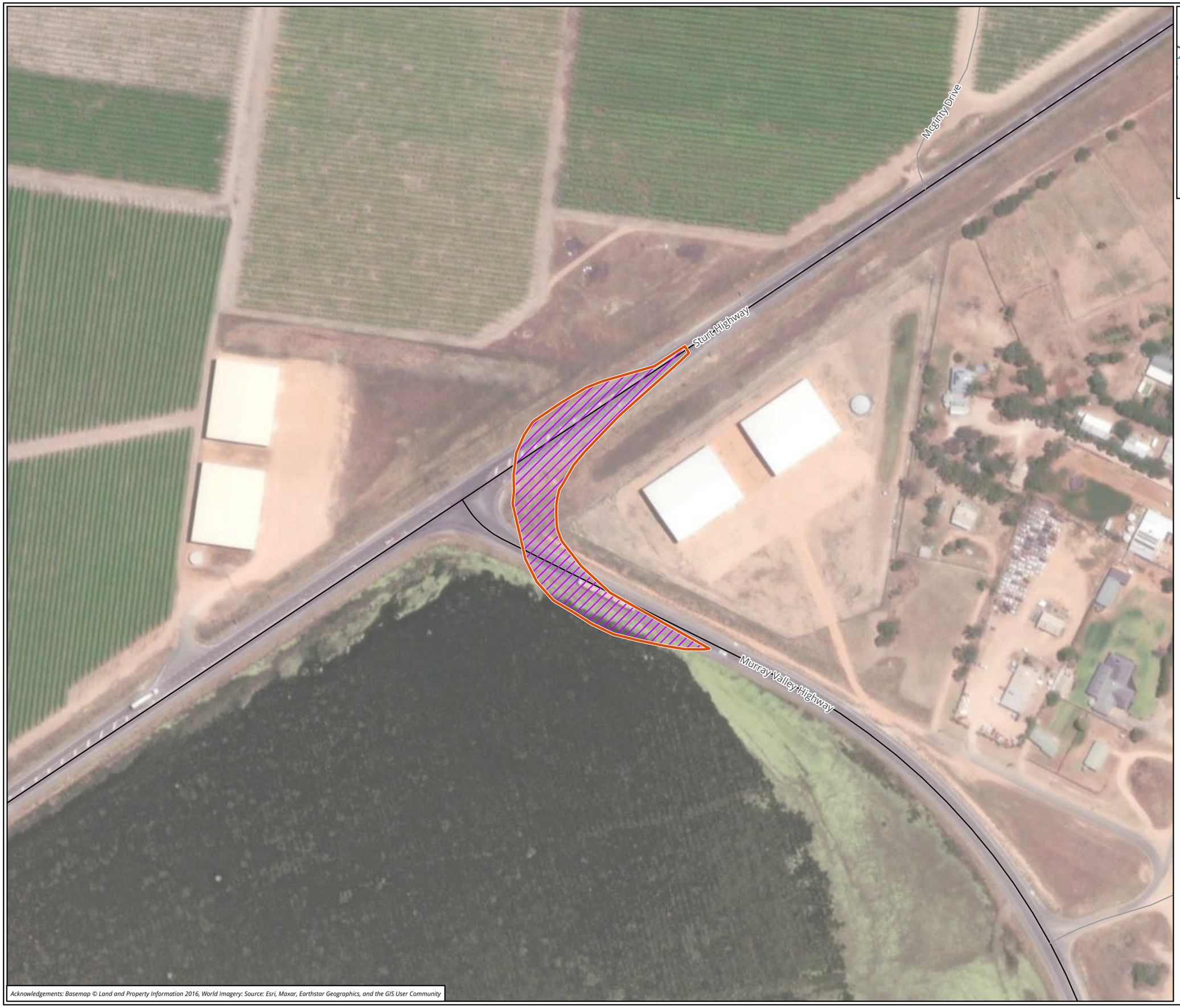
*Coordinate System: GDA2020 MGA Zone 54*

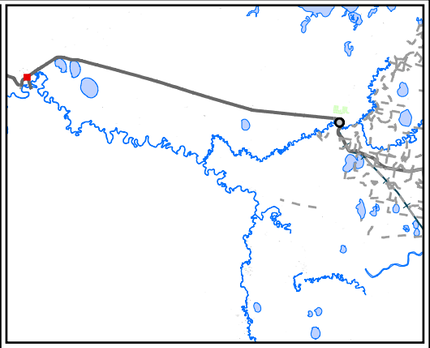
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
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**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Figure 20.17 Impacts requiring offsets, not requiring offset, not requiring assessment**

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

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# 11. Biodiversity credit report

Offsetting through the transfer and retirement of biodiversity credits, or paying into the BCT Offset Fund, is required for the current assessment for impacts to one vegetation zone at the subject land. Biodiversity credit reports provided on the following pages.

Biodiversity credit report 00034462/BAAS18138/22/00034463 relates to impacts to vegetation zones and species credit species habitats.

Biodiversity credit report 00044469/BAAS18138/23/00044470 relates to impacts to paddock tress undertaken in accordance with the BAM streamlined assessment module (see Appendix 7)

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# BAM Credit Summary Report

## Proposal Details

Assessment Id
00034462/BAAS18138/22/00034463

Proposal Name
Burrawong WF - BDAR Final

BAM data last updated *
14/03/2024

Assessor Name
Callan Wharfe

Report Created
15/05/2024

BAM Data version *
67

Assessor Number
BAAS18138

BAM Case Status
Finalised

Date Finalised
15/05/2024

Assessment Revision
11

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

| Zone | Vegetation zone name | TEC name | Current Vegetation integrity score | Change in Vegetation integrity (loss / gain) | Area (ha) | Sensitivity to loss (Justification) | Species sensitivity to gain class | BC Act Listing status | EPBC Act listing status | Biodiversity risk weighting | Potential SAII | Ecosystem credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion** | | | | | | | | | | | | |
| 7 | 57_Moderate | Not a TEC | 61.1 | 61.1 | 0.19 | PCT Cleared - 43% | High Sensitivity to Gain | | | 1.50 | | 4 |
| | | | | | | | | | | | **Subtotal** | **4** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)** | | | | | | | | | | | | |
| 1 | 16_Moderate | Not a TEC | 53.4 | 53.4 | 3.8 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 89 |
| 2 | 16_Low | Not a TEC | 28.6 | 28.6 | 0.36 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 5 |
| 3 | 16_DNG | Not a TEC | 14.7 | 14.7 | 2.8 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 0 |
| 4 | 16_Paddock_trees | Not a TEC | 10.7 | 10.7 | 0.21 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 0 |
| | | | | | | | | | | | **Subtotal** | **94** |
| **Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion** | | | | | | | | | | | | |
| 8 | 58_High | Not a TEC | 91 | 91.0 | 0.85 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 34 |
| 9 | 58_Moderate | Not a TEC | 74.8 | 74.8 | 20.9 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 685 |
| 10 | 58_DNG | Not a TEC | 17.7 | 17.7 | 31 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 241 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 58_Paddock_trees | Not a TEC | 46.6 | 46.6 | 0.07 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 1 |
| | | | | | | | | | | | **Subtotal** | **961** |
| **Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones** | | | | | | | | | | | | |
| 13 | 170_Moderate | Not a TEC | 59.5 | 59.5 | 4.7 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | | 104 |
| 14 | 170_Low | Not a TEC | 29.7 | 29.7 | 0.56 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | | 6 |
| 15 | 170_DNG | Not a TEC | 15 | 15.0 | 3.5 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | | 0 |
| | | | | | | | | | | | **Subtotal** | **110** |
| **Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones** | | | | | | | | | | | | |
| 12 | 163_Moderate | Not a TEC | 59.5 | 59.5 | 3.6 | PCT Cleared - 26% | High Sensitivity to Gain | | | 1.50 | | 80 |
| | | | | | | | | | | | **Subtotal** | **80** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion** | | | | | | | | | | | | |
| 5 | 21_Moderate | Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions | 64.6 | 64.6 | 1.2 | Biodiversity Conservation Act listing status | High Sensitivity to Gain | Endangered Ecological Community | Not Listed | 2.00 | | 38 |
| | | | | | | | | | | | **Subtotal** | **38** |
| **Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones** | | | | | | | | | | | | |
| 6 | 23_Moderate | Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions | 62.7 | 62.7 | 2 | Biodiversity Conservation Act listing status | High Sensitivity to Gain | Endangered Ecological Community | Not Listed | 2.00 | | 64 |
| | | | | | | | | | | | **Subtotal** | **64** |
| | | | | | | | | | | | **Total** | **1351** |

## Species credits for threatened species

| Vegetation zone name | Habitat condition (Vegetation Integrity) | Change in habitat condition | Area (ha)/Count (no. individuals) | Sensitivity to loss (Justification) | Sensitivity to gain (Justification) | BC Act Listing status | EPBC Act listing status | Potential SAII | Species credits |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Brachyscome papillosa / Mossgiel Daisy ( Flora )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 2.3 | Biodiversity Conservation Act listing status | Ability to colonise improved habitat | Vulnerable | Vulnerable | False | 62 |
| 163_Moderate | 59.5 | 59.5 | 1.6 | Biodiversity Conservation Act listing status | Ability to colonise improved habitat | Vulnerable | Vulnerable | False | 47 |
| | | | | | | | | **Subtotal** | **109** |
| ***Lepidium monoplocoides / Winged Peppercress ( Flora )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 2.2 | Biodiversity Conservation Act listing status | Effectiveness of management in controlling threats | Endangered | Endangered | False | 58 |
| 163_Moderate | 59.5 | 59.5 | 1.5 | Biodiversity Conservation Act listing status | Effectiveness of management in controlling threats | Endangered | Endangered | False | 45 |
| | | | | | | | | **Subtotal** | **103** |
| ***Lophochroa leadbeateri / Pink Cockatoo ( Fauna )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 2.3 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 60 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 16_Low | 28.6 | 28.6 | 0.36 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 5 |
| 16_DNG | 14.7 | 14.7 | 2.6 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 19 |
| 16_Paddock_trees | 10.7 | 10.7 | 0.21 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 1 |
| 21_Moderate | 64.6 | 64.6 | 0.85 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 27 |
| 23_Moderate | 62.7 | 62.7 | 1.7 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 52 |
| 57_Moderate | 61.1 | 61.1 | 0.19 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 6 |
| 58_High | 91.0 | 91.0 | 0.85 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 39 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 58_Moderate | 74.8 | 74.8 | 9.1 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 340 |
| 58_DNG | 17.7 | 17.7 | 11 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 97 |
| 58_Paddock_trees | 46.6 | 46.6 | 0.07 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 2 |
| 163_Moderate | 59.5 | 59.5 | 1.4 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 43 |
| 170_Moderate | 59.5 | 59.5 | 4.3 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 127 |
| 170_Low | 29.7 | 29.7 | 0.48 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 7 |
| 170_DNG | 15.0 | 15.0 | 2.1 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 15 |
| | | | | | | | | **Subtotal** | **840** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Solanum karsense / Menindee Nightshade ( Flora )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 2.3 | Biodiversity Conservation Act listing status | Effectiveness of management in controlling threats | Vulnerable | Vulnerable | False | 47 |
| | | | | | | | | **Subtotal** | **47** |

# BAM Credit Summary Report

## Proposal Details

| | | |
|---|---|---|
| Assessment Id | Proposal Name | BAM data last updated * |
| 00044469/BAAS18138/23/00044470 | Burrawong WF - Scattered trees | 14/03/2024 |
| Assessor Name | Report Created | BAM Data version * |
| Callan Wharfe | 15/05/2024 | 67 |
| Assessor Number | BAM Case Status | Date Finalised |
| BAAS18138 | Finalised | 15/05/2024 |
| Assessment Revision | Assessment Type | BOS entry trigger |
| 0 | Scattered Trees | Major Project |

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Scattered Trees Credit Requirement

| Class | Contains hollows | Number of trees | Ecosystem credits |
|---|---|---|---|
| **16-Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion** | | | |
| 3 | True | 4.0 | 4 |
| 2 | True | 3.0 | 2 |
| | | | **6** |
| **58-Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion** | | | |
| 3 | True | 14.0 | 14 |
| 3 | False | 8.0 | 6 |
| 2 | True | 2.0 | 2 |
| 2 | False | 1.0 | 1 |
| 3 | True | 10.0 | 10 |
| 3 | False | 4.0 | 3 |
| | | | **36** |
| **170-Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones** | | | |
| 3 | True | 3.0 | 3 |
| 2 | True | 2.0 | 2 |
| 2 | False | 1.0 | 1 |
| 2 | False | 1.0 | 1 |

| | | | |
|---|---|---|---|
| 2 | False | 1.0 | 1 |
| | | | **8** |
| **21-Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion** | | | |
| 3 | True | 14.0 | 14 |
| | | | **14** |
| **23-Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones** | | | |
| 3 | True | 1.0 | 1 |
| 3 | False | 1.0 | 1 |
| | | | **2** |
| | | | **66** |

## Species credits for threatened species

Nil

# 12. Assessment against EPBC Act and FM Act

## 12.1. Environment Protection and Biodiversity Conservation Act 1999

On the 14 November 2023, a delegate of the Federal Minister for the Environment and Water, determined the Junction Rivers Wind Project was a controlled action under Section 75 of the EPBC Act with the following controlling provisions:

- Listed threatened species and communities.
- Listed migratory species.

Supplementary SEARs were issued following the controlled action declaration.

### 12.1.1. Project assessment against the EPBC Act

The proposed Junction Rivers Wind Project is being assessed under the bilateral agreement addressing the matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulation 2000 (EPBC Regulation). As such, an assessment of the likelihood of occurrence of nationally listed biota occurring in the impact area and determination of significant impact likely to result from the project has been undertaken (Appendix 2). An assessment of significant impacts under the EPBC Act in accordance with the Significant Impact Guidelines (CoA 2013) was undertaken for threatened and migratory MNES biota (Appendix 5). Assessments of significant impacts on threatened species and ecological communities, and migratory species, presented herein are limited to biota recorded or identified as having a medium or higher likelihood of occurrence in the impact area and that have the potential to be impacted by construction and/or operation of the project. Assessments of significant impacts have also been completed for MNES considered 'At-risk' from potential turbine strike impacts (refer Section 6).

Post lodgement of the EPBC Act Referral (EPBC Act Referral 2023/09603), the development footprint and development corridor have been refined to prioritise avoid and minimise steps, with the completion of detailed ecological assessments. On this basis, an updated likelihood of occurrence and impact assessment using current information about the impact area and its biodiversity values has been prepared (Table 66 and Table 67).

As the controlled action decision specifies listed threatened species and ecological communities, and listed migratory species as controlling provisions. Impacts associated with World Heritage properties and National Heritage places are outside the scope of this assessment, and Ramsar wetlands are also not considered as they are not controlling provisions. MNES within the subject land are detailed within Table 65 below.

All MNES protected under the triggered controlling provisions are potentially relevant, however the supplementary SEARs issued 19 December 2023 by DCCEEW (Cth) consider that there is likely to be a significant impact on the following species:

- Major Mitchell's Cockatoo – Endangered.
- Regent Parrot – Vulnerable.
- Sharp-tailed Sandpiper – Migratory.

Additional to this, the following species protected under Part 3 are identified as potentially being at risk of impact:

- Plains-wanderer – Critically Endangered.
- Australian Painted Snipe – Endangered.
- South-eastern Hooded Robin – Endangered.
- Grey Snake – Endangered.
- Australasian Bittern – Endangered.
- Grey Falcon – Vulnerable.
- Blue-winged Parrot – Vulnerable.
- Painted Honeyeater – Vulnerable.
- Malleefowl – Vulnerable.
- Common Greenshank – Migratory.

This assessment determined the species outlined below as having the potential for significant impact from the project:

- Corben's Long-eared Bat.
- Sharp-tailed Sandpiper.
- Regent Parrot.
- Major Mitchell's Cockatoo.
- Australasian Bittern.
- Grey Falcon.
- Common Greenshank.
- Gul-billed Tern.
- Caspian Tern.

Assessments have been undertaken in accordance with the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (CoA 2013) for the above listed eight MNES, and are provided in Appendix 5. All relevant EPBC Act listed species and ecological communities, and listed migratory species considered herein are listed in Table 65 and Table 66, along with a summary of the evidence used to assess whether a significant impact is likely or unlikely to occur as a result of the project (Table 67).

### 12.1.2. MNES within the subject land

A summary of all MNES recorded, or considered to have the potential to occur, within the subject land is provided in Table 65 below.

**Table 65 MNES within the subject land**

| Matter of NES | Project specifics | Potential for significant impact |
|---|---|---|
| **Threatened species** | The Controlled Action decision identified the proposed action as likely to have a significant impact on the following species:<br>• Major Mitchell's Cockatoo.<br>• Regent Parrot.<br>The Controlled Action decision identified the following species as being at risk of impact:<br>• Plains Wanderer.<br>• Australian Painted Snipe.<br>• South-eastern Hooded Robin.<br>• Grey Snake.<br>• Australasian Bittern.<br>• Grey Falcon.<br>• Blue-winged Parrot.<br>• Painted Honeyeater.<br>• Malleefowl.<br>The following additional EPBC Act listed species were identified as part of this assessment:<br>• Fork-tailed Swift.<br>• Australasian Bittern.<br>• Corben's Long-eared Bat.<br>• Southern Whiteface.<br>• Mossgiel Daisy.<br>• Winged Peppercress.<br>• Menindee Nightshade.<br>• *Austrostipa metatoris.* | The following species were determined to be at risk of significant impact, and require assessment under the EPBC Act, refer to Table 66 and Table 67:<br>• Corben's Long-eared Bat.<br>• Regent Parrot.<br>• Major Mitchell's Cockatoo.<br>• Australasian Bittern.<br>• Grey Falcon. |
| **Threatened ecological communities** | No threatened ecological communities listed under the EPBC Act were identified as occurring within the subject land. | - |
| **Migratory species** | The Controlled Action decision identified the proposed action as likely to have a significant impact on the following species:<br>• Shar-tailed Sandpiper.<br>• Common Greenshank.<br>The following additional EPBC Act listed species were identified as part of this assessment:<br>• Fork-tailed Swift.<br>• Caspian Tern.<br>• Gull-billed Tern.<br>• Common Greenshank. | The following species were determined to be at risk of significant impact, and require assessment under the EPBC Act, refer to Table 66 and Table 67:<br>• Sharp-tailed Sandpiper.<br>• Common Greenshank.<br>• Caspian Tern.<br>• Gul-billed Tern. |
| **National Heritage Places** | No world heritage places were identified as occurring within the subject land or within 10 km of the subject land. | - |

| Matter of NES | Project specifics | Potential for significant impact |
|---|---|---|
| **Wetlands of international importance (Ramsar sites)** | No Ramsar wetlands are located within the subject land, or within 10 km of the subject land. | The proposed wind farm is not expected to incur any significant impacts, or modifications to the natural drainage systems including watercourses and lake areas within the subject land or surrounding landscape. |

**Table 66 Detailed summary of MNES with potential for impact within the subject land**

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| **Major Mitchell's Cockatoo *Lophochroa leadbeateri*** | Endangered | Found mainly in semi-arid and arid regions, in dry woodlands, particularly mallee - casuarina assemblages. They breed in the hollows of large trees, often near watercourse. | PCT 16, 21, 23, 57, 58, 163 and 170.<br>All HBTs identified as potential nest trees (refer to Figure 10).<br>All areas of native vegetation within the subject land are foraging habitat for this species.<br>It is expected that the subject land could support 5-6 breeding pairs of the species - a maximum of 12 individuals. | As an Endangered listed species, all populations are considered 'Important Populations'. | Habitat critical to the survival of the eastern Major Mitchell's cockatoo consist of:<br>• Arid and semi-arid woodlands dominated by Mulga, mallee and box eucalypts, Slender Cypress Pine or Belah.<br>• Known habitat containing suitable attributes, including potential habitat for the subspecies, especially where there are large mature trees with suitable hollows.<br>• Surrounding matrix of these areas for the role of providing movement corridors for dispersal across the landscape.<br>The potential breeding habitat within the development footprint is considered to support areas that conform to the attributes listed in the Conservation Advice (DCCEEW, 2023) as habitat critical to the survival of a species. |
| **Regent Parrot *Polytelis anthopeplus monarchoides*** | Vulnerable | In NSW, the Regent Parrot (eastern) is confined to the southern Lower Western Region, mainly along the Murray River, from Kyalite, north west to Mallee Cliffs State Forest, and is also recorded near | Primarily PCT 170, with secondary forage habitats supported by PCTs 16, 21, 57 and 58.<br>The field assessment included identification of potential roosting | A population of this of this species was identified within the subject land, where, connectivity pathways along the road reserves are considered to be used by this | Under the National Recovery Plan, habitat critical to the survival of the eastern Regent Parrot contains all known sites for nesting, food resources, water, shelter, essential |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | Wentworth and the Rufous River. Away from the Murray River, the subspecies is recorded at isolated localities including west of Moonlight Lake, Arumpo Station, and near Pooncarie. | and foraging habitat. Breeding habitat is not present, this species has a preference for River Red Gum along watercourses for breeding. | species between major watercourses within the landscape. This population would meet the definition of important as the individuals are likely to form part of the breeding population along the Murrumbidgee and Wakool Rivers (DSE 2011). | travel routes, dispersal, and buffer areas, and is defined as all potential eastern Regent Parrot habitat within its 'current normal range'. Habitat can be divided into those areas used during the breeding and non-breeding seasons. (DSE 2011) Non-breeding habitat known to be utilised by this species occurs within the subject land, and as such, critical habitat occurs. |
| **Sharp-tailed Sandpiper *Calidris acuminata*** | Vulnerable, Migratory | This species does not breed within Australia but prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes in inland Australia. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry.<br>Dams within the subject land are small and degraded and have a low potential of supporting foraging of this species. | These species are migratory, with annual seasonal international movements to and from Australia. These species are not considered likely to use the habitat present within the subject land. Long-distance movements generally occur at heights well above RSA, with steep flight trajectories. | The entire population of this species, due to its dispersive and migratory nature is considered a single population, and as such, any occurrence of this species would meet the definition of an important population under the Significant Impact Guidelines (DoE 2013). | Habitat critical to the survival of the species refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal.<br>• For the long-term maintenance of the species (including the maintenance of species essential to the survival of the sharp-tailed sandpiper, such as macrobenthos).<br>• To maintain genetic diversity and long-term evolutionary development.<br>• For the re-introduction of populations or recovery of the species. (Cth DCCEEW 2024a).<br>The assessment completed by Nature Advisory (Nature Advisory 2023e) noted this species is unlikely |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | | to utilise habitat within the subject land. Habitat within the subject land is not considered likely to meet the definition of critical habitat for this species. |
| **Plains Wanderer** ***Pedionomus torquatus*** | Critically Endangered | Plains-wanderers live in semi-arid, lowland native grasslands that typically occur on hard red-brown soils. Habitat structure appears to be more important than plant species composition. Preferred habitat typically comprises 50% bare ground, 10% fallen litter, and 40% herbs, forbs and grasses. They have been recorded in some agricultural land including unimproved pasture, and cropping on long rotation. | Grasslands and open shrublands. Targeted surveys undertaken for this species did not identify it as present. Habitat within the subject land is not likely to be suitable for this species. | As a Critically Endangered listed species, all populations are considered 'Important Populations'. A population of this species is not considered to be present within the subject land. | The national recovery plan for this species (DoE 2016) states habitat critical to the survival of this species includes:<br>• Any regions where the species is likely to occur, and<br>• Any newly discovered locations that extend the likely range of the species.<br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **Australian Painted Snipe** ***Rostratula australis*** | Endangered | The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or | Wetland habitat for this species is not present within or adjacent to the subject land. Recent records of the species are known to occur from the Balranald area, in flooded wheat stubble with receding water and mudflat islands, surrounded by extensive wetland complex managed for conservation (Murray Wildlife N/A). | As an Endangered listed species, all populations are considered 'Important Populations'.<br>A population of this species is not considered to be present within the subject land. | Critical habitat for this species is defined as any natural wetland habitat where the species is known or likely to occur (especially with suitable breeding habitat) within the indicative distribution map.<br>Any location outside the above area that may be periodically occupied by Australian Painted Snipe when wetland conditions are favourable. (Cth DCCEEW 2022a).<br>Habitat within the subject land is not |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | samphire; often with scattered clumps of lignum or canegrass. | | | considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **South-eastern Hooded Robin** ***Melanodryas cucullata cucullata*** | Endangered | Hooded robins (south-eastern) occur in south-eastern Australia from far south-east Queensland to Yorke Peninsula, South Australia, intergrading with M. c. picata in the southern Murray Darling basin. The subspecies is now absent from many formerly occupied sites, particularly in the wetter areas of the south and east. Hooded robins (south-eastern) are described as shy and largely sedentary and are mostly seen in pairs or small groups. They prefer dry eucalypt and acacia woodlands and shrublands with an open understorey, some grassy areas and a complex ground layer. They avoid woodlands with tall trees or dense tree cover but sometimes occur in tall, dense heaths with scattered open areas. While they can occur in patches as small as 2.9 ha, in agricultural landscapes they prefer larger patches greater than 10 ha with moderately deep to deep soils. | PCTs 16, 21, 23, 57, 58, and 170. Woodland areas within the subject land. This species was not identified during the BBUS / targeted diurnal bird survey effort. | As an Endangered listed species, all populations are considered 'Important Populations'. A population of this species is not considered to be present within the subject land. | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **Grey Snake** ***Hemiaspis*** | Endangered | In the Lowbidgee floodplain region of NSW (approx. 40 km north-east of | No suitable habitat that would support this species was identified | As an Endangered listed species, all populations are considered | Critical habitat has not been defined for the species. Therefore 'Habitat |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| ***damelii*** | | the subject land) the species habitat includes the margins of ephemeral wetlands within River Red Gum and Black Box vegetation communities and from Tangled Lignum swamps. Key attributes are the floodplains and ephemeral wetlands which provide breeding habitat for the frog species that are the species' main prey, the presence of the frog species themselves, and the heavy clay soils which provide and cracks and crevices that the species uses in its hunting strategy and for shelter (Cth DCCEEW 2022b). | within the subject land.<br><br>The dams within the subject land are small, disturbed and generally isolated from areas of Black Box and the areas Black Box swamps supporting Lignum are isolated, degraded and sparse. River Red Gum is not present within the subject land. As such, they are not considered likely to support suitable habitat for this species. | 'Important Populations'.<br>A population of this species is not considered to be present within the subject land. | critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **Australasian Bittern *Botaurus poiciloptilus*** | Endangered | Birds occupy reedy wetlands, with the largest population now nesting in irrigated rice fields in the Riverina (Cth DCCEEW 2024) (cantered around the Coleambally Irrigation Area).<br>The dams within the subject land are small and disturbed, they are not considered likely to support | Suitable wetlands habitats are absent from the subject land, but could occur during events in the surrounding area. Condouple Lake is the ephemeral wetland in closest proximity to the subject land, that could occasionally support habitat for the species. in the study area. | As an Endangered listed species, all populations are considered 'Important Populations'.<br>This species was not recorded within the subject land. An assessment completed by Nature Advisory (Nature Advisory 2023c) noted this species is unlikely to forage or breed | Critical habitat for this species is defined as any natural wetland habitat where the species is known or likely to occur (breeding or foraging habitat) within the indicative distribution map (Cth DCCEEW 2022c).<br>The habitat present within the |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | breeding habitat or foraging habitat for this species. | Dusty Lake, Harveys Lake, Lake Talbetts, and other larger watercourses in the broader locality also have some potential to occasionally support habitat for the species.<br>Based on historical flooding and weather patterns it is estimated that that wetlands in the broader locality could flood and serve as habitat for the species little more than once in the 20-year lifespan of the proposed wind farm. | within the subject land. The habitat within the subject land was determined by this BDAR to be unlikely to support this species due to its niche habitat preferences. | subject land is not considered likely to support this species, except in Condoulpe Lake (adjacent to the subject land) in very rare, prolonged flooding events, likely to occur once is a 20-year event. In the rare occurrence of prolonged flooding, areas of Condoulpe Lake could meet the definition of critical habitat for this species. |
| **Grey Falcon**<br>***Falco hypoleucos*** | Vulnerable | The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter. Eggs are laid in the old nests of other birds, particularly those of other raptors or corvids. The nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum and Coolibah *Eucalyptus coolabah*, but falcons also nest in telecommunication towers (Threatened Species Scientific Committee 2020a) | PCTs 16, 21, 23, 57, 58, 163 and 170.<br>Potential breeding habitat would occur in the form of eucalyptus woodland.<br>Potential roosting habitat would occur in the form of eucalyptus woodland.<br>This species was not identified during the BBUS / targeted diurnal bird survey effort. | Important populations have not been defined for Grey Falcon. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>A population of this species is not considered to be present within the subject land. | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | | • For the reintroduction of populations or recovery of the species or ecological community.<br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **Blue-winged Parrot** ***Neophema chrysostoma*** | Vulnerable | Breeding noted as typically occurring in Tasmania, coastal south-eastern Australia and southern Victoria.<br>Blue-winged parrots inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones. The species can also be seen in altered environments such as airfields, golf-courses and paddocks. Pairs or small parties of blue-winged parrots forage mainly near or on the ground for seeds of a wide range of native and introduced grasses, herbs and shrubs. | Subject land occurs within known distribution of this species, potential foraging habitat is marginal for this species, where a preference is shown for grasslands and woodlands near wetlands.<br>This species was not identified during the BBUS / targeted diurnal bird survey effort. | No important populations have been defined for the species. The species can be considered to comprise a single national population of an estimated 10,000 mature individuals (Commonwealth of Australia 2023)<br>A population of this species is not considered to be present within the subject land. | Critical habitat for this species is defined as foraging and staging habitats found from coastal, sub-coastal and inland areas, right through to semi-arid zones including: grasslands, grassy woodlands and semi-arid chenopod shrubland with native and introduced grasses, herbs and shrubs.<br>Wetlands both near the coast and in semi-arid zones used for foraging and staging.<br>Eucalypt forests and woodlands within the breeding range in Tasmania, coastal southeastern South Australia and southern Victoria.<br>Live and dead trees and stumps with suitable hollows within the breeding range. (Commonwealth of Australia 2023)<br>Habitat within the subject land is not considered to be utilised by a |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | | population of this species, therefore, no critical habitat is considered to be present. |
| **Painted Honeyeater** ***Grantiella picta*** | Vulnerable | Found mainly in dry open woodlands and forests, where it is strongly associated with mistletoe. Often found on plains with scattered eucalypts and remnant trees on farmlands. | PCTs 16, 21, 23, 57, 58, and 170. Nomadic species, population trends and movements tend to follow abundance of mistletoe. This species was not identified during the BBUS / targeted diurnal bird survey effort. | The species is considered to comprise a single national population of fewer than 10,000 mature individuals (DAWE 2021). A population of this species is not considered to be present within the subject land. | The National Recovery Plan for the Painted Honeyeater lists critical habitat as:<br>• Known or likely breeding habitat in Weeping Myall, Brigalow *Acacia harpophylla* woodlands, box-gum woodlands and box-ironbark forests on the inland slopes of the Great Dividing Range in New South Wales, Victoria and southern Queensland.<br>• All preferred foraging species within known and likely foraging habitat particularly mistletoes of the genus Amyema growing on forest and woodland eucalypts and acacias. (DAWE 2021).<br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |

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| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| **Malleefowl** ***Leipoa ocellata*** | Vulnerable | Inhabit semi-arid to arid zone in shrublands and low woodlands dominated by mallee and associated habitats such as Broombush *Melaleuca uncinata* and Scrub Pine *Callitris verrucosa*. Malleefowl also occur in Red Ironbark *E. sideroxylon* woodland at the eastern limit of their distribution. A sandy substrate and abundance of leaf litter are clear requirements for the construction of the birds' incubator-nests. | Potential habitat for this species occurs within the subject land, especially within areas of sandy soils. This species, including presence of breeding mounds are conspicuous and were not identified during the targeted survey effort for woodland bird species or BBUS.<br>Chenopod mallee, which typically forms on heavy soils, is among the least preferred mallee habitats for Malleefowl (DEH & Benshemesh 2007). | Important populations have not been defined for Malleefowl. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>A population of this species is not considered to be present within the subject land. | The National Recovery Plan for this species outlined all areas where this species is known to occur as critical (DEH & Benshemesh 2007).<br><br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **Common Greenshank** ***Tringa nebularia*** | Migratory | This species is a non-breeding migrant to Australia. Within Australia, this species occurs in all types of wetlands and has the largest distribution of any shorebird in Australia. Typical habitat includes inland wetlands, sheltered coastal habitat, large mudflats, saltmarsh, mangroves, embayment's, harbours, rivers and estuaries, deltas and lagoons, lakes, swamps, dams, creeks, billabongs and inundated floodplains, claypans and salt flats. Both permanent and ephemeral habitats are utilised for foraging and roosting. | This species is migratory, with annual seasonal international movements to and from Australia. This species is not considered likely to use the habitat present within the subject land.<br>A potential was identified for rare occurrence within the subject land, or for flocks to pass through airspace when travelling between areas of suitable habitat. | Not applicable for Migratory listed species. | Habitat critical to the survival of this species refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | | • For the reintroduction of populations or recovery of the species or ecological community.<br>This includes a mosaic of feeding and roosting habitat where the species frequents, including freshwater, marine and artificial wetland (Cth DCCEEW 2024b).<br>An assessment completed by Nature Advisory (Nature Advisory 2023e) noted this species is unlikely to utilise habitat within the subject land, as such the habitat within the subject land would not meet the definition of critical habitat for this species. |
| **Corben's Long-eared Bat *Nyctophilus corbeni*** | Vulnerable | Corben's Long-eared Bat is found in a wide range of inland woodland vegetation types.<br>These include box / ironbark / cypress pine woodlands, Buloke woodlands, Brigalow woodland, Belah woodland, smooth-barked apple woodland, river red gum forest, black box woodland, and various types of tree mallee (Threatened Species Scientific Committee 2015) | Corben's Long-eared Bat was identified as potentially occurring, where call complexes of the genus *Nyctophilus* were recorded. PCTs within the subject land associated with this species include PCT 23, 21, 170, 57, 58 and 170. | Important populations have not been defined for Corben's Long-eared Bat. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>No records of this species are present under the NSW BioNet atlas within 40 km of the subject land, | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | with the nearest identified population located from around 10 kilometres north-west of Balranald, leading west and north-west to the Mallee Cliffs National Park and Mungo National Park. An important population is not considered present. | • To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>The potential Corben's Long-eared Bat habitat affected by the proposal is not considered necessary for the long-term maintenance of the species or to maintain genetic diversity and long-term evolutionary development, nor is that habitat necessary for reintroduction of populations or for the species recovery. |
| **Fork-tailed Swift** ***Apus pacificus*** | Migratory | The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher. Mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or | Species is largely aerial but may forage at ground level and roost in woodland vegetation. PCTs 23, 21, 170, 57 and 58 are associate with the species in NSW BioNet.<br>Fork-tailed Swift was not recorded within the subject land during 24 months of BBUS completed by Nature Advisory.<br>The potential for occurrence of the species within the subject land is considered relatively low, with a paucity of the species' records in the broader region. | Not applicable for Migratory listed species. | Critical habitat is not determined for Migratory listed species, but could be considered known breeding habitat for the species.<br><br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. | | | |
| **Caspian Tern *Hydroprogne caspia*** | Migratory | Within Australia, this species occurs in sheltered coastal embayment's including harbours, lagoons, inlets, bays, estuaries and river deltas. areas with muddy or sandy margins are preferred. This species also occurs on near-coastal and inland terrestrial wetlands. Artificial wetlands are also used, including reservoirs, sewage ponds and saltworks (Cwth DCCEEW 2024a).. | These species are migratory, with annual seasonal international movements to and from Australia. Species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. These species are not considered likely to use the habitat present within the subject land.<br>A potential was identified for rare occurrence within the subject land, or for flocks to pass through airspace when travelling between areas of suitable habitat. (Nature Advisory 2023e) | Not applicable for Migratory listed species. | Critical habitat is not determined for Migratory listed species, but could be considered known breeding habitat for the species (BirdLife International 2010).<br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be present. |
| **Gull-billed Tern *Gelochelidon nilotica*** | Migratory | Within Australia this species utilises freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodplains, sewage farms, irrigated crops and flooded grasslands (Birdlife Australia 2024). This species breeds within Australia, typically between September – May, forming large colonies to breed on islets in temporary lakes and | These species are migratory, with annual seasonal international movements to and from Australia. Species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. These species are not considered likely to use the habitat | Not applicable for Migratory listed species. | Critical habitat is not determined for Migratory listed species, but could be considered known breeding habitat for the species.<br><br>Habitat within the subject land is not considered to be utilised by a population of this species, therefore, no critical habitat is considered to be |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | saltmarshes of interior Australia and drier costal regions. Nests are formed on sand ridges and mud banks as shallow depressions scraped in the ground lined with minimal vegetation (Morcombe 2002). | present within the subject land. A potential was identified for rare occurrence within the subject land, or for flocks to pass through airspace when travelling between areas of suitable habitat. (Nature Advisory 2023e) | | present. |
| **Southern Whiteface *Aphelocephala leucopsis*** | Vulnerable | Southern Whiteface live in a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains (Cth DCCEEW 2023e). | Potential foraging and possibly breeding habitat for this species is present within the subject land in all areas of vegetation. | Important populations have not been defined for Southern Whiteface. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>This species was identified within the subject land, a population is present, however it is unlikely to meet the definition of an important population. | Habitat critical to the survival of the Southern Whiteface includes areas of:<br>• Relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both.<br>• Habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat<br>• Living and dead trees with hollows and crevices which are essential for roosting and nesting. (Cth DCCEEW 2023e).<br>Habitat within the subject land may meet this definition. |
| **Mossgiel Daisy *Brachyscome papillosa*** | Vulnerable | Multi-stemmed perennial herb endemic to NSW, primarily distributed throughout the Riverina bioregion with one site occurring in the South Western Slopes. Grows on Saltbush plains in a variety of | PCTs 16 and 163. Despite the flora survey efforts outline above there were a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints | Important populations have not been defined for Mossgiel Daisy. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary: |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | communities including Aeolian Chenopod Shrublands, Inland Floodplain Shrublands, Riverine Plain Grasslands and Inland Saline Lakes. Grows in clay soils. | associated with waterlogging and inundation in October 2022, and areas being cleared for agricultural purposes. This has resulted in a requirement for assumed presence of Mossgiel Daisy. | • Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>A population of this species is not considered to be present within the subject land, however some areas have been assumed as present on a precautionary approach as per the BAM guidelines. | • For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>Critical habitat is not considered to be present within the subject land, however some areas have been assumed as present on a precautionary approach as per the BAM guidelines. |
| **Winged Peppercress *Lepidium monoplocoides*** | Endangered | Erect, annual herb with populations sparsely scattered throughout a widespread distribution spanning the semi-arid western plains. Historical records are numerous although recent records are confined to two collections from Broken Hill, in 1915 and 1950. Grows in areas receiving between 300 mm to 500 mm annual rainfall on periodically inundated and | PCTs 16 and 163.<br>Despite the flora survey efforts outline above there were a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation in October 2022, and areas being cleared for agricultural purposes. This has resulted in a | As an Endangered listed species, all populations are considered 'Important Populations'.<br>A population of this species is not considered to be present within the subject land, however some areas have been assumed as present on a precautionary approach as per the BAM guidelines. | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | waterlogged habitats in a variety of communities including Inland Floodplain Shrublands,<br>Floodplain Transition Woodlands, Inland Saline Lakes, Sand Plain Mallee Woodlands and Western Peneplain Woodlands. Grows on waterlogged grey-brown clays | requirement for assumed presence of Winged Peppercress. | | maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>Critical habitat is not considered to be present within the subject land, however some areas have been assumed as present on a precautionary approach as per the BAM guidelines. |
| **Menindee Nightshade *Solanum karsense*** | Vulnerable | The Menindee Nightshade is largely confined to floodplain lakes, depressions and Black Box (*Eucalyptus largiflorens*) swamps. This species is found in heavy grey clays with a highly self-mulching surface and also on sandy floodplains and ridges and in calcareous soild, red sands, red-brown earths and loamy soils. The vegetation associated with this species includes Saltbush and Bluebush plains and Mallee associations | PCT 16.<br>Despite the flora survey efforts outline above there were a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation in October 2022, and areas being cleared for agricultural purposes. This has resulted in a requirement for assumed presence of Menindee Nightshade. | Important populations have not been defined for Mossgiel Daisy. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>A population of this species is not considered to be present within the subject land, however some areas have been assumed as present on a | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | precautionary approach as per the BAM guidelines. | • To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>Critical habitat is not considered to be present within the subject land, however some areas have been assumed as present on a precautionary approach as per the BAM guidelines. |
| ***Austrostipa metatoris*** | Vulnerable | *Austrostipa metatoris* grows in sandy mallee areas of the Murray Valley. Habitat includes sandhills, sand ridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils. Associated species include the trees and shrubs Bimble Box (*Eucalyptus populnea*), Gum Coolibah (*E. intertexta*), White Cypress Pine (*Callitris glaucophylla*), Belah (*Casuarina cristata*), Sweet Quandong (*Santalum acuminatum*), Sticky Hopbush (*Dodonaea viscosa*), *Hakea ivoryi*, and the grasses *Austrostipa drummondii* and *A. eremophila*. | Road reserve of Yanga Way (and associated 8 Mile TSR) – not identified within development corridor or development footprint. Species was identified during targeted surveys within a TSR adjacent to the subject land. Targeted surveys did not find this species elsewhere within the subject land. | Important populations have not been defined for *Austrostipa metatoris*. Therefore important population would be those that are considered:<br>• Key source populations either for breeding or dispersal<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>The population identified is not considered an important population. | Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community. |

| MNES species | EPBC listing status | Habitat description | Potential habitat within the subject land | Important populations | Critical habitat |
|---|---|---|---|---|---|
| | | | | | Critical habitat for this species has not been defined. The habitat where this species was identified is not considered critical habitat. |

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### 12.1.3. Survey effort for MNES entities

Habitat assessments to determine microhabitats for threatened species and communities across the development corridor and subject land have been completed. Suitable foraging and breeding habitat was identified for a number of species. Targeted surveys included the following:

- Targeted flora surveys.
- Targeted nocturnal bird surveys.
- Diurnal bird surveys (Bird Utilisation Surveys):
  - Two years survey effort covering summer/autumn/winter/spring.
- Microhiropteran bat survey (Bat Utilisation Survey):
  - Partial one year survey effort covering spring/summer.

Vegetation surveys comprising mapping of vegetation communities and collection of floristic plot data were also completed to determine the presence of TECs listed as MNES under the EPBC Act.

Section 4, provides details of survey method and effort, justification for surveys methods employed, timing of surveys, experience of personnel undertaking the surveys and the result of the surveys.

The following MNES listed species were identified during the survey effort:

- *Austrostipa metatoris*
- Major Mitchell's Cockatoo
- Regent Parrot
- Southern Whiteface
- Corben's Long-eared Bat (potential).
  - A positive identification was not confirmed for this species, however call complexes that have the potential to be attributed to this species were identified.

### 12.1.4. Avoidance of impacts to MNES

Avoidance and minimisation of impacts to biodiversity values that have been undertaken throughout the development and design of the project from initial desktop-based constraints information, followed by design workshops and updates based on a number of rounds of collection of ground-validated data. Table 45 in Section 7 provides detailed information of efforts undertaken to minimise impacts to biodiversity values, including MNES, which include (but are not limited to) the following:

- Avoidance of impact to known Regent Parrot movement corridor and forage habitat through 100 metre setbacks of infrastructure along Yanga Way (Nature Advisory 2023d).
- Avoidance of impacts to identified population of *Austrostipa metatoris*, supporting over 50 individual plants over an area of approximately 1.3 hectares.
- As per the key finding of the Nature Advisory analysis of potential waterbird collision years (Nature Advisory 2023e), a 400 metre buffer of non-operational turbines from flooded lake / wetland habitat will be maintained during flood to minimise the potential for waterbird collisions at the times when these birds are abundant in the landscape.

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- Key waterbodies and sources within the subject land have been avoided, including, Condoulpe Lake, Condoulpe Creek, The Forest Creek and majority of the watercourses feeding into Lake Talbetts directly west of the subject land.
- A 'nearest neighbour analysis' undertaken in GIS has determined that the average gap between RSAs along stings of turbines throughout the subject land is approximately 450 metres. There is evidence that birds are known to fly through gaps in RSAs less than half this size (see Section 8.3.5), thus the current separation is considered to minimise potential barrier effects along turbine strings.
- Major Mitchell's Cockatoo:
  - Of the 252 hollow-bearing trees mapped during Major Mitchell's Cockatoo habitat assessment, only 14 occur within the development footprint.
  - Of the 269 scattered paddock trees mapped within the development corridor during the application of 'Streamlined assessment module – Scattered trees assessment', 165 have been avoided (note approximately 30 impacted trees were found not to conform to the definition of scattered trees, and became part of 'paddock tree' vegetation zones).
  - Of the 36 hollow-bearing trees mapped by NGH Consulting only three occur within the development footprint.
  - The above avoidance of paddock trees also directly avoids potential breeding habitat for Major Mitchell's Cockatoo. This is illustrated by no additional habitat being added to the species' habitat polygon on the basis of hollow-bearing trees mapping by NGH Consulting, despite 27 of the 36 trees meeting the species' habitat parameters, and not being located on Category 1 – Exempt land.

### 12.1.5. MNES potentially impacted by the project

The likelihood of occurrence of MNES within the impact area and subsequent potential impacts were assessed through desktop and field-based assessments. The following species were determined to be at risk of significant impact and were subject to assessment under the EPBC Act Significant Impact Guidelines (DoE 2013):

- Major Mitchell's Cockatoo.
- Regent Parrot.
- Corben's Long-eared Bat.
- Australasian Bittern.
- Grey Falcon.
- Sharp-tailed Sandpiper.
- Common Greenshank.
- Gull-billed Tern.
- Caspian Tern.

Significant Impact Criteria assessments for the above MNES are provided in Appendix 5

Table 67 below provides a summary of impact assessments undertaken for all MNES potentially impacted by the project.

**Table 67 Summary of significant impact assessment of EPBC threatened species, ecological communities and migratory species**

| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| **Controlled Action determination - Likely to be significantly impacted** | | | | | | |
| **Major Mitchell's Cockatoo *Lophochroa leadbeateri*** | Recorded | • Direct removal of breeding habitat.<br>• Direct removal of foraging habitat.<br>• Potential indirect impact to retained vegetation. | • Removal of at least 17 suitable HBTs supporting potential breeding habitat.<br>• Up to 39.45 ha of critical habitat | • Permanent from onset of clearing. | As a result of these impacts, the project is considered to have the potential to disrupt the breeding cycle of the local population and reduce the availability and quality of critical habitat. The removal of potential breeding resources is considered to have the potential to interfere with the recovery of the local population. Ongoing operational impacts associated with collision with turbine blades are not considered likely as the species is not commonly recorded at RSH, however habitat sterilisation and more broad-scale avoidance of operational wind areas farms is possible. | SIC undertaken – refer to Appendix 5.<br><br>**Significant impacted considered likely.** |
| **Regent Parrot *Polytelis anthopeplus monarchoides*** | Recorded | • Direct removal of foraging habitat.<br>• Potential indirect impact to retained vegetation. | • Up to 72 ha of forage habitat considered critical to the survival of the species.<br>• Impacts comprise 8.74 ha of PCT 170 providing secondary forage habitat, and 63.37 ha of habitat providing 'other forage | • Temporary and permanent<br>• Ongoing from construction and for the life of the project (up to 30 years). | The project is not considered likely to adversely affect habitat critical to the survival of Regent Parrot based on impacts to primary movement corridors and primary forage habitats being avoided.<br>Impacts to secondary and other forage habitats only representing a small fraction of the commensurate habitats available to the species, as well as impact being located away from keys habitats, in areas where the species has not been recorded in over two years of survey.<br>Potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species. | SIC undertaken – refer to Appendix 5.<br>Significant impact considered unlikely through the implementation of impact avoidance measures as well as mitigation measures and adaptive management. |

| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| | | | habitat' for the species | | | |
| **Sharp-tailed Sandpiper** ***Calidris acuminata*** | Low | • Possible turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land.<br>• Species not recorded during 24 months BBUS. | • No areas of breeding or foraging habitat proposed for impact.<br>• Potential impacts to individuals. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Turbine strikes are not considered likely to occur at a rate or regular occurrence as this species typically flies well above RSA height, with a steep flight trajectory. Monitoring and adaptive management will be employed to reduce collision risk for this species. Refer to further information in Sections 6, 7, 8.3.5 and 9. | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely due to infrequency of potential collisions, limited impacts to important habitats or an ecologically significant portion of the population, and through the implementation of mitigation measures and adaptive management. |
| **Controlled Action determination - At risk of impact** | | | | | | |
| **Plains Wanderer** ***Pedionomus torquatus*** | Low | • Species unlikely to occur due to lack of suitable habitat and was not detected during survey.<br>• Impacts not considered likely for this species. | • No areas of breeding or foraging habitat proposed for impact. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species is not considered likely to occur within the subject land. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |

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| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| **Australian Painted Snipe** ***Rostratula australis*** | Low | • Species unlikely to occur due to highly limited habitat present, and lack of detection during BBUS or targeted survey efforts.<br>• Impacts not considered likely for this species. | • No areas of breeding, and highly limited foraging habitat proposed for impact. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species was not detected during 2 years of BBUS survey effort, species are not considered likely to use the habitat present within the subject land. Also not recorded within the 20 km Nature Advisory (2023e) search area, and recent 2023 records occur from wetlands north of Balranald, with radio-tracked birds know to have travelled north from that location.<br>A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions, on the rare occasions the species could be present within the subject land.<br>Refer to further information in Sections 6, 7, 8.3.5 and 9. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |
| **South-eastern Hooded Robin** ***Melanodryas cucullata cucullata*** | Low | • Species unlikely to occur and was not detected during BBUS or targeted survey efforts.<br>• Impacts not considered likely for this species. | • Up to 34.5 ha of potential breeding and foraging woodland habitat. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within the subject land. One record of this species occurs around 11 km from the subject land. Species is not considered likely to occur.<br>Potential habitat offset through BC Act bilateral agreement as an ecosystem species. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |
| **Grey Snake** ***Hemiaspis damelii*** | Low | • Habitat in the subject land is unlikely to support this species.<br>• Impacts not considered likely for this species. | • No areas of breeding or foraging habitat proposed for impact. | • Not applicable. | Habitat suitable for this species was not identified within the subject land. Species is not considered likely to occur. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |
| **Australasian Bittern** ***Botaurus poiciloptilus*** | Low | • Possible turbine collision risk during periods of high rainfall producing wetland | • No areas of breeding or foraging habitat | • Temporary and permanent. | Turbine strikes are not considered likely to occur at a rate or regular occurrence as this species typically flies well above RSA height, with a steep flight | SIC undertaken – refer to Appendix 5. |

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| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| | | habitat within proximity of the subject land.<br>• Species not recorded during 24 months BBUS. | proposed for impact.<br>• Potential impacts to individuals. | • Ongoing from construction and for the life of the project (up to 30 years. | trajectory. Monitoring and adaptive management will be employed to reduce collision risk for this species. Potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species. Refer to further information in Sections 6, 7, 8.3.5 and 9. | Significant impact considered unlikely due to infrequency of potential collisions and through the implementation of mitigation measures and adaptive management. |
| **Grey Falcon *Falco hypoleucos*** | Low | • Species may very occasionally occur within the subject land, was not detected during BBUS or targeted survey efforts.<br>• Possible turbine collision risk. | • Up to 75.68 ha of potential forage habitat, and limited potential breeding habitat. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within the subject land. The nearest record of this species occurs over 30 km from the subject land. Species is considered only to occur on a transient and infrequent basis. Raptors are at inherent risk of turbine strike, however the frequency with which impacts may occur is considered to be very low. Refer to further information in Sections 6, 7, 8.3.5 and 9. | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely due to infrequency of potential collisions and through the implementation of mitigation measures and adaptive management. |
| **Blue-winged Parrot *Neophema chrysostoma*** | Low | • Species unlikely to occur and was not detected during BBUS or targeted survey efforts.<br>• Impacts not considered likely for this species. | • Up to 75.68 ha of habitat assessed as unlikely to support the species. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within the subject land. The nearest record of this species occurs around 30 km from the subject land. Species is not considered likely to occur. Potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |

| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| **Painted Honeyeater** ***Grantiella picta*** | Low | • Species unlikely to occur and was not detected during BBUS or targeted survey efforts.<br>• Impacts not considered likely for this species. | • Up to 75.68 ha of habitat assessed as unlikely to support the species. | • Temporary and permanent<br>• Ongoing from construction and for the life of the project (up to 30 years | Species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within the subject land. Within a 50 km radius, only 2 records of this species are present, both are over 30km from the subject land. Species is not considered likely to occur, however potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |
| **Malleefowl** ***Leipoa ocellata*** | Low | • Species unlikely to occur and was not detected during BBUS or targeted survey efforts.<br>• Impacts not considered likely for this species. | • Up to 5.23 ha assessed as unlikely to support the species. | • Temporary and permanent<br>• Ongoing from construction and for the life of the project (up to 30 years | Potential habitat for this species is present in the subject land in the form of sandy soils and semi-arid/arid woodlands, however, this species and its breeding mounds are conspicuous and were not detected during 2 years of BBUS and targeted woodland bird surveys. A population of this species is not known south of Balranald, with records of the nearest population starting around 30 km from the subject land. Chenopod mallee, which typically forms on heavy soils, is among the least preferred mallee habitats for Malleefowl (J, Benshemesh & DEH 2007). Potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species. | SIC not undertaken, species is not considered likely to be present. No potential significant impact. |
| **Common Greenshank** ***Tringa nebularia*** | Low | • Possible turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land. | • No areas of breeding or foraging habitat proposed for impact. | • Temporary and permanent.<br>• Ongoing from construction and for the life | Turbine strikes are not considered likely to occur at a rate or regular occurrence as this species typically flies well above RSA height, with a steep flight trajectory. Monitoring and adaptive management will be employed to reduce collision risk for this species. | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely due to infrequency of |

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| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| | | • Species not recorded during 24 months BBUS. | | of the project (up to 30 years. | Refer to further information in Sections 6, 7, 8.3.5 and 9. | potential collisions, limited impacts to important habitats or an ecologically significant portion of the population, and through the implementation of mitigation measures and adaptive management. |
| **MNES not included in Controlled Action but assessed by Biosis** | | | | | | |
| **Corben's Long-eared Bat** ***Nyctophilus corbeni*** | Low | • Impacts to potential foraging and roosting habitat.<br>• Potential indirect impact to retained vegetation. | • Up to 30.37 ha of potential foraging and breeding habitat. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | A population of this species has some potential to be present within the subject land, or immediate surrounding areas. This species was not determined through the Nature Advisory assessment, or this BDAR as a species 'At Risk' of wind farm collision. Potential habitat offset through BC Act bilateral agreement as an ecosystem species.<br>Refer to further information in Sections 6, 7, 8.3.5 and 9. | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely. <1% of the potential habitat that may be used by this species would be impacted by the project. |
| **Fork-tailed Swift** ***Apus pacificus*** | Low | • Species unlikely to occur and was not detected during BBUS or targeted survey efforts.<br>• Impacts not considered likely for this species.<br>• Low potential for possible turbine collision risk | • No areas of breeding or foraging habitat proposed for impact. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project | Species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within the subject land. This species has been recorded once at Yanga Lake, around 4 km north of the subject land, with <5 isolated records from Balranald and north of Balranald. | SIC not undertaken, species is not considered likely to be present. Potential significant impact is unlikely.<br>Significant impacts |

| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| | | during periods of high rainfall producing wetland habitat within proximity of the subject land. | | (up to 30 years. | The species is known to fly regularly at RSA height and has been known to collide with turbines wind farms elsewhere in NSW and eastern Australia (Nature Advisory 2023f), however the frequency of potential impacts is expected to be very low. Monitoring and adaptive management will be employed to reduce collision risk for this species. Refer to further information in Sections 6, 7, 8.3.5 and 9. | assessed as part of the EPBC Act Referral and species not considered potentially impacted by Controlled Action notification. |
| **Caspian Tern *Hydroprogne caspia*** | Low | • Possible turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land.<br>• Species not recorded during 24 months BBUS. | • No areas of breeding or foraging habitat proposed for impact. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. The proportion of flights made at RSA heights is unknown for each species, but known flight behaviour suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat in the subject land near turbines could pose a risk to these species, as they may fly at RSA height in this context. (Nature Advisory 2023e)<br>Refer to further information in Sections 6, 7, 8.3.5 and 9. | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely due to limited impacts to important habitats or an ecologically significant portion of the population. |
| **Gull-billed Tern *Gelochelidon nilotica*** | Low | • Possible turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land.<br>• Species not recorded during 24 months BBUS. | • No areas of breeding or foraging habitat proposed for impact. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. The proportion of flights made at RSA heights is unknown for each species, but known flight behaviour suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat in the subject land near turbines could pose a risk to these | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely due to limited impacts to important habitats or an ecologically significant portion of the population. |

| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| | | | | | species, as they may fly at RSA height in this context. (Nature Advisory 2023e)<br>Refer to further information in Sections 6, 7, 8.3.5 and 9. | |
| **Southern Whiteface *Aphelocephala leucopsis*** | Recorded | • Recorded within subject land<br>• Unlikely to fly at RSA height.<br>• Direct impact to potential breeding and foraging habitat. | • Up to 32.44 hectares of potential breeding and foraging habitat. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Species habitat will be impacted be the project, that can be considered habitat critical to the survival of the species. However, the local population of the species is not considered an Important Population, and impacts will occur to <1% of the potential habitat that may be used by this species within the assessment area, and around 4% within the subject land.<br>Potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species. | SIC undertaken – refer to Appendix 5. Significant impact considered unlikely. <1% of the potential habitat that may be used by this species would be impacted by the project. |
| **Mossgiel Daisy *Brachyscome papillosa*** | Low. Presence assumed in unsurveyed areas. | • Impacts to areas of assumed presence for this species are offset under the bilateral agreement of the BC Act. | • Up to 3.9 ha of vegetation where species has been assumed to occur due to survey limitations. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Surveys were completed for these species within the subject land. This species was not identified, however, a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation in October 2022, and areas being cleared for agricultural purposes. This has resulted in a requirement for assumed presence.<br>The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. | SIC not undertaken, species is not considered likely to be present, areas of assumed presence offset due to survey restrictions. No potential significant impact. |

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| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| **Winged Peppercress *Lepidium monoplocoides*** | Low. Presence assumed in unsurveyed areas. | • Impacts to areas of assumed presence for this species are offset under the bilateral agreement of the BC Act. | • Up to 3.7 ha of vegetation where species has been assumed to occur due to survey limitations. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Surveys were completed for these species within the subject land. This species was not identified, however, a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation in October 2022, and areas being cleared for agricultural purposes. This has resulted in a requirement for assumed presence.<br>The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. | SIC not undertaken, species is not considered likely to be present, areas of assumed presence offset due to survey restrictions. No potential significant impact. |
| **Menindee Nightshade *Solanum karsense*** | Presence assumed in unsurveyed areas. | • Impacts to areas of assumed presence for this species are offset under the bilateral agreement of the BC Act. | • Up to 2.3 ha of vegetation where species has been assumed to occur due to survey limitations. | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Surveys were completed for these species within the subject land. This species was not identified, however, a number of localised areas where sufficient survey coverage was unable to be achieved due to access constraints associated with waterlogging and inundation in October 2022, and areas being cleared for agricultural purposes. This has resulted in a requirement for assumed presence.<br>The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. | SIC not undertaken, species is not considered likely to be present, areas of assumed presence offset due to survey restrictions. No potential significant impact. |
| **A Spear Grass *Austrostipa metatoris*** | Confirmed absent from current subject land. | • Species was not identified within the subject land or impact area.<br>• Impacts to this species will not occur under the current project design and with the implementation of mitigation measures. | • All areas where this species was identified will be avoided by the proposed works.<br>• No direct or indirect | • Temporary and permanent.<br>• Ongoing from construction and for the life of the project (up to 30 years. | Targeted surveys were completed for this species. This species was identified in a roadside TSR directly adjacent to the subject land, but was not identified within the subject land. Avoid Principles have been allocated to protect the identified population of this species.<br>The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. | SIC not undertaken, all areas where this species was identified have been avoided, as such, potential for significant impact has been avoided. |

| MNES | Updated likelihood of occurrence | Nature & consequence of impact (direct & indirect) | Quantum of impact | Duration of impact | Consequence of impact (local, state & national scale) | SIC self-assessment undertaken and result |
|---|---|---|---|---|---|---|
| | | | impacts expected. | | | |

### 12.1.6. Mitigation to MNES

Ongoing avoidance, minimisation and mitigation of impacts to biodiversity values will be undertaken through detailed design, construction and operation of the project. Table 56 in Section 9 provides detailed information on mitigation measures and commitment to ensure impacts to MNES continued to be minimised during future project stages. Such measures include (but are not limited to) the following:

- Development of adaptive management plans that provide clear mitigation and management measures required to benefit MNES, and to ensure unexpected or indirect impacts are prevented from occurring, or if unforeseen impacts do occur these are realised early, arrested, prevented from reoccurring, and if significant enough additional offsets are secured.
- Impact minimisation and mitigation strategies to prevent and minimise collision risk such as those detailed in Section 9 above, including the key measure of maintenance of a 400 metre buffer between potential wetland habitat in flood years and operational turbines.

#### Major Mitchell's Cockatoo

Specific measures for this species include:

- Once final development footprint is determined undertake a HBT survey to create an inventory of potential Major Mitchell's Cockatoo nest trees, at least one month prior to scheduled vegetation removal.
- Removal of potential nest trees will not occur during breeding season (September – December) unless the tree has been confirmed as not being used for breeding.
- Pre-clearance survey of potential nest trees is to be undertaken within one week of scheduled vegetation removal to determine whether hollows are being used by the species.
- Removal of potential nest trees could occur as early works, outside breeding season, and prior to the main vegetation clearing program. It would be ensured that this would not result in the removal of potential nest trees more than one breeding season prior to the main vegetation clearing program.
- Two-staged tree removal under ecologist supervision is required for the removal of all potential Major Mitchell's Cockatoo nest trees.

#### Regent Parrot

Specific measures for this species include:

- Area of expected high use for Regent Parrot are to be mapped once final development footprint has been determined at least one month prior to scheduled vegetation removal.
- Pre-clearance surveys are to be undertaken to determine if these areas of habitat are being used by the species 24-48 hours before vegetation removal.
- Two-staged tree removal under ecologist supervision is required for the removal of all potential Regent Parrot high use areas.
- A 100 metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable Regent Parrot foraging and roosting habitat and along the known movement corridor along the western boundary of the subject land. A slight overlap remains adjacent to WTG 48, however the proponent is committed to micro-siting this turbine outside the recommended setback.

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### *Austrostipa metatoris*

Specific measures for this species include:

- Any future works associated with the project proposed within the road reserve of Yanga Way (and associated 8 Mile TSR) must complete targeted surveys for this species.
- If future works are required in the vicinity of the known population, no-go zones and ongoing monitoring will be established as per the recommendations associated with Bitter Quandong above.

### 12.1.7. Residual impacts to MNES

Following all efforts to avoid and minimise impacts to MNES (and biodiversity values generally) the project is expected to result in the following unavoidable residual impacts (Table 68).

**Table 68 Residual impacts to MNES**

| Residual project impact | MNES impacted | Impact to MNES |
|---|---|---|
| **Removal of native vegetation providing habitat to MNES** | Major Mitchell's Cockatoo | Removal of at least 17 suitable HBTs supporting potential breeding habitat.<br>Up to 39.45 ha of habitat meeting the definition of habitat critical to the survival of the species to be removed/impacted.<br>Significant impact considered likely. |
| | Regent Parrot | Up to 72.11 ha of foraging habitat (secondary and other forage habitats only) meeting the definition of habitat critical to the survival of the species to be removed/impacted.<br>Impacts to primary movement corridors and primary foraging habitats being avoided.<br>Significant impact considered unlikely. |
| | Corben's Long-eared Bat | Up to 30.37 ha of potential foraging and breeding habitat to be removed/impacted.<br>Significant impact considered unlikely. |
| | Southern Whiteface | Up to 32.44 hectares of potential breeding and foraging habitat, meeting the definition of habitat critical to the survival of the species to be removed/impacted.<br>Significant impact considered unlikely. |
| | Grey Falcon | Up to 75.68 ha of rarely used potential forage habitat, and limited potential breeding habitat to be removed/impacted..<br>Significant impact considered unlikely. |
| | Malleefowl<br>Painted Honeyeater<br>Blue-winger Parrot<br>South-eastern Hooded Robin<br>Plains-wanderer<br>Grey Snake | Impacts to habitat assessed as unlikely to support these species. |

| Residual project impact | MNES impacted | Impact to MNES |
|---|---|---|
| | Sharp-tailed Sandpiper<br>Australasian Bittern<br>Common Greenshank<br>Gul-billed Tern<br>Caspian Tern<br>Fork-tailed Swift | No areas of important breeding or foraging habitat proposed for impact, or to an ecologically important portion of a population. |
| | Menindee Nightshade | 2.3 ha of vegetation where species has been assumed to occur due to survey restrictions to be removed/impacted. |
| | Mossgiel Daisy | 3.9 ha of vegetation where species has been assumed to occur due to survey restrictions to be removed/impacted. |
| | Winged Peppercress | 3.7 ha of vegetation where species has been assumed to occur due to survey restrictions to be removed/impacted. |
| | *Austrostipa metatoris* | All areas where this species was identified will be avoided by the proposed works.<br>No direct or indirect impacts expected |
| **Indirect impacts** | All MNES recorded or considered likely to occur within the subject land | The project has the potential to result in residual indirect impacts to MNES, associated with the potential impacts listed below. Various impacts are more likely to occur to different MNES and the severity of potential impacts will also range between MNES. However as assessed in Table 51 in Section 8.2, indirect impacts are unlikely to be substantial or significant due to avoidance and minimisation measures undertaken to date, and commitments to ongoing mitigation during future project stages. Potential indirect impacts to MNES include:<br>• Inadvertent impacts on adjacent habitat or vegetation.<br>• Reduced viability of adjacent habitat due to edge effects.<br>• Reduced viability of adjacent habitat due to noise, dust or light spill.<br>• Transport of weeds and pathogens from the site to adjacent vegetation.<br>• Increased risk of starvation, exposure and loss of shade or shelter.<br>• Loss of specialist breeding habitats.<br>• Increase in predators and pest animal populations.<br>• Fragmentation of movement corridors. |
| | MNES considered to be at-risk of impact from turbine strike, and possible barrier effects:<br>• Sharp-tailed Sandpiper<br>• Australasian Bittern<br>• Common Greenshank | Potential for collision with operational turbines could occur to a number of MNES. Stringent mitigation measures, monitoring and adaptive management will be employed to reduce collision risk for these species. Collisions and/or barrier effect are not expected to result in a significant impact to any MNES considered to have |

| Residual project impact | MNES impacted | Impact to MNES |
|---|---|---|
| | • Gul-billed Tern<br>• Caspian Tern<br>• Fork-tailed Swift<br>• Grey Falcon | the potential to occur within the subject land. Detailed assessment of the potential for these impacts to occur is provided in Section 6 and Section 8.3.5. |

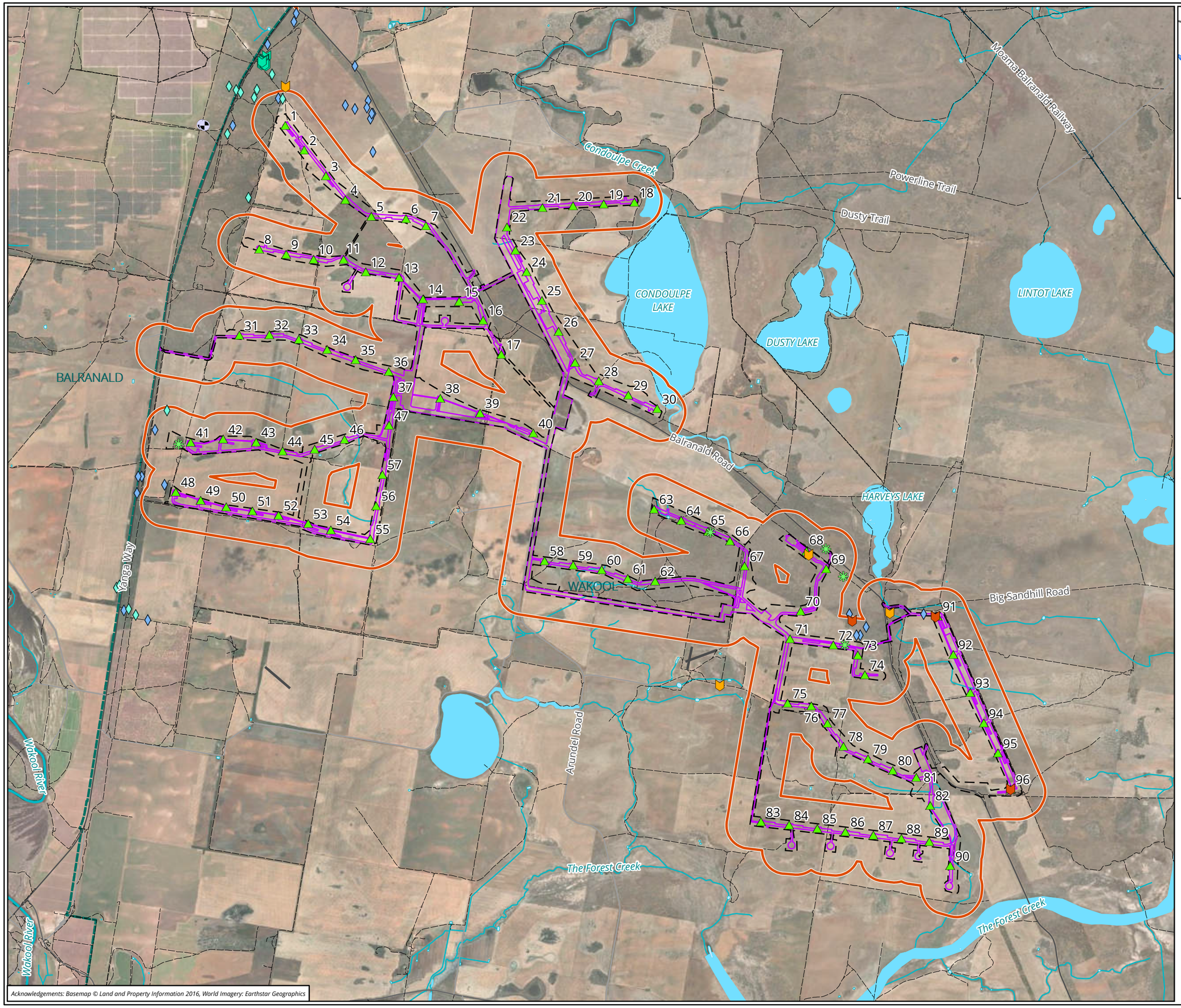
### 12.1.8. Offsetting of residual impacts to MNES

Impacts to Major Mitchell's Cockatoo as a result of the project following all efforts to avoid minimise and mitigate, have been determined as likely to be significant, in accordance with Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DoE 2013) (refer Appendix 5). As such offsetting in accordance with the EPBC Act Environmental Offsets Policy (CoA 2012) and the EPBC Act is required for this species.

Impacts to the remaining MNES considered as part of this assessment have been determined to not be significant, in accordance with Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (DoE 2013), and as such offsetting in accordance with the EPBC Act Environmental Offsets Policy (CoA 2012) and the EPBC Act is not required.

Impacts to all MNES will however be offset in accordance with the NSW BOS through either direct establishment of Biodiversity Stewardship Sites to generate biodiversity credits to offset the project's impacts, through securing biodiversity credits from the open market, or from payment to the Biodiversity Conservation Fund. Offsets for Major Mitchell's Cockatoo will ensure the EPBC Act Environmental Offsets Policy (CoA 2012) requirement of 90 % direct offsets will be met.

Further information on the project's biodiversity offset strategy is provided in Section 13.




**Legend**

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators

**Threatened flora (Biosis)**

- *Austrostipa metatoris*

**Threatened fauna (Nature advisory)**

- Southern Whiteface
- Major Mitchell's Cockatoo
- Regent parrot

**Threatened fauna (NGH)**

- Major Mitchells Cockatoo (NGH)

**Threatened fauna (Biosis)**

- Major Mitchell's Cockatoo

**Threatened fauna (Bionet)**

- Regent Parrot (eastern subspecies)

**Figure 21 MNES within the subject land**

0 750 1,500 2,250 3,000

Meters

Scale: 1:75,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

biosis

Matter: 37502, Date: 19 April 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F21_MNES

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics*

## 12.2. Fisheries Management Act 1994

The FM Act provides for the protection and conservation of aquatic species and their habitat throughout NSW. Impacts to threatened species, populations and communities, and critical habitats listed under the FM Act must be assessed through an Assessment of Significance process.

Key Fish Habitat as mapped by the NSW Department of Primary Industries (DPI) occurs within the subject land and within the adjacent area (DPI 2013). The Key Fish Habitat runs from Lake Talbetts (west of the subject land), through an unnamed ephemeral watercourse within the subject land and into The Forest Creek where it exits the subject land.

No watercourses within the subject land are identified within the NSW DPI Freshwater Fish Community map (DPI 2023). The nearest mapped freshwater fish community is the Eward River south of the subject land, which is identified as occurring in 'Poor' condition. Given this, it is unlikely any watercourses within the subject land would be considered higher than 'very poor' condition. The subject land falls within the polygon of potential habitat for the Murray Hardhead *Craterocephalus fluviatilis*, a small freshwater fish listed as Endangered under the EPBC Act and Critically Endangered under the FM Act . Given the disturbed, modified and non-perennial nature of the watercourses within the subject land, it is considered unlikely that this species occurs. This species is known to occur in lakes and billabongs, and may occur within Condoulpe Lake when it holds water and is connected to other waterbodies. Condoulpe Lake within the subject land is identified as a dryland lake, filling only during above average rainfall events and is utilised for agricultural cropping and grazing. The proposed wind farm does not include works within key areas of aquatic habitat. No works are proposed within at least 600 metres of Condoulpe Lake, The Forest Creek (and associated tributaries within the subject land) and the associated areas of Key Fish Habitat.

The proposed wind farm is not considered an action that would alter the surface drainage, natural drainage systems or flow of watercourses within or adjacent to the subject land. No instream woody debris will be removed and no modification to key areas of aquatic habitat is proposed. As such, a permit under Part 7 of the FM Act is not required.

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# 13. Biodiversity offset strategy

## 13.1. Overview

In order to secure the biodiversity offset liability expected to be required for the project's residual unavoidable impacts, Windlab has commenced investigations into the establishment of local Biodiversity Stewardship Sites.

To date, two properties have been subject to desktop and on-ground assessment to determine their suitability for establishment of Biodiversity Stewardship Sites, and to generate offset credits suitable for the project's requirements, these properties are as follows:

- Property 1: Approximately 550 hectares land parcel supporting approximately 135 hectares of native vegetation that would be suitable to enter into a Biodiversity Stewardship Agreement. The property is bounded by the project's development corridor to the east and south-west, however suitable setbacks would be possible from the project to avoid indirect impacts to any future Biodiversity Stewardship Sites.
- Property 2: Approximately 350 hectare land parcel covered by native vegetation. The property occurs approximately 2.5 kilometres to the south of the project's development corridor.

Both properties support native vegetation and habitats commensurate with those present within the development footprint, and both would be able to generate credits considered like-for-like matches under the BAM. Further detail is provided below.

## 13.2. Offsetting obligations and options

As outlined above in Table 61, Table 62 and Table 63, and summarised in Table 69 below, the project is expected to require offsets for residual unavoidable impacts to seven Offset Trading Groups (OTGs), including two TECs, and four species credit species.

**Table 69 Summary of project offset requirement**

| Species / Offset trading group (OTG) | Credits required |
|---|---|
| **Inland Floodplain Woodlands ≥50% and <70% cleared** | 100 |
| **Sandhill Pine Woodland** | 52 |
| **Acacia melvillei Shrubland** | 66 |
| **Semi-arid Sand Plain Woodlands <50% cleared** | 4 |
| **Semi-arid Sand Plain Woodlands ≥50% and <70% cleared** | 997 |
| **Riverine Chenopod Shrublands <50% cleared** | 80 |
| **Sand Plain Mallee Woodlands <50% cleared** | 118 |
| **Menindee Nightshade** | 47 |
| **Mossgiel Daisy** | 109 |
| **Winged Peppercress** | 103 |
| **Major Mitchell's Cockatoo** | 840 |

To secure the above offset liability Windlab has three broad options, which include:

- Payment to the Biodiversity Conservation Fund (the Fund) managed by the Biodiversity Conservation Trust (BCT).
- Purchase of credits from the open market.
- Establishment of a Biodiversity Stewardship Site(s) to generate credits for offsetting the project specifically.

Each of these options has some potential benefits and drawbacks, which are briefly outlined below.

### Option 1: Payment to the Biodiversity Offset Fund managed by the BCT

Satisfying an offset obligation by paying to the Biodiversity Offset Fund (the Fund) has the major benefit of being an expedited and unambiguous way for a proponent to meet their obligations. However, it does include increased costs associated with the 'Risk premium', and an administrative cost per credit added on top of the costs to source/generate the credits, calculated by the BCT. As such, Payment to the Fund is considered likely to be the most expensive option available to a proponent, however it requires the least amount time and effort in offset security, which can both be substantial (e.g. compared to establishing a Stewardship Site). This option is considered likely to be pursued to secure any residual offsets once Option 2 and Option 3 below have been exhausted.

### Option 2: Purchase credits from the open market

Biodiversity credits exist in an open market-based system whereby an owner of a Biodiversity Stewardship Site, who has generated a range of biodiversity credits, lists their credits in an online database for proponents with a credit obligation to interrogate and enter into price negotiations with relevant credit holders. As an open market, the price of credits is set by supply and demand factors as well as requirements for credits generated at a Biodiversity Stewardship Site to be sold for at least the minimum portion each credit contributes to the management costs of that site (Part A cost, further detailed below). Initial credit sales must all go to funding the management actions required to be undertaken at the Biodiversity Stewardship Site (the costing of which is termed the 'Total Fund Deposit' [TFD]), however once the TFD has been fully satisfied, any future credit sales are generally direct profit to the credit owner. Credits on the open market will initially be sought to secure any residual offsets following the establishment of local Biodiversity Offset Sites, however the potential availability of matching credits is the limiting factors in the Proponent pursuing this option.

### Option 3: Establish a Biodiversity Stewardship Site

Establishment of a Biodiversity Stewardship Site (or multiple sites) with the intention of generating credits to satisfy the project's offset obligation is considered likely to be the most suitable option available. This is partly due to the quantum of offsets required for the project, and the associated cost of securing those offsets through either the open credit market or via payment to the Fund. The suitability of this option is dependent on securing land that is both suitable for the establishment of a Biodiversity Stewardship Site and supports PCTs/habitats considered Like-for-Like with those impacted by the project. Establishing local Biodiversity Stewardship Sites provides the greatest benefit to locally occurring (and impacted) biodiversity values by establishing offsets and undertaking ecological restoration in the local area, potentially allowing for the benefits to be realised by populations of species impacted by the project.

Establishment of local Biodiversity Stewardship Sites will be pursued as the primary means to secure offsets required for the project, a portion of which are expected to be able to be generated at the two properties

detailed herein. It is expected however, that there will be some residual credits that remain outstanding after the establishment of these (and/or other) local offsets which will be secured via the open market of payments to the Fund.

## 13.3. Local offset feasibility

### Background research and ground-truthing surveys

Assessments undertaken to date of offset suitability over the two subject properties has included:

- Desktop review of background information to provide ecological context to the subject properties.
- A review of local threatened species records and relevant vegetation mapping projects.
- Establishment of a Stewardship Site case for the project in the BAM Calculator and assessment of predicted threatened species.
- Research into factors influencing the boundaries of the potential Biodiversity Stewardship Sites such as areas to be excluded via review of Land and Property Information easements spatial layers, MinView searches, current cadastral databases, land zoning, and research into any existing offset obligations.
- Field investigations of the subject properties were completed by Biosis ecologists in June 2023.
- Ground-validation of mapped vegetation to preliminary PCTs and broad scale mapping of ecological condition states.
- Collection of BAM plot data used for calculation of credit generation potential.
- Assessment of areas of potential habitat for threatened species that could generate species credits.
- Determination of high-level expected management issues/actions required.

### Credit calculations and suitability assessment

Following completion of the field investigations, analysis of the data collected was undertaken to:

- Map and calculate the areas of vegetation zones.
- Calculate the estimated number of biodiversity credits generated by the subject properties
- Complete a suitability assessment, based on OTGs, to determine which areas of the subject properties would be best suited to generate credits that could be used to offset the impacts of the project.

Field investigations confirmed the presence of four PCTs, comprising 10 vegetation zones, across the two subject properties, details of which are provided in Table 70 below. Ecological condition was found to range from high to low and areas of derived native grasslands.

**Table 70 PCTs confirmed present within the subject properties**

| PCT | Offset Trading Group (OTG) | Property 1 | Property 2 |
|---|---|---|---|
| **PCT 16 Black Box grassy open woodland wetland** | Inland Floodplain Woodlands ≥50% and <70% cleared | - | 52.94 ha |
| **PCT 23 Yarran tall open shrubland** | *Acacia melvillei* Shrubland | 1.42 ha | 1.36 ha |

| PCT | Offset Trading Group (OTG) | Property 1 | Property 2 |
|---|---|---|---|
| **PCT 58 Black Oak - Western Rosewood open woodland** | Semi-arid Sand Plain Woodlands ≥50% and <70% cleared | 38.93 ha | 20.26 ha |
| **PCT 170 Chenopod sandplain mallee woodland** | Sand Plain Mallee Woodlands <50% cleared | 304 30 ha | 60.48 ha |

Threatened species habitat was assessed and habitat was recorded for species expected to require offsets as a result of the project, including potential breeding habitat for Major Mitchell's Cockatoo. Further assessment and targeted surveys are required to determine the presence of the target threatened species across the subject properties.

Management actions required to be undertaken following the establishment of a Biodiversity Stewardship Site across the subject properties were found to include standard requirements such as; weed control, fence removal for fauna passage, fence installation/maintenance for stock exclusion, access track closures and maintenance, removal of dumped farm refuse and scrap building material. None were found to be of significant concern in terms of preventing a Biodiversity Stewardship Agreement from being established over the properties.

The offset credits that could potentially be generated at each property were assessed using BAM plot data collected across the subject properties, supplemented with relevant data collected from the BDAR. Table 71 provides the areas of each PCT and OTG recorded across the subject properties along with an estimate of the potential credits that could be generated. It should be noted that offset credit generation potential is considered an estimate only and further detailed assessment and collection of additional plot data is required to confirm the numbers presented herein. However, the data in Table 71 provides a good indication of the amount of offsets each property would be able to provide, which match those which will be required by the project.

**Table 71 Summary of OTGs and PCTs mapped and estimated ecosystem credit generation across the subject properties**

| PCT | Offset Trading Group (OTG) | Property 1 credits | Property 2 credits | Total credits |
|---|---|---|---|---|
| **PCT 16 Black Box grassy open woodland wetland** | Inland Floodplain Woodlands ≥50% and <70% cleared | 212 | - | 212 |
| **PCT 23 Yarran tall open shrubland** | *Acacia melvillei* Shrubland | 17 | 4 | 21 |
| **PCT 58 Black Oak - Western Rosewood open woodland** | Semi-arid Sand Plain Woodlands ≥50% and <70% cleared | 105 | 180 | 285 |
| **PCT 170 Chenopod sandplain mallee woodland** | Sand Plain Mallee Woodlands <50% cleared | 271 | 1174 | 1445 |

Table 72 below provides a comparison for the credits potentially generated across the subject properties to those known and expected to be required by the project.

**Table 72 Estimated ecosystem credits generated across subject properties and suitability for offsetting project impacts**

| Offset Trading Group (OTG) | Total credits required | Total credits generated | Residual credits required |
|---|---|---|---|
| **Inland Floodplain Woodlands ≥50% and <70% cleared** | 100 | 212 | 0 |
| **Sandhill Pine Woodland** | 52 | 0 | 52 |
| ***Acacia melvillei* Shrubland** | 66 | 21 | 45 |
| **Semi-arid Sand Plain Woodlands <50% cleared** | 4 | 0 | 4 |
| **Semi-arid Sand Plain Woodlands ≥50% and <70% cleared** | 997 | 285 | 712 |
| **Riverine Chenopod Shrublands <50% cleared** | 80 | 0 | 80 |
| **Sand Plain Mallee Woodlands <50% cleared** | 118 | 1445 | 0 |

It can be seen from the above table that the majority of PCTs and OTGs that could generate credits at the subject properties are required to offset expected impacts of the project, and that the subject properties could satisfy approximately 37 % of ecosystem credit offsets required for the project. Further assessment will be undertaken to determine to suitability of the proposed offset properties to satisfy the project's species credit offset requirement.

## 13.4. Nature positive opportunities

Further to the above, the Proponent is committed to looking into other opportunities to investigate a more 'Nature Positive' offset scenario to benefit the biodiversity values impacted by the project, targeted to the locality of the subject land. Such opportunities could include:

- Working with landholders and authorities to manage and restore the habitats known to support the avoided local populations of Bitter Quandong and *Austrostipa metatoris*.
- Undertaking additional 'non-credit generating' management actions at any locally established Biodiversity Stewardship Sites, such as revegetation of cleared areas to benefit habitat connectivity and promote the establishment of future nesting/roosting resources for impacted bird and bat species.
- Targeted installation of nest boxes and artificial hollows to benefit Major Michell's Cockatoo. As outlined in the EPBC Act Conservation Advice for the species, trials have occurred in Slender Cypress Pine *Callitris gracilis murrayensis* (as occurs within the subject land), with some documented success (Hurley & Harris 2014; Hurley & Stark 2015). These studies have shown an increase in occupancy rate from 22 to 30 for the eight years (2007-2014), and again from 30 to 39 from 2014 – 2021 (Hurley 2022). Major Michell's Cockatoo occupy arid and semi-arid woodlands, consideration of the positioning and orientation of the nest boxes will be a crucial as it affects the internal temperature and microclimate of the nesting habitat. Nest boxes should only be considered where there is evidence that a shortage of natural hollows exists or as a temporary solution, to supplement for the lack of hollows, in sites managed for long-term retention and recovery of hollow-bearing trees, such as Biodiversity Stewardship Sites, but in which there may be a temporal gap in the availability of hollows. (DCCEEW, 2023)
- Provide opportunities for year-round availability of surface water in close proximity to foraging and nesting habitat for Major Mitchell's Cockatoos within offset sites or the wind farm site. This could

include, installing or maintaining artificial water recourses to ensure continued access to food and nest sites during periods when natural surface water is absent. (DCCEEW, 2023)

- Contribute to regional threatened species monitoring programs or pest control programs within the proximal National Parks estate areas.

Net positive outcomes are one of the main aims of the re-evaluation of environmental offsets outlined in the Commonwealth Governments 'Nature Positive Plan' and the Proponent is committed to contributing to achieving these goals.

## 13.5. Offset staging plan

As outlined in Section 1.1.2, the development footprint has been broken up into two areas to stage the development and facilitate the staged retirement of the project's biodiversity credit liability. Prior to works commencing in each area, the biodiversity offset associated with that area will be secured.

Indicative staged impact are considered possible to be discrete packages of work for which staging of offset obligations is feasible. The components of planned to be included in Stage 1 are detailed in Table 2, in Section 1.1.2. The residual infrastructure to be built in Stage 2 will be dependent on final detailed design and connection into Project Energy Connect with exact details dependent on the access scheme defined in the Renewable Energy Zone (South West) Access Scheme Order.

Staged impacts and biodiversity credit requirements for Stage 1 and an indicative Stage 2 are presented in Table 73 and Table 74 respectively. BAM Calculator Credit Summary Reports for each stage are provided below.

**Table 73 Offset staging plan – Stage 1 impacts and credit requirements**

| PCT / Species | Vegetation zone | Impact (Ha) | Credits required |
|---|---|---|---|
| **Stage 1** | | | |
| **PCT 16** | 16_Moderate | 0.62 | 14 |
| | 16_DNG | 0.74 | 0 |
| | 16_Paddock Trees | 0.21 | 0 |
| **PCT 58** | 58_High | 0.33 | 13 |
| | 58_Moderate | 1.58 | 52 |
| | 58_DNG | 4.58 | 36 |
| | 58_Paddock Trees | 0.01 | 1 |
| **PCT 170** | 170_Moderate | 0.12 | 3 |
| | 170_Low | 0.01 | 1 |
| | 170_DNG | 0.25 | 0 |
| **Totals** | - | **8.45** | **120** |
| **Major Mitchell's Cockatoo** | 16_Moderate | 0.59 | 16 |
| | 16_DNG | 0.68 | 5 |

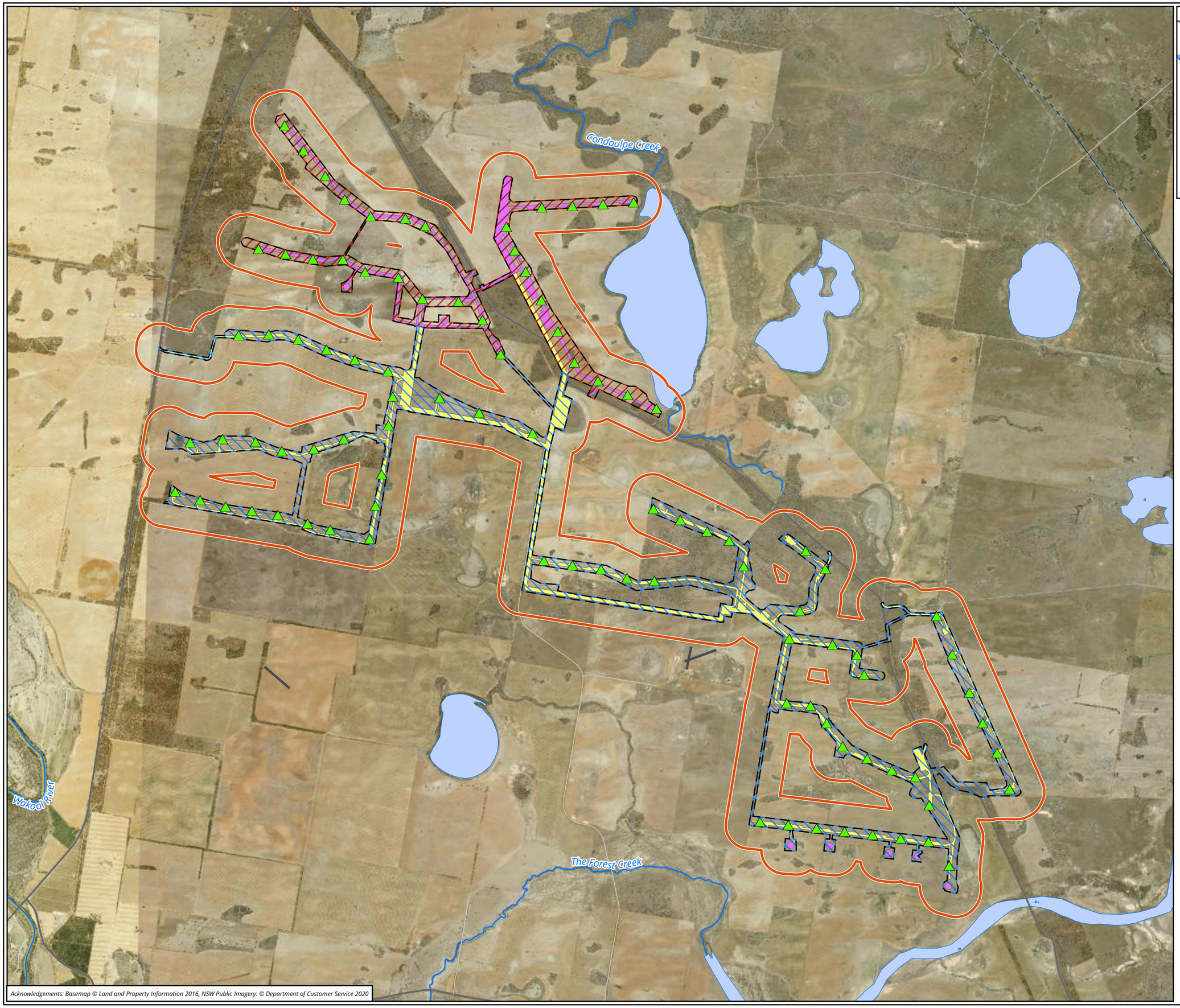
| PCT / Species | Vegetation zone | Impact (Ha) | Credits required |
|---|---|---|---|
| | 16_Paddock Trees | 0.21 | 1 |
| | 58_High | 0.31 | 14 |
| | 58_Moderate | 1.05 | 39 |
| | 58_DNG | 4.24 | 38 |
| | 58_Paddock Trees | 0.01 | 1 |
| | 170_Moderate | 0.12 | 4 |
| | 170_DNG | 0.25 | 2 |
| **Totals** | - | **7.46** | **120** |

**Table 74 Offset staging plan – Stage 2 impacts and credit requirements**

| PCT / Species | Vegetation zone | Impact (Ha) | Credits required |
|---|---|---|---|
| **Stage 2** | | | |
| **PCT 16** | 16_Moderate | 3.18 | 74 |
| | 16_Low | 0.36 | 5 |
| | 16_DNG | 2.04 | 0 |
| **PCT 21** | 21_Moderate (Sandhill Pine TEC) | 1.17 | 38 |
| **PCT 23** | 23_Moderate (Acacia melvillei Shrubland TEC) | 2.03 | 64 |
| **PCT 57** | 57_Moderate | 0.19 | 4 |
| **PCT 58** | 58_High | 0.52 | 21 |
| | 58_Moderate | 19.33 | 633 |
| | 58_DNG | 26.43 | 205 |
| | 58_Paddock Trees | 0.06 | 1 |
| **PCT 163** | 163_Moderate | 3.58 | 80 |
| **PCT 170** | 170_Moderate | 4.55 | 101 |
| | 170_Low | 0.55 | 6 |
| | 170_DNG | 3.25 | 0 |
| **Totals** | - | **67.24** | **1232** |
| **Major Mitchell's Cockatoo** | 16_Moderate | 1.67 | 45 |
| | 16_Low | 0.36 | 5 |
| | 16_DNG | 1.95 | 14 |
| | 21_Moderate | 0.85 | 27 |
| | 23_Moderate | 1.67 | 52 |

| PCT / Species | Vegetation zone | Impact (Ha) | Credits required |
|---|---|---|---|
| | 57_Moderate | 0.19 | 6 |
| | 58_High | 0.54 | 24 |
| | 58_Moderate | 8.03 | 301 |
| | 58_DNG | 6.75 | 60 |
| | 58_Paddock Trees | 0.06 | 1 |
| | 163_Moderate | 3.57 | 43 |
| | 170_Moderate | 4.14 | 123 |
| | 170_Low | 0.48 | 7 |
| | 170_DNG | 1.42 | 11 |
| **Totals** | - | **31.68** | **719** |
| **Mendinee Nightshade** | 16_Moderate | 2.34 | 47 |
| **Totals** | - | **2.34** | **47** |
| **Mossgeil Daisy** | 16_Moderate | 2.34 | 62 |
| | 163_Moderate | 1.57 | 47 |
| **Totals** | -- | **3.91** | **109** |
| **Winged Peppercress** | 16_Moderate | 2.16 | 58 |
| | 163_Moderate | 1.50 | 45 |
| **Totals** | - | **3.66** | **103** |

The Proponent will confirm the offset staging plan with DPHI prior to the commencement of construction.




**Legend**

- Subject land
- Development corridor
- Wind turbine generators

**Stage**

- Stage1
- Stage2

**Development footprint**

- Development footprint - Stage 1
- Development footprint - Stage 2

**Figure 22 Project staging**

0 750 1,500 2,250 3,000

Meters

Scale: 1:75,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

*Acknowledgements: Basemap © Land and Property Information 2016, NSW Public Imagery: © Department of Customer Service 2020*

Matter: 37502, Date: 19 April 2024,
Drawn by: JET, Checked by: CW, Last edited by: jtownsend
Layout: 37502_F22_Staging
Project: P:\37500s\37502\Mapping\
37502_BDAR 10 +.aprx

# BAM Credit Summary Report

## Proposal Details

Assessment Id
00034462/BAAS18138/22/00034463

Proposal Name
Burrawong WF - BDAR - Stage 1

BAM data last updated *
14/03/2024

Assessor Name
Callan Wharfe

Report Created
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7

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

| Zone | Vegetation zone name | TEC name | Current Vegetation integrity score | Change in Vegetation integrity (loss / gain) | Area (ha) | Sensitivity to loss (Justification) | Species sensitivity to gain class | BC Act Listing status | EPBC Act listing status | Biodiversity risk weighting | Potential SAII | Ecosystem credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)** | | | | | | | | | | | | |
| 1 | 16_Moderate | Not a TEC | 53.4 | 53.4 | 0.62 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 14 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 16_DNG | Not a TEC | 14.7 | 14.7 | 0.74 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 0 |
| 3 | 16_Paddock_trees | Not a TEC | 10.7 | 10.7 | 0.21 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 0 |
| | | | | | | | | | | | **Subtotal** | **14** |
| **Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion** | | | | | | | | | | | | |
| 4 | 58_High | Not a TEC | 91 | 91.0 | 0.33 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 13 |
| 5 | 58_Moderate | Not a TEC | 74.8 | 74.8 | 1.6 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 52 |
| 6 | 58_DNG | Not a TEC | 17.7 | 17.7 | 4.6 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 36 |
| 7 | 58_Paddock_trees | Not a TEC | 46.6 | 46.6 | 0.01 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 1 |
| | | | | | | | | | | | **Subtotal** | **102** |
| **Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones** | | | | | | | | | | | | |
| 8 | 170_Moderate | Not a TEC | 59.5 | 59.5 | 0.12 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | | 3 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 170_Low | Not a TEC | 29.7 | 29.7 | 0.01 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | | 1 |
| 10 | 170_DNG | Not a TEC | 15 | 15.0 | 0.25 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | | 0 |
| | | | | | | | | | | | **Subtotal** | **4** |
| | | | | | | | | | | | **Total** | **120** |

## Species credits for threatened species

| Vegetation zone name | Habitat condition (Vegetation Integrity) | Change in habitat condition | Area (ha)/Count (no. individuals) | Sensitivity to loss (Justification) | Sensitivity to gain (Justification) | BC Act Listing status | EPBC Act listing status | Potential SAII | Species credits |
|---|---|---|---|---|---|---|---|---|---|
| ***Lophochroa leadbeateri / Pink Cockatoo ( Fauna )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 0.59 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 16 |
| 16_DNG | 14.7 | 14.7 | 0.68 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 5 |
| 16_Paddock_trees | 10.7 | 10.7 | 0.21 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 58_High | 91.0 | 91.0 | 0.31 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 14 |
| 58_Moderate | 74.8 | 74.8 | 1 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 39 |
| 58_DNG | 17.7 | 17.7 | 4.2 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 38 |
| 58_Paddock_trees | 46.6 | 46.6 | 0.01 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 1 |
| 170_Moderate | 59.5 | 59.5 | 0.12 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 4 |
| 170_DNG | 15.0 | 15.0 | 0.25 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 2 |
| | | | | | | | | **Subtotal** | **120** |

# BAM Credit Summary Report

## Proposal Details

Assessment Id
00034462/BAAS18138/22/00034463

Proposal Name
Burrawong WF - BDAR - Stage 2

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Assessor Name
Callan Wharfe

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BAM Case Status
Open

Date Finalised
To be finalised

Assessment Revision
8

Assessment Type
Major Projects

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

## Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

| Zone | Vegetation zone name | TEC name | Current Vegetation integrity score | Change in Vegetation integrity (loss / gain) | Area (ha) | Sensitivity to loss (Justification) | Species sensitivity to gain class | BC Act Listing status | EPBC Act listing status | Biodiversity risk weighting | Potential SAII | Ecosystem credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion** | | | | | | | | | | | | |
| 6 | 57_Moderate | Not a TEC | 61.1 | 61.1 | 0.19 | PCT Cleared - 43% | High Sensitivity to Gain | | | 1.50 | | 4 |
| | | | | | | | | | | | **Subtotal** | **4** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)** | | | | | | | | | | | | |
| 1 | 16_Moderate | Not a TEC | 53.4 | 53.4 | 3.2 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 74 |
| 2 | 16_Low | Not a TEC | 28.6 | 28.6 | 0.36 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 5 |
| 3 | 16_DNG | Not a TEC | 14.7 | 14.7 | 2 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 0 |
| | | | | | | | | | | | **Subtotal** | **79** |
| **Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion** | | | | | | | | | | | | |
| 7 | 58_High | Not a TEC | 91 | 91.0 | 0.52 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 21 |
| 8 | 58_Moderate | Not a TEC | 74.8 | 74.8 | 19.3 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 633 |
| 9 | 58_DNG | Not a TEC | 17.7 | 17.7 | 26.4 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 205 |
| 10 | 58_Paddock_trees | Not a TEC | 46.6 | 46.6 | 0.06 | PCT Cleared - 50% | High Sensitivity to Gain | | | 1.75 | | 1 |
| | | | | | | | | | | | **Subtotal** | **860** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones** | | | | | | | | | | | |
| 12 | 170_Moderate | Not a TEC | 59.5 | 59.5 | 4.6 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | 101 |
| 13 | 170_Low | Not a TEC | 29.7 | 29.7 | 0.55 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | 6 |
| 14 | 170_DNG | Not a TEC | 15 | 15.0 | 3.2 | PCT Cleared - 41% | High Sensitivity to Gain | | | 1.50 | 0 |
| | | | | | | | | | | **Subtotal** | **107** |
| **Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones** | | | | | | | | | | | |
| 11 | 163_Moderate | Not a TEC | 59.5 | 59.5 | 3.6 | PCT Cleared - 26% | High Sensitivity to Gain | | | 1.50 | 80 |
| | | | | | | | | | | **Subtotal** | **80** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion** | | | | | | | | | | | | |
| 4 | 21_Moderate | Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions | 64.6 | 64.6 | 1.2 | Biodiversity Conservation Act listing status | High Sensitivity to Gain | Endangered Ecological Community | Not Listed | 2.00 | | 38 |
| | | | | | | | | | | | **Subtotal** | **38** |
| **Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones** | | | | | | | | | | | | |
| 5 | 23_Moderate | Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions | 62.7 | 62.7 | 2 | Biodiversity Conservation Act listing status | High Sensitivity to Gain | Endangered Ecological Community | Not Listed | 2.00 | | 64 |
| | | | | | | | | | | | **Subtotal** | **64** |
| | | | | | | | | | | | **Total** | **1232** |

## Species credits for threatened species

| Vegetation zone name | Habitat condition (Vegetation Integrity) | Change in habitat condition | Area (ha)/Count (no. individuals) | Sensitivity to loss (Justification) | Sensitivity to gain (Justification) | BC Act Listing status | EPBC Act listing status | Potential SAII | Species credits |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Brachyscome papillosa / Mossgiel Daisy ( Flora )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 2.3 | Biodiversity Conservation Act listing status | Ability to colonise improved habitat | Vulnerable | Vulnerable | False | 62 |
| 163_Moderate | 59.5 | 59.5 | 1.6 | Biodiversity Conservation Act listing status | Ability to colonise improved habitat | Vulnerable | Vulnerable | False | 47 |
| | | | | | | | | **Subtotal** | **109** |
| ***Lepidium monoplocoides / Winged Peppercress ( Flora )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 2.2 | Biodiversity Conservation Act listing status | Effectiveness of management in controlling threats | Endangered | Endangered | False | 58 |
| 163_Moderate | 59.5 | 59.5 | 1.5 | Biodiversity Conservation Act listing status | Effectiveness of management in controlling threats | Endangered | Endangered | False | 45 |
| | | | | | | | | **Subtotal** | **103** |
| ***Lophochroa leadbeateri / Pink Cockatoo ( Fauna )*** | | | | | | | | | |
| 16_Moderate | 53.4 | 53.4 | 1.7 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 45 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 16_Low | 28.6 | 28.6 | 0.36 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 5 |
| 16_DNG | 14.7 | 14.7 | 2 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 14 |
| 21_Moderate | 64.6 | 64.6 | 0.85 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 27 |
| 23_Moderate | 62.7 | 62.7 | 1.7 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 52 |
| 57_Moderate | 61.1 | 61.1 | 0.19 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 6 |
| 58_High | 91.0 | 91.0 | 0.52 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 24 |
| 58_Moderate | 74.8 | 74.8 | 8 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 301 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 58_DNG | 17.7 | 17.7 | 6.8 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 60 |
| 58_Paddock_trees | 46.6 | 46.6 | 0.06 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 1 |
| 163_Moderate | 59.5 | 59.5 | 1.4 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 43 |
| 170_Moderate | 59.5 | 59.5 | 4.1 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 123 |
| 170_Low | 29.7 | 29.7 | 0.48 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 7 |
| 170_DNG | 15.0 | 15.0 | 1.4 | Biodiversity Conservation Act listing status | Species dependent on habitat attributes | Vulnerable | Not Listed | False | 11 |
| | | | | | | | | **Subtotal** | **719** |

| ***Solanum karsense / Menindee Nightshade ( Flora )*** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 16_Moderate | 53.4 | 53.4 | 2.3 | Biodiversity Conservation Act listing status | Effectiveness of management in controlling threats | Vulnerable | Vulnerable | False | 47 |
| | | | | | | | | **Subtotal** | **47** |

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# APPENDICES

# Appendix 1. Survey methods

## Appendix 1.1. Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2000, Harden 2002). All doubtful species names were verified with the online Australian Plant Name Index (Australian National Botanic Gardens & Australian National Herbarium 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 3.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the DCCEEW (DSEWPaC 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

## Appendix 1.2. Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by NSW DCCEEW (SL100758, expiry date 31 May 2024). The BAM Assessment and quality review of the BDAR was carried out by Accredited Assessors Callan Wharfe (BAAS18138) and Mitch Palmer (BAAS17051).

## Appendix 1.3. Limitations

Field surveys were undertaken in accordance with the BAM (DPIE 2020a). Ecological surveys provide a sampling of flora and fauna at a given time and season. Factors influencing detectability of species during survey include species dormancy, seasonal conditions, ephemeral status of waterbodies, and migration and breeding behaviours of some fauna. In many cases, these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

Surveys undertaken, combined with habitat assessments and desktop analysis are considered sufficient to reach the conclusions herein regarding this and all other species' likelihood of occurrence within the subject land.

Database searches, and associated conclusions on the likelihood of species to occur within the assessment area, are reliant upon external data sources and information managed by third parties.

# Appendix 2. BAM Candidate species assessment

**Table A 1: Threatened flora species assessment**

| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| ***Acacia acanthoclada*** Harrow Wattle | - | En | Yes – Sth Olary Plain | Low, rigid shrub growing in south-west NSW in the Buronga Region. Grows in mallee communities on ridges, low dune ridges and occasionally on rocky outcrops primarily in Dune Mallee Woodlands and Sand Plain Mallee Woodlands. Grows in full sun on deep sandy soils. | Low | Yes | Yes Targeted survey September and October. | No | Species was not recorded during the targeted survey effort. Species known area of occurrence 110-130 kms north-west of the subject land. |
| ***Acacia carneorum*** Purple-wood Wattle | Vu | Vu | Yes – Sth Olary Plain | Prickly shrub to small tree growing in the far west from south-west Tibooburra to the Menindee area. Grows on sand dunes and along watercourses primarily in Sand Plain Mulga Shrublands, Stony Desert Mulga Shrublands, Semi-arid Sand Plain Woodlands and Riverine Sandhill Woodlands. Grows on sand hills and ridges in brown and red earth dune soils. | Nil | No | No | No | Species was excluded from the Candidate Species list based on a lack of suitable habitat present within the subject land. Furthermore the species known area of occurrence is on the Far Western Plains approximately 250 km north-west of the subject land. |
| ***Atriplex infrequens*** A saltbush | Vu | Vu | Yes – Sth Olary Plain | Small spreading herb confined to the NSW far western plains with populations located in Tibooburra, south-east of Brewarrina, near Wilcannia and Pooncarie. Grows near broad drainage tracts, clay flats and occasionally inundated habitats in a variety of communities including Riverine Chenopod Shrublands, Inland Floodplain Shrublands, Inland Saline Lakes and Sand Plain Mallee Woodlands. | Nil | No | No | No | Species was excluded from the Candidate Species list based on a lack of suitable habitat present within the subject land. Furthermore the species known area of occurrence is on the Far Western Plains approximately 200 km north-west of the subject land. |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| ***Austrostipa metatoris*** A spear-grass | Vu | Vu | Yes – Sth Olary Plain | Perennial grass found growing in locations throughout the Murray Valley including Cunninyeuk Creek, Stony Crossing, Kyalite State Forest and Lake Benanee. Also found in scattered locations in Central NSW including Lake Cargelligo, east of Goolgowi, Condobolin and south-west of Nymagee. Grows on sandhills, sand ridges, undulating plains and mallee country in a variety of communities including Western Slopes Dry Sclerophyll Forest, Floodplain Transition Woodlands, Sand Plain Mallee Woodlands and Western Peneplain Woodlands. Grows in red to brown clay loam and sandy loam soils. | Recorded adjacent to subject land | Yes | Yes Targeted survey October and December (see section 4.3) | No | **Species was identified within the subject land, the final design avoids this area. Refer to Section 7 and 9.** |
| ***Brachyscome papillosa*** Mossgiel Daisy | Vu | Vu | Yes – Sth Olary Plain and M'bidgee | Multistemmed perennial herb endemic to NSW, primarily distributed throughout the Riverina bioregion with one site occurring in the South Western Slopes. Grows on Saltbush plains in a variety of communities including Aeolian Chenopod Shrublands, Inland Floodplain Shrublands, Riverine Plain Grasslands and Inland Saline Lakes. Grows in clay soils. | Moderate | Yes | Yes Targeted survey September and October. | Yes - Assumed | Assumed present in under-surveyed areas of PCT 16 in Moderate and DNG condition, and PCT 163 in Moderate condition. All other areas of suitable potential habitat have been subject to survey or comprise degraded edges that would not support the species' presence. |
| ***Calotis moorei*** A burr-daisy | En | En | Yes – Sth Olary Plain and M'bidgee | Erect perennial herb limited to four populations in NSW, north-west of Louth, west of Wilcannia, around Menindee area and Zara Station near Deniliquin. Grows on flat areas associated with Acacia woodlands in a variety of communities including Sand Plain Mulga Shrublands, Aeolian Chenopod Shrublands, Riverine Sandhill Woodlands and Sand Plain | Low | Yes | Yes Targeted survey September and October. | No | Species was not found during the targeted survey effort. Highly restricted species with a single, low accuracy, historical record 125 km from the subject land. |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | Mallee Woodlands. Grows in sand soils. | | | | | |
| ***Convolvulus tedmoorei*** Bindweed | - | En | Yes – M'bidgee | Perennial herb restricted to four areas, two on the Murrumbidgee and Darling Rivers, one on the road to Wilcannia east of Broken Hill and one from Menindee Road near Scarsdale. Found on floodplains in a variety of communities including Riverine Chenopod Shrublands, Inland Floodplain Shrublands, Semi-arid Floodplain Grasslands and Inland Saline Lakes. Grows in grey clay soils. | Nil | No | No | No | Species was excluded from the Candidate Species list based on not being associated with South Olary Plain IBRA subregion, and known records over 170 km to east of subject land. |
| ***Cratystylis conocephala*** Bluebush Daisy | - | En | Yes – Sth Olary Plain | Small shrub confined to a few small populations in the Wentworth district in the south-western plains. Grows in mallee in association with Belah *Casuarina pauper* in Dune Mallee Woodlands, Sand Plain Mallee Woodlands and Semi-arid Sand Plain Woodlands. Grows in alkaline soils, preferably red loams with calcareous inclusions as well as yellow loamy sands and red loamy laterites. | Nil | No | No | No | Species was excluded from the Candidate Species list based on BioNet noting the species is restricted to a few small populations in the Wentworth district in the far south-western plains. The closest record being 180 km from the subject land, with the majority of records a further 100 km to the north-west (over 250 km from the subject land) |
| ***Dodonaea stenozyga*** Desert Hopbush | - | Critically Endangered | Yes – Sth Olary Plain | Rounded shrub, presumed extinct in NSW with one record from the Darling River prior to 1859 until rediscovered in 1998 at Nanya Station, north-west of Wentworth. Grows in mallee shrubland on dune swales in Dune Mallee Woodlands and Sand Plain Mallee Woodlands. Grows in a variety of soils including sand soils. | Nil | No | No | No | Species was excluded from the Candidate Species list based on BioNet noting only known population occurs north-west of Wentworth in far south-western NSW, over 250 km from the subject land. |
| ***Eucalyptus leucoxylon* subsp. *pruinosa*** Yellow Gum | - | Vu | Yes – M'bidgee | Small to medium sized tree, restricted to several locations between Barham and Euston, known to occur in Campbells Island and Euston State Forests. Grows at the bases of sandy rises and on loamy clay flats on the | Low | No | No Incidental survey September, October, | No | Species was excluded from the Candidate Species list based on not being associated with South Olary Plain IBRA subregion, however incidental surveys were completed, and species was not recorded. |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | floodplains of the Murray River and its tributaries in Inland Riverine Forests, Inland Floodplain Wetlands, Riverine Sandhill Woodlands, and Floodplain Transition Woodlands. Grows on moderately fertile loamy or alluvial soils. | | | December and March | | |
| ***Lasiopetalum behrii*** Pink Velvet Bush | - | CE | Yes – Sth Olary Plain | Medium sized shrub restricted to a single record in 1997 on leasehold land south-east of Pooncarie in the far south-western plains. Grows in mallee and red dune/swale country in Dune Mallee Woodlands and Sand Plain Mallee Woodlands. | Low | Yes | Yes Targeted survey September, October, December, March | No | Species was not found during the targeted survey effort. |
| ***Lepidium monoplocoides*** Winged Peppercress | En | En | Yes – Sth Olary Plain and M'bidgee | Erect, annual herb with populations sparsely scattered throughout a widespread distribution spanning the semi-arid western plains. Historical records are numerous although recent records are confined to two collections from Broken Hill, in 1915 and 1950. Grows in areas receiving between 300 mm to 500 mm annual rainfall on periodically inundated and waterlogged habitats in a variety of communities including Inland Floodplain Shrublands, Floodplain Transition Woodlands, Inland Saline Lakes, Sand Plain Mallee Woodlands and Western Peneplain Woodlands. Grows on waterlogged grey-brown clays | Moderate | Yes | Yes Targeted survey September, October, December | Yes - Assumed | Assumed present in under-surveyed areas of PCT 16 in Moderate and DNG condition, and PCT 163 in Moderate condition.<br>All other areas of suitable potential habitat have been subject to survey or comprise degraded edges that would not support the species' presence. |
| ***Leptorhynchos waitzia*** Button Immortelle | - | En | Yes – Sth Olary Plain | Small annual herb restricted in NSW to early records from around the Darling River region and one recent collection from Kinchega National Park. Grows in ephemeral flood lands, grassy plains, grassy woodlands, salt flats and on open Bluebush Plain amongst | Nil | No | No | No | Species was excluded from the Candidate Species list based on BioNet noting species is only known in NSW from records in the Darling River region and from Kinchega National Park. Records of the species are over 280 km from the subject |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | scattered chenopods in Aeolian Chenopod Shrublands, Riverine Chenopod Shrublands, Inland Saline Lakes and Sand Plain Mallee Woodlands. Grows on sandy or loamy soils with isolated occurrences on cracking clays. | | | | | land, and suitable habitats are not considered to occur. |
| ***Pilularia novae-hollandiae*** Austral Pillwort | - | En | Yes – M'bidgee | Semi-aquatic fern with the only extant populations located at Lake Cowal and Oolambeyan National Park. Historical distribution ranged from Sydney, Khancoban, The Riverina near Albury and Urana. Grows in seasonally dry depressions, drainage lines, margins of marshes, shallow swamps and waterways in a variety of communities including Inland Riverine Forests, Inland Floodplain Swamps, Southern Tableland Dry Sclerophyll Forests, Coastal Floodplain Wetlands, Coastal Swamp Forests, Coastal Freshwater Lagoons. Grows in mud amongst grasses and sedges. | Nil | No | No | No | Species was excluded from the Candidate species list based on geographic constraints. |
| ***Pterostylis cobarensis*** Greenhood Orchid | - | Vu | Yes – Sth Olary Plain | Deciduous terrestrial orchid occurring from Bourke, Nyngan, Cobar, Nymagee, Warren, Gilgandra, Narrabri and Coonabarabran districts including Mutawintji, Gundabooka, Culgoa and Warrumbungles National Parks, the Quanda and Ythong nature reserves, the Mount Grenfell Historic Site and the Bimbilwindi and Pilliga East State Forests. Found growing on low stony ridges and slopes in a variety of communities including Pilliga Outwash Dry Sclerophyll Forests, Western Slopes Grassy Woodlands, Sand Plain Mallee Woodlands, Floodplain Transition Woodlands and Inland | Low | Yes | Yesa Targeted survey October. | No | Species was not found during the targeted survey effort.<br>Habitats present within the subject land are marginal, with limited presence of BioNet listed associated species. |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | Riverine Forests. Grows in skeletal sandy loam soils. | | | | | |
| ***Santalum murrayanum*** Bitter Quandong | - | En | Yes – Sth Olary Plain | Tall shrub to small tree confined to south-west NSW within the vicinity of the Sturt Highway between Dareton and Balranald, Kyalite and Moulamein, west of Lake Victoria and south-east of Menindee. Found growing in mallee communities on dune crests in Dune Mallee Woodlands and Sand Plain Mallee Woodlands. Grows in deep, well drained calcareous earths or red and brown sands, loamy sands or clay loams. | Recorded | Yes | Yes Targeted survey September, October, December, March | Yes | Species was identified during the targeted survey. |
| ***Solanum karsense*** Menindee Nightshade | Vu | Vu | Yes – Sth Olary Plain and M'bidgee | Small perennial herb, endemic to NSW, restricted to the far south-western plains spanning from the Darling River to the Menindee and Wilcannia districts. Found growing in flooded depressions and level river floodplains in a variety of communities including Aeolian Chenopod Shrublands, Riverine Chenopod Shrublands, Inland Floodplain Shrublands, Inland Saline Lakes and Inland Floodplain Woodlands. Grows in a variety of soils including grey clays, calcareous soils, brown soils, red sands, red-brown earths and loamy soils. | Moderate | Yes | Yes Targeted survey September and October. | Yes - Assumed | Assumed present in under-surveyed areas of PCT 16 in Moderate and DNG condition.<br>All other areas of suitable potential habitat have been subject to survey or comprise degraded edges that would not support the species' presence. |
| ***Swainsona colutoides*** Bladder Senna | - | En | Yes – Sth Olary Plain | Small erect annual shrub restricted to several populations existing in one location within Tarawi Nature Reserve. Found growing on sandy flats or amongst mallee in Dune Mallee Woodlands and Sand Plain Mallee Woodlands. Grows in skeletal sandy soils. | Nil | No | No | No | Species was excluded from the Candidate Species list based on BioNet noting the species occurs in the south-western corner of NSW, with several populations all located within Tarawi Nature Reserve, known distribution is over 250km from the subject land. |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| ***Swainsona murrayana*** Slender Darling Pea | Vu | Vu | Yes – M'bidgee | Small sparsely downy forb distributed between Jerilderie and Deniliquin areas of the southern Riverine Plain as far north as Willandra National Park, near Broken Hill and between Dubbo and Mudgee. Found growing on level plains, floodplains and depressions in a variety of communities including Riverine Chenopod Shrublands, Semi-arid Floodplain Shrublands, Western Slopes Grasslands, Brigalow Clay Plain Woodlands, Riverine Plain Woodlands and Inland Saline Lakes. Grows in heavy clay based soils ranging from grey, red and brown cracking clays to red-brown earths and loams. | Low | No | Incidental survey September. | No | Species was excluded from the Candidate Species list based on not being associated with South Olary Plain IBRA subregion, species known distribution is approximately 80-100 km to the east, incidental surveys were completed, and species was not recorded. |
| ***Swainsona pyrophila*** Yellow Swainson-pea | Vu | Vu | Yes – Sth Olary Plain | Small erect perennial forb with a sparse distribution throughout the south-western regions of NSW and into South Australia and Victoria. Found growing amongst mallee scrub, disturbed woodlands, sheltered aspects, roadsides, claypans and edges of fire ash in Dune Mallee Woodlands and Sand Plain Mallee Woodlands. Grows in sandy or loamy soils. | Low | Yes | Targeted survey September and October. | No | Species was not found during the targeted survey effort. |
| ***Swainsona sericea*** Silky Swainson-pea | - | Vu | Yes – Sth Olary Plain and M'bidgee | Small prostrate or erect perennial herb with a distribution spanning from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains with an additional outlying population in the far north-west of NSW. Found growing in a variety of communities including Natural Temperate Grasslands, Snow Gum Eucalyptus pauciflora Woodlands on the Monaro, Box-Gum Woodland, New England Dry | Low | Yes | Targeted survey September and October. | No | Species was not found during the targeted survey effort. |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | Sclerophyll Forests, North-west Slopes Dry Sclerophyll Woodlands, North-west Plain Shrublands, Western Slopes Grasslands, Floodplain Transition Woodlands and Subalpine Woodlands. | | | | | |

**Table A 2: Threatened fauna species assessment**

| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| **Birds** | | | | | | | | | |
| ***Ardeotis australis*** Australian Bustard | - | En | Species | This species appears to be confined to areas where the upper vegetation canopy cover is less than 10% or under 2 m high (NPWS 1996). Mainly occurs in open woodland, low shrubland, farmland and roost in tree or on a high vantage point on the ground (Blakers et al. 1984, NPWS 1996). This species does not build nest, eggs are laid on open bare ground beside grass or tussock (NPWS 1996). | Low | Yes | Yes All biodiversity surveys completed by Biosis, Nature Advisory and NGH Consulting | No | Species not recorded during survey |
| ***Burhinus grallarius*** Bush Stone-curlew | - | En | Species | The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Occurs in lightly timbered open forest and woodland, or partly cleared farmland with remnants of woodland, with a ground cover of short sparse grass and few or no shrubs where fallen branches and leaf litter are present. | Low | Yes | Yes Targeted surveys completed February 2023 | No | Species not recorded during survey |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| ***Haliaeetus leucogaster*** White-bellied Sea-Eagle | - | Vu | Species (Breeding) | A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees. | Low | Yes | Yes Surveyed - August, November 2021 and July, October 2022 | No | Species not recorded during survey |
| ***Hamirostra melanosternon*** Black-breasted Buzzard | - | Vu | Species (Breeding) | Occur in woodland and open country of tropical and temperate Australian. They prefer tree-lined watercourses, billabongs, ephemeral lakes and floodplains. Have been recorded in areas where Melaleuca dominate the vegetation. Nest in dead or partly dead trees usually near watercourses. | Low | Yes | Yes Surveyed - November 2021 and October 2022 | No | Species not recorded during survey |
| ***Hieraaetus morphnoides*** Little Eagle | - | Vu | Species (Breeding) | The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests. | Low | Yes | Yes Surveyed - August 2021 and October 2022 | No | Species not recorded during survey |
| ***Lophochroa leadbeateri*** Major Mitchell's Cockatoo | - | Vu | Species (Breeding) | Found mainly in semi-arid and arid regions, in dry woodlands, particularly mallee - casuarina assemblages. They breed in the hollows of large trees, often near watercourse. | Recorded | Yes | Yes Surveyed - November 2021 and October 2022 | Yes | Species recorded on multiple occasions, with breeding activity noted and assumed. |
| ***Lophoictinia isura*** Square-tailed Kite | - | Vu | Species/E cosystem | Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, | Low | Yes | Yes Surveyed - November 2021 and October 2022 | No | Species not recorded during survey |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs. | | | | | |
| ***Manorina melanotis*** Black-eared Miner | En | CE | Species | This species is restricted to swale areas in mature mallee (NPWS 1996). They prefer dense, undisturbed woodland and construct nest from grass and sticks within the mallee woodland (NPWS 1996). | Nil | No | No | No | Species was excluded from the Candidate Species list based on BioNet noting the species is restricted to large tracts (30,000 hectares or greater) of mature, unfragmented mallee on the more fertile soils. Large patches of unfragmented mallee do not occur within, our contiguous with, the subject land |
| ***Ninox connivens*** Barking Owl | - | Vu | Species (Breeding) | Generally found in open forests, woodlands, swamp woodlands, farmlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country. Territories are typically 2000 ha in NSW habitats. Hunts small arboreal mammals or birds and terrestrial mammals when tree hollows are absent. | Nil | No | Yes Incidental surveys completed over four nights in February 2023 | No | Species' breeding habitat is not considered present within the subject land based on:<br>• The species typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NPWS 2003).<br>• The species seems most abundant in the largest remnants but also occurs at low density in fragmented habitat, where it uses healthy riparian woodland or gallery forest amid extensive, diverse woodland supporting a diversity of native prey. (Debus 2001).<br>• Sometimes able to successfully breed along timbered watercourses in heavily cleared |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. (BioNet 2024).<br>• It was also noted that Barking Owl habitat has a strong spatial association with hydrological features such as rivers and wetlands (Taylor & Kirsten 1999).<br>Species not recorded during targeted surveys. |
| ***Polytelis anthopeplus monarchoides*** Regent Parrot (eastern subspecies) | Vu | En | Species (Breeding) | In southeast Australia they are found in riparian or littoral River Red Gum forests, adjacent Black Box woodlands, and in nearby open mallee woodland or shrubland, as well as Belah, Buloke or Slender Cypress Pine. Moves between the riverine nesting habitat and foraging sites along corridors of natural vegetation. | Nil | No | No | No (Breeding) | Species excluded from candidate species listed based on habitat constraints. Refer to Section 4.3. |
| **Mammals** | | | | | | | | | |
| ***Lasiorhinus latifrons*** Southern Hairy-nosed Wombat | - | En | Species | Occurs in semi-arid grasslands and open woodlands, including plant communities such as mallee woodland and Belah with a Bluebush understorey. The diet is restricted to a variety of grasses, and its distribution is related to the p | Nil | No | No | No | No wombat burrow recorded during surveys, species noted in BioNet as having a fragmented and contracted distribution in NSW, once being regarded as common in south-western NSW but the current size of this population is unknown. Only known form two BioNet records in NSW both >200 kms to the north-west of the subject land. |
| ***Pseudomys desertor*** Desert Mouse | - | CE | Species | This species occurs within the arid areas in sparsely vegetated sand dune or plains dominated by spinifex. They have also been recorded in riparian scrub and woodland along the Murray and Darling rivers. Predominantly eats leaves and shoots. | Nil | No | No | No | Suitable habitat for the specie is not present in the subject land. Habitat associated with this species (i.e. PCT 163) is generally degraded and grazed within the subject land. Highly restricted and very rare species within NSW. BioNet records 140km north- |

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| Species | Status | | BAM predicted SCS | Habitat Description | Potential occurrence in subject land | BAM Candidate species | Survey required/ undertaken | Potential for impact | Conclusion and rationale |
|---|---|---|---|---|---|---|---|---|---|
| | EPBC | BC | | | | | | | |
| | | | | | | | | | west noted as extinct, next closest records are 270 kms north-west, or 600 kms NNW |
| **Amphibians** | | | | | | | | | |
| ***Neobatrachus pictus*** Painted Burrowing Frog | - | En | Species | Found in only 2 locations in NSW - 120 km north-west of Mildura on Scotia Sanctuary, adjacent to the South Australian border and 22 km west of Pooncarie. It breeds after summer rains in grassy marshes, lagoons, roadside pools, dams ditches and claypans. | Nil | No | No | No | Limited potential refuge habitat for the species within the subject land is degraded and isolated from areas of higher quality habitat associated with larger waterbodies, flood-outs and depressions. |
| **Reptiles** | | | | | | | | | |
| ***Lucasium stenodactylum*** Crowned Gecko | - | Vu | Species | Widespread through a variety of arid and semi-arid habitats in SA, NT and WA. In NSW only known from four sites in far west. Habitat requirements are poorly known. | Nil | No | No | No | BioNet notes species is only known from four separate locations in far west NSW, no records are closer than 250 km from the subject land, with some >600km. Furthermore BioNet notes the species has been reported from red sand habitats and elsewhere from savannah woodland and stony areas with shrubs. these habitats are not present within the subject land. |

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# Appendix 3. Flora

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# Appendix 3.1. BAM plot field data

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| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Native species | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Carpobrotus spp. | - | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 5 |
| Aizoaceae | Tetragonia eremaea | - | 0.1 | 10 | 2 | 500 | 0.1 | 5 | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia moorei | - | | | | | | | | | 0.1 | 10 | | | 0.5 | 20 | 0.5 | 200 | | | 1 | 50 | | | 1 | 100 |
| Aizoaceae | Tetragonia tetragonioides | New Zealand Spinach | | | | | | | | | | | 10 | 20 | | | | | 5 | 30 | | | | | | |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed | | | | | | | | | | | | | | | | | 0.2 | 5 | 0.1 | | 1 | 50 | | |
| Amaranthaceae | Alternanthera spp. | Joyweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus nobilis | Yellowtails | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus spathulatus f. spathulatus | Pussy-tails | | | | | | | | | | | | | | | | | | | | | | | | |
| Anthericaceae | Thysanotus baueri | Fringe-lily | | | | | | | | | | | | | | | | | | | | | | | | |
| Apiaceae | Daucus glochidiatus | Native Carrot | | | | | 0.1 | 50 | | | | | | | | | | | | | | | | | | |
| Asparagaceae | Arthropodium minus | Small Vanilla Lily | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 |
| Asphodelaceae | Bulbine semibarbata | Wild Onion | | | | | | | | | | | | | 0.1 | 5 | | | 0.2 | 5 | 0.2 | 100 | | | | |
| Asteraceae | Brachyscome lineariloba | Hard-headed Daisy | 0.1 | 10 | 0.2 | 300 | 0.1 | 50 | | | | | | | | | | | 0.5 | 200 | 0.1 | 100 | | | 0.1 | 20 |
| Asteraceae | Brachyscome spp. | - | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis erinacea | Tangled Burr-daisy | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis hispidula | Bogan Flea | 0.1 | 10 | 0.1 | 50 | 0.1 | 100 | | | | | 0.1 | 20 | | | 0.1 | 100 | 0.1 | 20 | 0.1 | 100 | | | | |
| Asteraceae | Centipeda cunninghamii | Common Sneezeweed | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | | | |
| Asteraceae | Chrysocephalum apiculatum | Common Everlasting | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Craspedia haplorrhiza | Billy Buttons | | | | | | | | | | | 0.1 | 5 | | | | | | | 0.1 | 20 | | | | |
| Asteraceae | Euchiton sphaericus | Star Cudweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma demissum | Moss Sunray | | | | | | | | | | | | | | | | | 0.2 | 50 | | | | | | |
| Asteraceae | Hyalosperma semisterile | - | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | | 0.1 | 5 |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Native species | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Carpobrotus spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia eremaea | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia moorei | - | | | | | 0.1 | 20 | | | | | | | | | | | | | | | | | 1 | 100 |
| Aizoaceae | Tetragonia tetragonioides | New Zealand Spinach | | | | | | | | | | | | | | | | | | | | | 0.2 | 20 | | |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Alternanthera spp. | Joyweed | | | | | | | 0.1 | 1 | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus nobilis | Yellowtails | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus spathulatus f. spathulatus | Pussy-tails | | | | | | | | | | | | | | | | | | | | | | | | |
| Anthericaceae | Thysanotus baueri | Fringe-lily | | | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | |
| Apiaceae | Daucus glochidiatus | Native Carrot | | | | | | | | | | | 0.1 | 10 | | | | | | | 0.1 | 10 | | | | |
| Asparagaceae | Arthropodium minus | Small Vanilla Lily | | | | | | | | | | | 0.1 | 5 | | | 0.1 | 5 | | | | | | | | |
| Asphodelaceae | Bulbine semibarbata | Wild Onion | 0.5 | 100 | | | | | | | | | | | | | | | 0.1 | 1 | | | 0.1 | 20 | | |
| Asteraceae | Brachyscome lineariloba | Hard-headed Daisy | 0.2 | 200 | | | | | 0.1 | 10 | | | | | | | | | | | 0.1 | 10 | | | | |
| Asteraceae | Brachyscome spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis erinacea | Tangled Burr-daisy | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis hispidula | Bogan Flea | 0.1 | 20 | | | 0.1 | 100 | 0.1 | 50 | 0.1 | 20 | 0.1 | 100 | | | | | | | 0.2 | 100 | | | | |
| Asteraceae | Centipeda cunninghamii | Common Sneezeweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Chrysocephalum apiculatum | Common Everlasting | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Craspedia haplorrhiza | Billy Buttons | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Euchiton sphaericus | Star Cudweed | | | | | | | | | | | | | | | | | | | | | 0.1 | 20 | | |
| Asteraceae | Hyalosperma demissum | Moss Sunray | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma semisterile | - | | | | | | | 0.1 | 10 | | | | | | | | | | | 0.1 | 10 | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Native species | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Carpobrotus spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia eremaea | - | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia moorei | - | | | 1 | 100 | | | 0.1 | 5 | 0.2 | 50 | 0.2 | 30 | 2 | 200 | | | | | | | | | |
| Aizoaceae | Tetragonia tetragonioides | New Zealand Spinach | | | | | 5 | 50 | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Alternanthera spp. | Joyweed | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus nobilis | Yellowtails | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus spathulatus f. spathulatus | Pussy-tails | | | | | | | | | | | | | | | | | | | | | | | |
| Anthericaceae | Thysanotus baueri | Fringe-lily | | | | | | | | | | | | | | | | | | | | | | | |
| Apiaceae | Daucus glochidiatus | Native Carrot | | | | | | | | | | | 0.1 | 10 | | | | | 0.1 | 4 | | | 0.1 | 20 | |
| Asparagaceae | Arthropodium minus | Small Vanilla Lily | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | | |
| Asphodelaceae | Bulbine semibarbata | Wild Onion | 0.1 | 1 | | | | | 0.1 | 10 | 0.1 | 50 | | | | | | | | | | | | | |
| Asteraceae | Brachyscome lineariloba | Hard-headed Daisy | 0.1 | 20 | 0.1 | 20 | | | 0.1 | 50 | 0.2 | 200 | 0.1 | 100 | | | 0.5 | 500 | 0.1 | 50 | 0.2 | 100 | | | |
| Asteraceae | Brachyscome spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis erinacea | Tangled Burr-daisy | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis hispidula | Bogan Flea | 0.1 | 50 | 0.1 | 50 | 0.1 | 20 | 0.1 | 100 | 0.1 | 100 | 0.1 | 100 | 0.1 | 50 | | | 0.1 | 50 | 0.1 | 50 | | | 0.1 |
| Asteraceae | Centipeda cunninghamii | Common Sneezeweed | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Chrysocephalum apiculatum | Common Everlasting | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Craspedia haplorrhiza | Billy Buttons | | | | | 0.1 | 5 | | | 0.1 | 50 | | | | | 1 | 100 | 0.2 | 20 | | | 0.5 | 50 | 0.1 |
| Asteraceae | Euchiton sphaericus | Star Cudweed | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma demissum | Moss Sunray | | | | | | | | | | | | | | | | | | | 2 | 500 | 0.1 | 20 | |
| Asteraceae | Hyalosperma semisterile | - | | | | | | | | | | | | | | | | | 0.2 | 200 | 15 | 2000 | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Native species | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Carpobrotus spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia eremaea | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia moorei | - | | | 1 | 100 | | | 0.2 | 20 | 1 | 50 | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia tetragonioides | New Zealand Spinach | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | | | 0.1 |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Alternanthera spp. | Joyweed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus nobilis | Yellowtails | | | | | 0.1 | 2 | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus spathulatus f. spathulatus | Pussy-tails | | | | | | | | | | | | | | | | | | | | | | | | | |
| Anthericaceae | Thysanotus baueri | Fringe-lily | | | | | | | | | | | | | | | | | | | | | | | | | |
| Apiaceae | Daucus glochidiatus | Native Carrot | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | |
| Asparagaceae | Arthropodium minus | Small Vanilla Lily | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asphodelaceae | Bulbine semibarbata | Wild Onion | | | | | | | | | | | | | 0.1 | 5 | 0.1 | 1 | | | | | 0.1 | 1 | 0.1 | 10 | |
| Asteraceae | Brachyscome lineariloba | Hard-headed Daisy | | | | | | | | | 0.1 | 50 | | | | | 0.2 | 40 | | | | | | | | | |
| Asteraceae | Brachyscome spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis erinacea | Tangled Burr-daisy | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis hispidula | Bogan Flea | 50 | | | | 0.1 | 10 | | | 0.1 | 20 | | | | | | | | | | | | | | | |
| Asteraceae | Centipeda cunninghamii | Common Sneezeweed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Chrysocephalum apiculatum | Common Everlasting | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 20 | |
| Asteraceae | Craspedia haplorrhiza | Billy Buttons | 50 | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Euchiton sphaericus | Star Cudweed | | | | | | | | | | | 0.1 | 20 | | | 0.1 | 10 | 0.1 | 20 | | | | | 0.1 | 10 | |
| Asteraceae | Hyalosperma demissum | Moss Sunray | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma semisterile | - | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Native species | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Carpobrotus spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia eremaea | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia moorei | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia tetragonioides | New Zealand Spinach | 5 | 25 | 100 | | | | | 0.1 | 5 | | | | | | | | | | | | | 0.1 | 5 | | | |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed | | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 20 | |
| Amaranthaceae | Alternanthera spp. | Joyweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus nobilis | Yellowtails | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus spathulatus f. spathulatus | Pussy-tails | | | | | | | | | | | | | 0.1 | 2 | | | | | | | | | | | | |
| Anthericaceae | Thysanotus baueri | Fringe-lily | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Apiaceae | Daucus glochidiatus | Native Carrot | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Asparagaceae | Arthropodium minus | Small Vanilla Lily | | | | 0.1 | 5 | | | | | 0.1 | 20 | | | | | | | | | | | | | | | |
| Asphodelaceae | Bulbine semibarbata | Wild Onion | | 0.1 | 5 | | | 0.1 | 5 | 0.1 | 10 | 0.1 | 20 | | | | | | | | 0.1 | 5 | 0.1 | 10 | | | | |
| Asteraceae | Brachyscome lineariloba | Hard-headed Daisy | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Brachyscome spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis erinacea | Tangled Burr-daisy | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis hispidula | Bogan Flea | | | | | | | | | | | | | 0.1 | 100 | | | 0.1 | 20 | | | | | | | | |
| Asteraceae | Centipeda cunninghamii | Common Sneezeweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Chrysocephalum apiculatum | Common Everlasting | | | | | | | | | | 0.2 | 20 | | | | | | | | 2 | 500 | | | | | | |
| Asteraceae | Craspedia haplorrhiza | Billy Buttons | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Euchiton sphaericus | Star Cudweed | | | | 0.1 | 20 | | | 0.1 | 20 | 0.1 | 20 | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma demissum | Moss Sunray | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma semisterile | - | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Native species | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Carpobrotus spp. | - | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia eremaea | - | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia moorei | - | | | | | | | | | | | | | | | | |
| Aizoaceae | Tetragonia tetragonioides | New Zealand Spinach | | | | | | | | | | | | | | | | |
| Amaranthaceae | Alternanthera denticulata | Lesser Joyweed | | | | | | | | | | | | | | | | |
| Amaranthaceae | Alternanthera spp. | Joyweed | | | | | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus nobilis | Yellowtails | | | 0.1 | 20 | | | | | | | | | | | | |
| Amaranthaceae | Ptilotus spathulatus f. spathulatus | Pussy-tails | | | | | | | | | | | | | | | | |
| Anthericaceae | Thysanotus baueri | Fringe-lily | 0.1 | 2 | | | | | | | | | | | | | | |
| Apiaceae | Daucus glochidiatus | Native Carrot | | | | | | | | | | | | | | | | |
| Asparagaceae | Arthropodium minus | Small Vanilla Lily | | | | | | | | | | | | | | | | |
| Asphodelaceae | Bulbine semibarbata | Wild Onion | | | | | | | | | | | | | | | | |
| Asteraceae | Brachyscome lineariloba | Hard-headed Daisy | | | | | | | | | | | | | | | | |
| Asteraceae | Brachyscome spp. | - | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis erinacea | Tangled Burr-daisy | | | | | | | | | | | | | | | | |
| Asteraceae | Calotis hispidula | Bogan Flea | | | | | | | | | | | | | | | | |
| Asteraceae | Centipeda cunninghamii | Common Sneezeweed | | | | | | | | | | | | | | | | |
| Asteraceae | Chrysocephalum apiculatum | Common Everlasting | | | | | | | | | | | | | | | | |
| Asteraceae | Craspedia haplorrhiza | Billy Buttons | | | | | | | | | | | | | | | | |
| Asteraceae | Euchiton sphaericus | Star Cudweed | 0.1 | 5 | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma demissum | Moss Sunray | | | | | | | | | | | | | | | | |
| Asteraceae | Hyalosperma semisterile | - | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Leiocarpa leptolepis | Pale Plover-daisy | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Leiocarpa tomentosa | Woolly Plover-daisy | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria cunninghamii | Bush Minuria | | | | | | | | | | | 0.5 | 2 | | | | | | | | | | | | |
| Asteraceae | Minuria leptophylla | - | | | | | | | 10 | 1000 | | | | | | | | | | | | | | | | |
| Asteraceae | Myriocephalus rhizocephalus | Woolly-heads | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Pseudognaphalium luteoalbum | Jersey Cudweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe corymbiflora | Small White Sunray | | | 0.1 | 10 | | | 10 | 100 | | | 0.1 | 5 | | | | | 1 | 200 | 0.4 | 100 | | | 0.1 | 5 |
| Asteraceae | Rhodanthe floribunda | Common White Sunray | | | | | | | 0.1 | 5 | | | | | | | | | | | 0.1 | 20 | | | | |
| Asteraceae | Rhodanthe moschata | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe pygmaea | Pigmy Sunray | | | | | | | 0.2 | 500 | | | | | | | | | | | | | | | | |
| Asteraceae | Senecio glossanthus | Streaked Poverty Bush | | | | | 0.1 | 5 | | | | | 0.1 | 5 | | | | | 0.1 | 2 | | | | | | |
| Asteraceae | Stuartina muelleri | Spoon Cudweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cervicularis var. cervicularis | - | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cuneata | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia spp. | Fuzzweed | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | |
| Boraginaceae | Omphalolappula concava | Burr Stickseed | | | 0.1 | 5 | | | 0.1 | 20 | | | | | | | | | | | | | | | | |
| Brassicaceae | Arabidella nasturtium | - | | | | | | | 0.2 | 1000 | | | | | | | | | | | | | | | | |
| Brassicaceae | Lepidium phlebopetalum | Veined Peppercress | | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia fluminalis | River Bluebell | | | | | | | | | | | | | | | | | | | | | 0.1 | 20 | | |
| Campanulaceae | Wahlenbergia gracilis | Sprawling Bluebell | | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia spp. | Bluebell | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Leiocarpa leptolepis | Pale Plover-daisy | | | | | | | 0.1 | 1 | | | | | | | 0.1 | 2 | | | | | | | | |
| Asteraceae | Leiocarpa tomentosa | Woolly Plover-daisy | | | | | | | | | | | | | 0.1 | 2 | | | | | | | | | | |
| Asteraceae | Minuria cunninghamii | Bush Minuria | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria leptophylla | - | | | | | | | 0.5 | 30 | 0.1 | 10 | 1 | 200 | | | 2 | 100 | 0.1 | 5 | | | | | | |
| Asteraceae | Myriocephalus rhizocephalus | Woolly-heads | | | | | | | | | | | | | | | | | | | 0.1 | 10 | | | | |
| Asteraceae | Pseudognaphalium luteoalbum | Jersey Cudweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe corymbiflora | Small White Sunray | | | | | | | 0.2 | 20 | | | 0.1 | 10 | | | | | | | 0.1 | 10 | | | | |
| Asteraceae | Rhodanthe floribunda | Common White Sunray | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe moschata | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe pygmaea | Pigmy Sunray | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Senecio glossanthus | Streaked Poverty Bush | 0.1 | 10 | | | | | 0.1 | 2 | | | 0.1 | 5 | | | | | | | | | | | | |
| Asteraceae | Stuartina muelleri | Spoon Cudweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cervicularis var. cervicularis | - | | | | | | | | | | | 0.2 | 20 | | | | | | | | | | | | |
| Asteraceae | Vittadinia cuneata | - | | | | | | | | | | | | | | | 0.5 | 50 | 0.1 | 10 | | | 0.1 | 5 | | |
| Asteraceae | Vittadinia spp. | Fuzzweed | | | 0.5 | 70 | | | | | 0.1 | 10 | 0.1 | 5 | | | | | | | | | | | | |
| Boraginaceae | Omphalolappula concava | Burr Stickseed | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Arabidella nasturtium | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Lepidium phlebopetalum | Veined Peppercress | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia fluminalis | River Bluebell | | | | | | | | | | | | | | | 0.1 | 20 | 0.1 | 20 | | | 0.1 | 20 | | |
| Campanulaceae | Wahlenbergia gracilis | Sprawling Bluebell | | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia spp. | Bluebell | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Asteraceae | Leiocarpa leptolepis | Pale Plover-daisy | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 | |
| Asteraceae | Leiocarpa tomentosa | Woolly Plover-daisy | | | | | | | | | | | | | | | | | | | | | 0.1 | 5 | |
| Asteraceae | Minuria cunninghamii | Bush Minuria | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria leptophylla | - | | | | | | | | | | | | | | | | | 0.1 | 1 | | | 2 | 100 | |
| Asteraceae | Myriocephalus rhizocephalus | Woolly-heads | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | | |
| Asteraceae | Pseudognaphalium luteoalbum | Jersey Cudweed | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe corymbiflora | Small White Sunray | 0.1 | 10 | 0.1 | 10 | | | | | 0.4 | 100 | 0.5 | 50 | | | 0.1 | 10 | 0.1 | 5 | 10 | 500 | 0.1 | 20 | 0.1 |
| Asteraceae | Rhodanthe floribunda | Common White Sunray | | | | | | | | | | | | | | | 0.1 | 10 | | | | | | | |
| Asteraceae | Rhodanthe moschata | - | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe pygmaea | Pigmy Sunray | | | | | | | | | | | | | | | 0.2 | 500 | | | 0.5 | 500 | | | |
| Asteraceae | Senecio glossanthus | Streaked Poverty Bush | | | | | | | | | 0.1 | 50 | 0.2 | 20 | | | | | | | | | | | |
| Asteraceae | Stuartina muelleri | Spoon Cudweed | | | | | | | | | | | | | 0.1 | 10 | | | | | | | | | |
| Asteraceae | Vittadinia cervicularis var. cervicularis | - | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cuneata | - | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia spp. | Fuzzweed | | | | | | | | | 0.1 | 50 | | | | | | | 0.1 | 2 | 0.2 | 30 | 0.1 | 5 | 0.5 |
| Boraginaceae | Omphalolappula concava | Burr Stickseed | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | |
| Brassicaceae | Arabidella nasturtium | - | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Lepidium phlebopetalum | Veined Peppercress | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia fluminalis | River Bluebell | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia gracilis | Sprawling Bluebell | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia spp. | Bluebell | | | | | | | | | | | 0.1 | 5 | 0.1 | 1 | | | | | 0.1 | 20 | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Asteraceae | Leiocarpa leptolepis | Pale Plover-daisy | | | | | | | | | | | | | | | | | 0.1 | 20 | | | | | | | |
| Asteraceae | Leiocarpa tomentosa | Woolly Plover-daisy | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria cunninghamii | Bush Minuria | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria leptophylla | - | | | | | | | | | 0.1 | 10 | | | | | | | 20 | 500 | | | | | | | |
| Asteraceae | Myriocephalus rhizocephalus | Woolly-heads | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Pseudognaphalium luteoalbum | Jersey Cudweed | | | | | | | | | | | | | | | | | | | | | 0.1 | 6 | | | |
| Asteraceae | Rhodanthe corymbiflora | Small White Sunray | 5 | | | | | | | | | | 0.1 | 20 | | | 0.2 | 50 | | | | | | | | | |
| Asteraceae | Rhodanthe floribunda | Common White Sunray | | | | | | | | | | | | | | | 0.2 | 50 | | | | | | | | | |
| Asteraceae | Rhodanthe moschata | - | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe pygmaea | Pigmy Sunray | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Senecio glossanthus | Streaked Poverty Bush | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Stuartina muelleri | Spoon Cudweed | | | | | | | | | | | | | 0.1 | 20 | | | | | | | | | | | |
| Asteraceae | Vittadinia cervicularis var. cervicularis | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cuneata | - | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 20 | 15 | 500 | | | 0.1 | 2 | 0.1 | 1 | |
| Asteraceae | Vittadinia spp. | Fuzzweed | 20 | | | | | | | | | | | | | | | | | | | | | | | | |
| Boraginaceae | Omphalolappula concava | Burr Stickseed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Arabidella nasturtium | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Lepidium phlebopetalum | Veined Peppercress | | | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia fluminalis | River Bluebell | | | | | | | | | | | | | | | 0.1 | 2 | | | | | 0.1 | 20 | | | 0.2 |
| Campanulaceae | Wahlenbergia gracilis | Sprawling Bluebell | | | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia spp. | Bluebell | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Leiocarpa leptolepis | Pale Plover-daisy | | | | | | | | | | | 0.2 | 20 | | | | | | | | | | | | | | |
| Asteraceae | Leiocarpa tomentosa | Woolly Plover-daisy | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | | | |
| Asteraceae | Minuria cunninghamii | Bush Minuria | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria leptophylla | - | | | | | | | | | | | 5 | 50 | 0.5 | 20 | 0.2 | 10 | 0.1 | 3 | | | | | | | | |
| Asteraceae | Myriocephalus rhizocephalus | Woolly-heads | | | | | | | | | | | | | | | | | 0.1 | 20 | | | | | | | | |
| Asteraceae | Pseudognaphalium luteoalbum | Jersey Cudweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe corymbiflora | Small White Sunray | | | | | | | 0.1 | 20 | 0.1 | 50 | 0.1 | 20 | | | 0.1 | 5 | 0.1 | 5 | | | | | | | | |
| Asteraceae | Rhodanthe floribunda | Common White Sunray | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | | | | |
| Asteraceae | Rhodanthe moschata | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe pygmaea | Pigmy Sunray | | | | 0.5 | 200 | | | | | | 0.2 | 100 | 4 | 2000 | | | 0.1 | 20 | | | | | | | | |
| Asteraceae | Senecio glossanthus | Streaked Poverty Bush | | | | | | | | | | | | | | | 0.1 | 10 | | | | | | | | | | |
| Asteraceae | Stuartina muelleri | Spoon Cudweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cervicularis var. cervicularis | - | | | | | | | | | | | | | 1 | 100 | | | | | | | | | | | | |
| Asteraceae | Vittadinia cuneata | - | | | | 0.2 | 20 | 0.1 | 10 | | | | 0.5 | 100 | | | | | | | | | 0.1 | 5 | | | | |
| Asteraceae | Vittadinia spp. | Fuzzweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Boraginaceae | Omphalolappula concava | Burr Stickseed | | | | | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | |
| Brassicaceae | Arabidella nasturtium | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Lepidium phlebopetalum | Veined Peppercress | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia fluminalis | River Bluebell | 60 | 0.5 | 20 | 0.1 | 50 | | | | | | 0.1 | 5 | | | | | | | | | 0.1 | 10 | 0.1 | 10 | | |
| Campanulaceae | Wahlenbergia gracilis | Sprawling Bluebell | | | | | | 5 | 500 | | | | | | | | | | | | | | | | | | 0.2 | 50 |
| Campanulaceae | Wahlenbergia spp. | Bluebell | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Leiocarpa leptolepis | Pale Plover-daisy | 0.1 | 1 | | | | | | | | | | | | | | |
| Asteraceae | Leiocarpa tomentosa | Woolly Plover-daisy | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria cunninghamii | Bush Minuria | | | | | | | | | | | | | | | | |
| Asteraceae | Minuria leptophylla | - | | | | | | | | | | | | | | | | |
| Asteraceae | Myriocephalus rhizocephalus | Woolly-heads | | | | | | | | | | | | | | | | |
| Asteraceae | Pseudognaphalium luteoalbum | Jersey Cudweed | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe corymbiflora | Small White Sunray | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe floribunda | Common White Sunray | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe moschata | - | | | | | | | | | | | | | | | | |
| Asteraceae | Rhodanthe pygmaea | Pigmy Sunray | | | | | | | | | | | | | | | | |
| Asteraceae | Senecio glossanthus | Streaked Poverty Bush | | | | | | | | | | | | | | | | |
| Asteraceae | Stuartina muelleri | Spoon Cudweed | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cervicularis var. cervicularis | - | | | | | | | | | | | | | | | | |
| Asteraceae | Vittadinia cuneata | - | 0.1 | 6 | 0.1 | 1 | 0.1 | 1 | 0.1 | 1 | 0.1 | 5 | 0.1 | 1 | | | | |
| Asteraceae | Vittadinia spp. | Fuzzweed | | | | | | | | | | | | | | | | |
| Boraginaceae | Omphalolappula concava | Burr Stickseed | | | | | | | | | | | | | | | | |
| Brassicaceae | Arabidella nasturtium | - | | | | | | | | | | | | | | | | |
| Brassicaceae | Lepidium phlebopetalum | Veined Peppercress | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia fluminalis | River Bluebell | 0.1 | 10 | | | 0.2 | 20 | | | 0.3 | 20 | | | | | | |
| Campanulaceae | Wahlenbergia gracilis | Sprawling Bluebell | | | | | | | | | | | | | | | | |
| Campanulaceae | Wahlenbergia spp. | Bluebell | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Campanulaceae | Wahlenbergia stricta | Tall Bluebell | | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergularia spp. | - | | | | | | | | | | | | | | | | | 0.5 | 200 | 0.1 | 100 | | | | |
| Casuarinaceae | Casuarina pauper | Black Oak | | | 15 | 3 | | | | | 7 | 3 | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex angulata | Fan Saltbush | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex eardleyae | Small Saltbush | 0.1 | 5 | 0.1 | 5 | | | | | 0.1 | 2 | 0.2 | 5 | | | 0.2 | 20 | | | 1 | 100 | | | 0.1 | 5 |
| Chenopodiaceae | Atriplex leptocarpa | Slender-fruit Saltbush | 0.1 | 5 | | | | | | | | | | | 0.1 | 10 | 0.5 | 30 | 3 | 50 | 0.5 | 20 | | | 0.1 | 5 |
| Chenopodiaceae | Atriplex lindleyi | Eastern Flat-top Saltbush | 0.1 | 1 | | | | | | | | | 0.5 | 5 | 0.2 | 20 | | | 1 | 20 | 1 | 30 | 3 | 50 | | |
| Chenopodiaceae | Atriplex semibaccata | Creeping Saltbush | | | | | | | | | 0.1 | 3 | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium curvispicatum | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium desertorum | Desert Goosefoot | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium spp. | Goosefoot, Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dissocarpus paradoxus | Cannonball Burr | | | | | 0.1 | 10 | | | 1 | 30 | 0.2 | 3 | | | | | | | | | 0.1 | 5 | | |
| Chenopodiaceae | Dysphania cristata | Crested Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dysphania melanocarpa | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush | 0.1 | 5 | 0.1 | 5 | 0.1 | 1000 | | | 0.5 | 10 | 1 | 20 | | | 0.1 | 5 | 1 | 10 | 2 | 40 | 10 | 50 | 0.1 | 10 |
| Chenopodiaceae | Enchylaena tomentosa | Ruby Saltbush | 7 | 100 | | | 1 | 20 | 0.1 | 5 | 2 | 30 | 2 | 10 | 0.2 | 10 | 0.1 | 5 | | | | | 1 | 20 | 0.5 | 10 |
| Chenopodiaceae | Maireana aphylla | Cotton Bush | | | | | | | | | 0.2 | 1 | | | | | 0.1 | 1 | | | | | 0.3 | 1 | | |
| Chenopodiaceae | Maireana brevifolia | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana decalvans | Black Cotton Bush | 0.1 | 1 | 3 | 40 | 7 | 50 | | | 3 | 20 | 0.2 | 3 | 0.5 | 10 | 0.2 | 5 | | | | | 1 | 20 | | |
| Chenopodiaceae | Maireana erioclada | - | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 |
| Chenopodiaceae | Maireana excavata | - | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Campanulaceae | Wahlenbergia stricta | Tall Bluebell | | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergularia spp. | - | 0.1 | 10 | | | | | 0.2 | 20 | | | | | | | | | | | 0.1 | 5 | | | 0.1 | 5 |
| Casuarinaceae | Casuarina pauper | Black Oak | | | | | | | | | | | | | | | | | | | | | | | 20 | 10 |
| Chenopodiaceae | Atriplex angulata | Fan Saltbush | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex eardleyae | Small Saltbush | 2 | 100 | | | | | 0.1 | 1 | | | | | | | | | | | 0.1 | 5 | | | 0.1 | 20 |
| Chenopodiaceae | Atriplex leptocarpa | Slender-fruit Saltbush | 2 | 100 | | | | | 0.1 | 3 | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex lindleyi | Eastern Flat-top Saltbush | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 5 |
| Chenopodiaceae | Atriplex semibaccata | Creeping Saltbush | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium curvispicatum | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium desertorum | Desert Goosefoot | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium spp. | Goosefoot, Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dissocarpus paradoxus | Cannonball Burr | | | 0.1 | 3 | 0.5 | 30 | | | 0.1 | 5 | | | 0.5 | 30 | 0.1 | 5 | 0.1 | 5 | 0.1 | 2 | | | | |
| Chenopodiaceae | Dysphania cristata | Crested Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dysphania melanocarpa | - | | | | | | | | | | | | | | | | | | | | | 0.2 | 20 | | |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush | 0.1 | 10 | | | | | 0.1 | 3 | 0.1 | 5 | | | 0.2 | 10 | | | 0.1 | 5 | | | | | 0.1 | 5 |
| Chenopodiaceae | Enchylaena tomentosa | Ruby Saltbush | | | | | | | 0.5 | 10 | 1 | 50 | 0.5 | 5 | | | 5 | 40 | 0.5 | 20 | 1 | 5 | 5 | 20 | 10 | 100 |
| Chenopodiaceae | Maireana aphylla | Cotton Bush | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana brevifolia | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana decalvans | Black Cotton Bush | 2 | 20 | 1 | 10 | 5 | 20 | 0.1 | 1 | 0.2 | 5 | | | | | | | | | | | 0.1 | 5 | | |
| Chenopodiaceae | Maireana erioclada | - | | | | | | | 0.1 | 1 | | | 0.1 | 5 | | | | | | | | | | | | |
| Chenopodiaceae | Maireana excavata | - | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Campanulaceae | Wahlenbergia stricta | Tall Bluebell | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergularia spp. | - | | | | | | | | | 1 | 500 | | | | | 0.1 | 10 | | | 0.2 | 50 | | | |
| Casuarinaceae | Casuarina pauper | Black Oak | 15 | 3 | 35 | 4 | 15 | 10 | 15 | 4 | 5 | 2 | 20 | 1 | | | | | | | | | | | |
| Chenopodiaceae | Atriplex angulata | Fan Saltbush | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex eardleyae | Small Saltbush | 0.2 | 50 | 1 | 50 | 1 | 20 | | | 0.3 | 20 | | | | | 0.1 | 5 | | | | | | | |
| Chenopodiaceae | Atriplex leptocarpa | Slender-fruit Saltbush | | | | | | | | | 0.2 | 20 | 2 | 40 | | | 0.1 | 2 | | | | | | | |
| Chenopodiaceae | Atriplex lindleyi | Eastern Flat-top Saltbush | 0.1 | 10 | 0.1 | 5 | | | | | 0.2 | 20 | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex semibaccata | Creeping Saltbush | | | | | 0.2 | 5 | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium curvispicatum | - | | | | | | | | | | | | | | | | | | | | | | | 0.2 |
| Chenopodiaceae | Chenopodium desertorum | Desert Goosefoot | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium spp. | Goosefoot, Crumbweed | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dissocarpus paradoxus | Cannonball Burr | | | 1 | 50 | | | 0.5 | 100 | 0.3 | 20 | | | | | | | 0.1 | 2 | | | 0.1 | 5 | 0.5 |
| Chenopodiaceae | Dysphania cristata | Crested Crumbweed | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dysphania melanocarpa | - | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush | 0.1 | 5 | 0.1 | 10 | 3 | 30 | 0.1 | 5 | 1 | 50 | 0.5 | 20 | | | | | | | | | | | |
| Chenopodiaceae | Enchylaena tomentosa | Ruby Saltbush | 1 | 30 | 0.1 | 5 | 5 | 40 | 1 | 20 | 2 | 30 | 0.5 | 5 | 0.2 | 5 | | | 2 | 20 | 2 | 30 | | | 3 |
| Chenopodiaceae | Maireana aphylla | Cotton Bush | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana brevifolia | - | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana decalvans | Black Cotton Bush | | | 0.5 | 10 | 0.5 | 7 | | | 1 | 20 | 0.5 | 5 | 2 | 5 | | | 1 | 5 | | | | | |
| Chenopodiaceae | Maireana erioclada | - | | | | | | | | | | | | | | | | | | | 0.2 | 5 | | | |
| Chenopodiaceae | Maireana excavata | - | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Campanulaceae | Wahlenbergia stricta | Tall Bluebell | | | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergularia spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Casuarinaceae | Casuarina pauper | Black Oak | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex angulata | Fan Saltbush | | | | | | | | | | | | | | | | | | | | | | | | | 0.2 |
| Chenopodiaceae | Atriplex eardleyae | Small Saltbush | | 0.1 | 5 | | | | | 0.1 | 10 | | | 0.1 | 10 | 0.2 | 50 | | | | | 0.1 | 10 | 5 | 50 | 0.4 |
| Chenopodiaceae | Atriplex leptocarpa | Slender-fruit Saltbush | | | | 0.1 | 2 | | | | | | | 0.1 | 5 | 0.1 | 1 | | | | | | | 2 | 5 | |
| Chenopodiaceae | Atriplex lindleyi | Eastern Flat-top Saltbush | | | | | | | | | | | | | | 0.5 | 10 | | | | | | | | | |
| Chenopodiaceae | Atriplex semibaccata | Creeping Saltbush | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium curvispicatum | - | 10 | | | 1 | 100 | | | | | | | | | | | | | | | | | | | | 0.1 |
| Chenopodiaceae | Chenopodium desertorum | Desert Goosefoot | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium spp. | Goosefoot, Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dissocarpus paradoxus | Cannonball Burr | 20 | 0.2 | 20 | | | | | | | | | | | | | 0.1 | 20 | | | | | | | | 0.1 |
| Chenopodiaceae | Dysphania cristata | Crested Crumbweed | | | | | | | | | | | | | | | | | | 0.1 | 20 | | | | | | |
| Chenopodiaceae | Dysphania melanocarpa | - | | | | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush | | | | | | | | 0.1 | 5 | 0.2 | 5 | 0.5 | 5 | | | | | 0.1 | 10 | 0.2 | 2 | | | | 1 |
| Chenopodiaceae | Enchylaena tomentosa | Ruby Saltbush | 30 | 0.1 | 5 | 1 | 100 | 5 | 70 | 5 | 50 | 0.5 | 20 | 0.1 | 5 | | | 0.3 | 20 | | | 2 | 20 | 0.2 | 10 | 2 | |
| Chenopodiaceae | Maireana aphylla | Cotton Bush | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana brevifolia | - | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana decalvans | Black Cotton Bush | | 0.1 | 5 | | | | | 0.2 | 10 | | | 0.1 | 10 | 0.1 | 10 | | | 2 | 10 | | | 0.1 | 2 | 10 | |
| Chenopodiaceae | Maireana erioclada | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana excavata | - | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Campanulaceae | Wahlenbergia stricta | Tall Bluebell | | 0.2 | 10 | | | | | | | 0.1 | 20 | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergularia spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Casuarinaceae | Casuarina pauper | Black Oak | | 15 | 20 | | | | | | | | | | | | | | 5 | 1 | | | | | | | | |
| Chenopodiaceae | Atriplex angulata | Fan Saltbush | 5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex eardleyae | Small Saltbush | 20 | | | | | 0.1 | 5 | 0.1 | 10 | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex leptocarpa | Slender-fruit Saltbush | | | | | | | | 1 | 10 | | | | | | | | | | | | | | | 0.1 | 10 | |
| Chenopodiaceae | Atriplex lindleyi | Eastern Flat-top Saltbush | | | | | | | | 0.1 | 10 | 2 | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex semibaccata | Creeping Saltbush | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium curvispicatum | - | 3 | 0.1 | 5 | | | | | | | | | | | | | | | | | | | 5 | 10 | | | |
| Chenopodiaceae | Chenopodium desertorum | Desert Goosefoot | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium spp. | Goosefoot, Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dissocarpus paradoxus | Cannonball Burr | 1 | 0.1 | 1 | 0.1 | 2 | 0.2 | 20 | | | 2 | 50 | | | | | | 0.1 | 2 | | | | | | | | |
| Chenopodiaceae | Dysphania cristata | Crested Crumbweed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dysphania melanocarpa | - | | | | 0.1 | 5 | | | 0.1 | 1 | | | | | | | | | | | | 0.2 | 50 | | | | |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush | 30 | 0.1 | 1 | | | 0.1 | 5 | 1 | 10 | | | | | 0.1 | 5 | | | 0.2 | 5 | | | | | | | |
| Chenopodiaceae | Enchylaena tomentosa | Ruby Saltbush | 20 | 1 | 20 | 1 | 20 | 2 | 50 | 0.1 | 5 | 2 | 50 | 0.2 | 5 | 2 | 20 | 0.1 | 1 | | | 0.1 | 2 | 2 | 20 | 0.1 | 10 | |
| Chenopodiaceae | Maireana aphylla | Cotton Bush | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana brevifolia | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana decalvans | Black Cotton Bush | 40 | | | 0.2 | 10 | 0.2 | 20 | 0.1 | 1 | 0.2 | 20 | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana erioclada | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana excavata | - | 6 | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Campanulaceae | Wahlenbergia stricta | Tall Bluebell | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergularia spp. | - | | | | | | | | | | | | | | | | |
| Casuarinaceae | Casuarina pauper | Black Oak | | | | | | | | | 30 | 10 | | | | | 4 | 1 |
| Chenopodiaceae | Atriplex angulata | Fan Saltbush | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex eardleyae | Small Saltbush | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex leptocarpa | Slender-fruit Saltbush | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Atriplex lindleyi | Eastern Flat-top Saltbush | | | 0.4 | 10 | | | | | 0.3 | 10 | | | 0.1 | 10 | | |
| Chenopodiaceae | Atriplex semibaccata | Creeping Saltbush | | | 0.1 | 2 | 0.2 | 3 | | | | | 3 | 30 | 0.3 | 20 | 1 | 30 |
| Chenopodiaceae | Chenopodium curvispicatum | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium desertorum | Desert Goosefoot | | | | | | | 0.1 | 1 | | | | | | | | |
| Chenopodiaceae | Chenopodium spp. | Goosefoot, Crumbweed | | | | | 0.3 | 10 | | | | | | | | | | |
| Chenopodiaceae | Dissocarpus paradoxus | Cannonball Burr | | | | | | | | | 0.1 | 1 | | | 0.1 | 3 | | |
| Chenopodiaceae | Dysphania cristata | Crested Crumbweed | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Dysphania melanocarpa | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Einadia nutans | Climbing Saltbush | | | 0.5 | 5 | | | 0.1 | 1 | 0.2 | 5 | 0.1 | 2 | 0.1 | 1 | | |
| Chenopodiaceae | Enchylaena tomentosa | Ruby Saltbush | 2 | 20 | 0.3 | 2 | 1 | 5 | 2 | 10 | 6 | 40 | 5 | 40 | 0.4 | 10 | 0.1 | 2 |
| Chenopodiaceae | Maireana aphylla | Cotton Bush | | | 0.3 | 1 | | | 0.2 | 2 | | | | | | | | |
| Chenopodiaceae | Maireana brevifolia | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana decalvans | Black Cotton Bush | | | 4 | 30 | 0.5 | 4 | 4 | 30 | 10 | 60 | 0.5 | 10 | 0.2 | 5 | | |
| Chenopodiaceae | Maireana erioclada | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana excavata | - | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Chenopodiaceae | Maireana pentagona | Hairy Bluebush, Slender Fissure-weed | 0.1 | 50 | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | |
| Chenopodiaceae | Maireana sclerolaenoides | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Malacocera tricornis | Soft Horns | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum | Water Weed | | | | | | | | | | | | | | | | | 0.1 | 2 | 0.5 | 30 | | | | |
| Chenopodiaceae | Osteocarpum acropterum var. acropterum | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Rhagodia spinescens | Thorny Saltbush | 0.5 | 5 | 0.2 | 1 | 10 | 20 | 0.1 | 1 | 5 | 10 | 15 | 20 | | | 0.2 | 3 | 5 | 20 | 1 | 5 | 15 | 30 | 15 | 40 |
| Chenopodiaceae | Salsola australis | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Salsola tragus | Buckbush,Soft Rolpoly, Saltwort | | | | | | | 0.1 | 5 | | | 0.1 | 1 | | | | | 0.2 | 5 | | | | | | |
| Chenopodiaceae | Sclerolaena bicornis | Goathead Burr | | | | | | | | | | | | | | | | | | | | | 0.1 | 20 | | |
| Chenopodiaceae | Sclerolaena brachyptera | Short-winged Copperburr | | | 0.1 | 10 | | | 1 | 100 | | | | | | | | | 5 | 50 | 0.5 | 100 | 0.1 | 20 | 0.1 | 5 |
| Chenopodiaceae | Sclerolaena diacantha | Grey Copperburr | | | 1 | 200 | 2 | 500 | 0.1 | 5 | 5 | 200 | | | | | | | | | 7 | 100 | 0.1 | 20 | 0.1 | 20 |
| Chenopodiaceae | Sclerolaena divaricata | Tangled Copperburr | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena eriacantha | Silky Copperburr | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. semiglabra | Black Rolypoly | | | | | | | | | | | | | | | | | 5 | 10 | 0.1 | 3 | | | | |
| Chenopodiaceae | Sclerolaena muricata var. villosa | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena obliquicuspis | - | 1 | 50 | 0.2 | 40 | 0.5 | 100 | | | | | | | | | | | | | | | | | 0.1 | 10 |
| Chenopodiaceae | Sclerolaena stelligera | Star Copperburr | | | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | |
| Chenopodiaceae | Sclerolaena tricuspis | Giant Redburr | | | | | | | | | | | | | | | | | | | 0.2 | 1 | 2 | 20 | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Chenopodiaceae | Maireana pentagona | Hairy Bluebush, Slender Fissure-weed | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana sclerolaenoides | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Malacocera tricornis | Soft Horns | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum | Water Weed | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | |
| Chenopodiaceae | Osteocarpum acropterum var. acropterum | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Rhagodia spinescens | Thorny Saltbush | 10 | 20 | 0.1 | 5 | 0.1 | 5 | 15 | 40 | 15 | 30 | | | 0.5 | 10 | | | 0.1 | 1 | 1 | 5 | 0.2 | 5 | 1 | 5 |
| Chenopodiaceae | Salsola australis | - | | | | | | | | | | | | | | | | | 1 | 50 | | | | | | |
| Chenopodiaceae | Salsola tragus | Buckbush,Soft Rolpoly, Saltwort | | | | | | | | | | | 0.1 | 1 | 10 | 30 | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena bicornis | Goathead Burr | | | | | | | | | | | | | | | 0.2 | 20 | | | | | | | | |
| Chenopodiaceae | Sclerolaena brachyptera | Short-winged Copperburr | | | | | | | 0.2 | 10 | | | | | | | | | 0.1 | 1 | 0.1 | 2 | | | 0.2 | 100 |
| Chenopodiaceae | Sclerolaena diacantha | Grey Copperburr | | | 5 | 30 | | | 1 | 40 | 1 | 40 | 0.1 | 5 | | | 5 | 100 | 1 | 50 | 2 | 100 | 0.1 | 5 | 0.2 | 20 |
| Chenopodiaceae | Sclerolaena divaricata | Tangled Copperburr | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | | | |
| Chenopodiaceae | Sclerolaena eriacantha | Silky Copperburr | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata | Black Rolypoly | 0.2 | 5 | | | | | | | | | | | 1 | 5 | 0.1 | 5 | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. semiglabra | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. villosa | Black Rolypoly | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena obliquicuspis | - | 0.5 | 40 | | | 10 | 200 | | | 5 | 300 | 0.2 | 20 | | | | | | | 0.1 | 5 | | | 10 | 300 |
| Chenopodiaceae | Sclerolaena stelligera | Star Copperburr | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena tricuspis | Giant Redburr | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Chenopodiaceae | Maireana pentagona | Hairy Bluebush, Slender Fissure-weed | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Maireana sclerolaenoides | - | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | |
| Chenopodiaceae | Malacocera tricornis | Soft Horns | | | | | | | | | 0.1 | 2 | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum | Water Weed | | | | | | | | | 0.2 | 5 | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum var. acropterum | - | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Rhagodia spinescens | Thorny Saltbush | 10 | 20 | 0.1 | 1 | 5 | 30 | 0.5 | 2 | 25 | 100 | 7 | 10 | 0.5 | 1 | | | | | | | | | |
| Chenopodiaceae | Salsola australis | - | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Salsola tragus | Buckbush,Soft Rolpoly, Saltwort | | | 0.1 | 10 | 1 | 5 | 0.1 | 5 | 0.1 | 1 | | | | | | | | | 0.1 | 2 | | | |
| Chenopodiaceae | Sclerolaena bicornis | Goathead Burr | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena brachyptera | Short-winged Copperburr | 1 | 50 | | | 5 | 40 | | | 2 | 20 | 1 | 50 | | | | | 0.1 | 1 | 2 | 100 | | | |
| Chenopodiaceae | Sclerolaena diacantha | Grey Copperburr | | | 1 | 50 | 0.5 | 20 | 1 | 100 | 2 | 100 | 2 | 70 | | | 0.5 | 30 | 1 | 40 | | | | | 5 |
| Chenopodiaceae | Sclerolaena divaricata | Tangled Copperburr | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena eriacantha | Silky Copperburr | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata | Black Rolypoly | | | | | | | | | | | | | | | 0.5 | 5 | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. semiglabra | Black Rolypoly | | | | | | | | | 0.5 | 10 | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. villosa | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena obliquicuspis | - | | | 15 | 300 | | | 5 | 200 | | | | | 0.5 | 50 | | | 0.1 | 1 | | | | | 0.5 |
| Chenopodiaceae | Sclerolaena stelligera | Star Copperburr | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena tricuspis | Giant Redburr | | | | | | | | | 0.4 | 5 | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Chenopodiaceae | Maireana pentagona | Hairy Bluebush, Slender Fissure-weed | | | | 0.5 | 50 | | | | | | | | 0.1 | 5 | 2 | 100 | 0.2 | 40 | | | | | | | |
| Chenopodiaceae | Maireana sclerolaenoides | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Malacocera tricornis | Soft Horns | | | | | | | | | | | | | 0.1 | 2 | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum | Water Weed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum var. acropterum | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Rhagodia spinescens | Thorny Saltbush | | 0.1 | 2 | | | | | 5 | 10 | | | | 0.2 | 1 | | | 0.2 | 2 | | | 2 | 10 | 0.2 | 1 | 0.3 |
| Chenopodiaceae | Salsola australis | - | | | | | | | | | | 0.1 | 5 | | | | | | | | 2 | 10 | 0.2 | 10 | 0.1 | 5 | 0.1 |
| Chenopodiaceae | Salsola tragus | Buckbush,Soft Rolpoly, Saltwort | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena bicornis | Goathead Burr | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena brachyptera | Short-winged Copperburr | | | | | | | | | | | | | | | | | | | | | | | 2 | 50 | |
| Chenopodiaceae | Sclerolaena diacantha | Grey Copperburr | 200 | 0.2 | 40 | | | 3 | 100 | 5 | 100 | 0.1 | 10 | | | | | | 0.1 | 20 | | | 0.2 | 70 | 0.1 | 10 | 0.2 |
| Chenopodiaceae | Sclerolaena divaricata | Tangled Copperburr | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 5 | |
| Chenopodiaceae | Sclerolaena eriacantha | Silky Copperburr | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata | Black Rolypoly | | | | | | | | | | | | | 0.1 | 10 | | | | | 2 | 10 | | | 0.5 | 5 | 0.2 |
| Chenopodiaceae | Sclerolaena muricata var. semiglabra | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. villosa | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena obliquicuspis | - | 10 | 0.5 | 20 | 5 | 400 | | | | | 0.1 | 50 | 0.1 | 5 | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena stelligera | Star Copperburr | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | |
| Chenopodiaceae | Sclerolaena tricuspis | Giant Redburr | | | | | | | | | | | | 0.1 | 5 | 0.1 | 10 | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Chenopodiaceae | Maireana pentagona | Hairy Bluebush, Slender Fissure-weed | | | | | | | | | 0.1 | 20 | | | | | | | | | | | 0.1 | 5 | | | | |
| Chenopodiaceae | Maireana sclerolaenoides | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Malacocera tricornis | Soft Horns | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum | Water Weed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum var. acropterum | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Rhagodia spinescens | Thorny Saltbush | 5 | | | | | | | | | | 2 | 10 | | | 5 | 20 | | | | | | | | | | |
| Chenopodiaceae | Salsola australis | - | 3 | | | 0.1 | 10 | 1 | 100 | 0.1 | 5 | | | | | | | | | | | | 0.1 | 5 | | | | |
| Chenopodiaceae | Salsola tragus | Buckbush,Soft Rolpoly, Saltwort | | 0.1 | 5 | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena bicornis | Goathead Burr | | | | 0.5 | 50 | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena brachyptera | Short-winged Copperburr | | | | 0.1 | 2 | 2 | 100 | 0.1 | 50 | | | | | | 0.1 | 10 | 0.1 | 2 | | | | | | | | |
| Chenopodiaceae | Sclerolaena diacantha | Grey Copperburr | 20 | 2 | 20 | 15 | 500 | 5 | 100 | 0.1 | 10 | | | | | | | | 0.5 | 20 | 0.1 | 5 | 0.1 | 20 | 0.1 | 10 | | |
| Chenopodiaceae | Sclerolaena divaricata | Tangled Copperburr | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena eriacantha | Silky Copperburr | | | | | | | | | | | 1 | 100 | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata | Black Rolypoly | 20 | 10 | 50 | 0.2 | 10 | | | 5 | 20 | | | | | | | | | | 0.5 | 20 | | | | | 0.2 | 20 |
| Chenopodiaceae | Sclerolaena muricata var. semiglabra | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. villosa | Black Rolypoly | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena obliquicuspis | - | | | | | | | | | | | | | 0.1 | 5 | 2 | 100 | 0.1 | 2 | | | | | | | | |
| Chenopodiaceae | Sclerolaena stelligera | Star Copperburr | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | | | 0.1 | 10 |
| Chenopodiaceae | Sclerolaena tricuspis | Giant Redburr | | | | | | 0.5 | 20 | | | | | | | | | | | | | | | | | | 0.1 | 1 |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Chenopodiaceae | Maireana pentagona | Hairy Bluebush, Slender Fissure-weed | | | | | | | 0.1 | 3 | | | | | 0.3 | 20 | | |
| Chenopodiaceae | Maireana sclerolaenoides | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Malacocera tricornis | Soft Horns | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum | Water Weed | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Osteocarpum acropterum var. acropterum | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Rhagodia spinescens | Thorny Saltbush | | | | | 3 | 8 | 0.2 | 2 | 0.4 | 10 | 0.3 | 10 | 0.1 | 1 | 1 | 3 |
| Chenopodiaceae | Salsola australis | - | | | | | | | | | | | 0.1 | 3 | 0.1 | 3 | | |
| Chenopodiaceae | Salsola tragus | Buckbush,Soft Rolpoly, Saltwort | | | | | 0.2 | 5 | 3 | 20 | 0.5 | 10 | 2 | 20 | | | 0.1 | 3 |
| Chenopodiaceae | Sclerolaena bicornis | Goathead Burr | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena brachyptera | Short-winged Copperburr | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena diacantha | Grey Copperburr | 0.1 | 10 | | | | | | | 0.2 | 10 | | | 0.1 | 3 | | |
| Chenopodiaceae | Sclerolaena divaricata | Tangled Copperburr | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena eriacantha | Silky Copperburr | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata | Black Rolypoly | | | 3 | 20 | | | | | | | | | 0.1 | 2 | | |
| Chenopodiaceae | Sclerolaena muricata var. semiglabra | Black Rolypoly | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena muricata var. villosa | Black Rolypoly | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena obliquicuspis | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena stelligera | Star Copperburr | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Sclerolaena tricuspis | Giant Redburr | | | 0.1 | 2 | | | | | | | | | 6 | 200 | 40 | 400 |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Colchicaceae | Wurmbea dioica subsp. dioica | Early Nancy | | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus clementii | Desert Bindweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus erubescens | Pink Bindweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus spp. | - | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Convolvulaceae | Cressa australis | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Crassulaceae | Crassula colorata | Dense Stonecrop | 0.2 | 1000 | 0.1 | 100 | 0.5 | 2000 | | | | | 0.1 | 50 | 0.1 | 100 | 0.1 | 100 | 2 | 3000 | 1 | 3000 | | | 1 | 5000 |
| Cupressaceae | Callitris gracilis | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Cupressaceae | Callitris gracilis subsp. murrayensis | Murray Pine | | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis acuta | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis pallens | Pale Spike Sedge | | | | | | | | | | | | | | | | | | | | | | | | |
| Euphorbiaceae | Euphorbia drummondii | Caustic Weed | | | | | | | | | | | | | | | | | 0.1 | 2 | 0.1 | 1 | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. filifolia | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. zygophylla | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia homalophylla | Yarran | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia melvillei | Yarran | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia oswaldii | Miljee | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia spp. | Wattle | | | | | | | | | | | | | | | 0.1 | 3 | | | | | | | | |
| Geraniaceae | Erodium crinitum | Blue Crowfoot | | | | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia fascicularis | Mallee Goodenia | | | | | | | | | 0.1 | 10 | | | | | | | | | | | 0.2 | 40 | 0.1 | 5 |
| Goodeniaceae | Goodenia pinnatifida | Scrambles Eggs | | | | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pusilliflora | - | 0.1 | 50 | | | | | 5 | 2000 | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Colchicaceae | Wurmbea dioica subsp. dioica | Early Nancy | | | | | | | | | 0.1 | 5 | 0.1 | 5 | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus clementii | Desert Bindweed | | | | | | | | | | | | | | | | | 0.1 | 5 | | | 0.2 | 20 | | |
| Convolvulaceae | Convolvulus erubescens | Pink Bindweed | | | | | | | | | | | | | | | 0.5 | 100 | 0.1 | 20 | | | 0.2 | 20 | | |
| Convolvulaceae | Convolvulus spp. | - | | | | | | | | | | | 0.1 | 5 | 0.1 | 10 | | | | | 0.1 | 2 | | | | |
| Convolvulaceae | Cressa australis | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Crassulaceae | Crassula colorata | Dense Stonecrop | 0.2 | 1000 | 0.1 | 50 | 0.1 | 100 | 0.2 | 300 | 0.1 | 500 | | | | | | | | | 0.1 | 100 | | | | |
| Cupressaceae | Callitris gracilis | - | | | | | | | | | | | | | | | | | | | | | 5 | 1 | | |
| Cupressaceae | Callitris gracilis subsp. murrayensis | Murray Pine | | | 25 | 2 | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis acuta | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis pallens | Pale Spike Sedge | | | | | | | | | | | | | | | | | | | | | | | | |
| Euphorbiaceae | Euphorbia drummondii | Caustic Weed | | | | | | | | | | | | | 0.1 | 5 | | | 0.1 | 5 | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. filifolia | - | | | | | | | | | 5 | 10 | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. zygophylla | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia homalophylla | Yarran | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia melvillei | Yarran | | | | | 25 | 10 | 30 | 5 | 25 | 3 | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia oswaldii | Miljee | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia spp. | Wattle | | | | | | | | | | | | | | | | | | | | | | | | |
| Geraniaceae | Erodium crinitum | Blue Crowfoot | | | | | | | | | | | | | | | | | | | 0.2 | 20 | | | | |
| Goodeniaceae | Goodenia fascicularis | Mallee Goodenia | | | | | | | | | 0.1 | 20 | | | | | 0.5 | 50 | 0.1 | 10 | | | | | | |
| Goodeniaceae | Goodenia pinnatifida | Scrambles Eggs | | | | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pusilliflora | - | | | | | | | | | | | 1 | 400 | | | | | | | 0.3 | 100 | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Colchicaceae | Wurmbea dioica subsp. dioica | Early Nancy | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus clementii | Desert Bindweed | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus erubescens | Pink Bindweed | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus spp. | - | | | | | 0.1 | 2 | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Cressa australis | - | | | | | | | | | | | | | | | | | | | | | | | |
| Crassulaceae | Crassula colorata | Dense Stonecrop | 0.1 | 500 | 0.1 | 500 | 0.1 | 100 | 0.2 | 500 | 1 | 2000 | 0.5 | 2000 | 0.1 | 500 | 0.2 | 500 | 0.1 | 100 | 0.1 | 100 | | | |
| Cupressaceae | Callitris gracilis | - | | | | | | | | | | | | | | | | | | | | | | | |
| Cupressaceae | Callitris gracilis subsp. murrayensis | Murray Pine | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis acuta | - | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis pallens | Pale Spike Sedge | | | | | | | | | | | | | | | | | | | | | | | |
| Euphorbiaceae | Euphorbia drummondii | Caustic Weed | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. filifolia | - | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. zygophylla | - | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia homalophylla | Yarran | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia melvillei | Yarran | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia oswaldii | Miljee | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia spp. | Wattle | | | | | | | | | | | | | | | | | | | | | | | |
| Geraniaceae | Erodium crinitum | Blue Crowfoot | | | | | | | | | | | | | | | 0.1 | 5 | | | | | 0.1 | 2 | |
| Goodeniaceae | Goodenia fascicularis | Mallee Goodenia | 0.1 | 50 | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pinnatifida | Scrambles Eggs | | | | | 0.1 | 2 | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pusilliflora | - | | | | | | | | | | | | | | | 0.2 | 200 | 0.1 | 50 | 0.5 | 300 | 0.2 | 200 | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Colchicaceae | Wurmbea dioica subsp. dioica | Early Nancy | | | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus clementii | Desert Bindweed | | | | | | | | | | | 0.1 | 10 | 0.1 | 5 | | | | | 1 | 100 | | | | | |
| Convolvulaceae | Convolvulus erubescens | Pink Bindweed | | | | | | | | | | | 0.1 | 10 | 0.1 | 40 | | | 0.1 | 20 | 0.1 | 20 | | | 0.1 | 20 | 0.1 |
| Convolvulaceae | Convolvulus spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Convolvulaceae | Cressa australis | - | | | | | | | | | | | | | | | 0.1 | 20 | | | | | | | | | |
| Crassulaceae | Crassula colorata | Dense Stonecrop | | 0.1 | 200 | | | | | | 0.5 | 1000 | | | | | | | | | | | | | | | |
| Cupressaceae | Callitris gracilis | - | | | | | | | | | | | | | | | | | | | 15 | 1 | | | | | |
| Cupressaceae | Callitris gracilis subsp. murrayensis | Murray Pine | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis acuta | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis pallens | Pale Spike Sedge | | | | | | | | | | | | | | | | | | | | | | | | | |
| Euphorbiaceae | Euphorbia drummondii | Caustic Weed | | | | | | | | | | | | | | | 0.1 | 20 | 0.1 | 20 | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. filifolia | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. zygophylla | - | | | | | | | | | | | | | | | | | | | | | | | | | 0.3 |
| Fabaceae (Mimosoideae) | Acacia homalophylla | Yarran | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia melvillei | Yarran | | | | | | | | | | | | | | | | | | | | | 10 | 1 | | | |
| Fabaceae (Mimosoideae) | Acacia oswaldii | Miljee | | | | | | | | | | | | | | | | | | | | | 4 | 1 | | | |
| Fabaceae (Mimosoideae) | Acacia spp. | Wattle | | | | | | | | | | | | | | | | | | | | | | | | | |
| Geraniaceae | Erodium crinitum | Blue Crowfoot | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia fascicularis | Mallee Goodenia | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | | |
| Goodeniaceae | Goodenia pinnatifida | Scrambles Eggs | | | | | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pusilliflora | - | | | | | | | | | | | | | | | | | | | | | 0.1 | 2 | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Colchicaceae | Wurmbea dioica subsp. dioica | Early Nancy | | | | | | | | | | | | | 20 | 0.1 | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus clementii | Desert Bindweed | | | | | | | | | 20 | 0.5 | 20 | 0.2 | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus erubescens | Pink Bindweed | 6 | | | 0.5 | 100 | 0.2 | 20 | 0.1 | 50 | | | 0.1 | 5 | | | | | 0.5 | 100 | 0.1 | 20 | | | 0.1 | 20 | |
| Convolvulaceae | Convolvulus spp. | - | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | |
| Convolvulaceae | Cressa australis | - | | | | | | | | 1 | 100 | | | | | | | | | | | | | | | | | |
| Crassulaceae | Crassula colorata | Dense Stonecrop | | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | | |
| Cupressaceae | Callitris gracilis | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cupressaceae | Callitris gracilis subsp. murrayensis | Murray Pine | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis acuta | - | | | | | | | | | | | | | | | | | | | | | | | | | 20 | 0.2 |
| Cyperaceae | Eleocharis pallens | Pale Spike Sedge | | | | | | | | | | | | | | | | | | | | | | | | | 100 | 1 |
| Euphorbiaceae | Euphorbia drummondii | Caustic Weed | | | | 0.1 | 20 | 0.1 | 5 | | | | | | | | | | | | | | | | | | 10 | 0.1 |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. filifolia | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. zygophylla | - | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia homalophylla | Yarran | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia melvillei | Yarran | | | | | | | | | | | | | | | 9 | 35 | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia oswaldii | Miljee | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia spp. | Wattle | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Geraniaceae | Erodium crinitum | Blue Crowfoot | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia fascicularis | Mallee Goodenia | | | | 0.5 | 50 | | | | | | 20 | 0.2 | | | 1 | 0.1 | 5 | 0.1 | | | | | | | 20 | 0.2 |
| Goodeniaceae | Goodenia pinnatifida | Scrambles Eggs | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pusilliflora | - | | | | | | | | | | | | | 5000 | 30 | | | 20 | 0.1 | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Colchicaceae | Wurmbea dioica subsp. dioica | Early Nancy | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus clementii | Desert Bindweed | | | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus erubescens | Pink Bindweed | 0.2 | 3 | | | | | | | | | | | | | | |
| Convolvulaceae | Convolvulus spp. | - | | | | | | | | | | | | | | | | |
| Convolvulaceae | Cressa australis | - | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 40 |
| Crassulaceae | Crassula colorata | Dense Stonecrop | | | | | | | | | | | | | | | | |
| Cupressaceae | Callitris gracilis | - | | | | | | | 15 | 2 | | | | | | | | |
| Cupressaceae | Callitris gracilis subsp. murrayensis | Murray Pine | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis acuta | - | | | | | | | | | | | | | | | | |
| Cyperaceae | Eleocharis pallens | Pale Spike Sedge | | | | | | | | | | | | | | | | |
| Euphorbiaceae | Euphorbia drummondii | Caustic Weed | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. filifolia | - | | | | | | | | | | | | | | | | |
| Fabaceae (Caesalpinioideae) | Senna artemisioides subsp. zygophylla | - | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia homalophylla | Yarran | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia melvillei | Yarran | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia oswaldii | Miljee | | | | | | | | | | | | | | | | |
| Fabaceae (Mimosoideae) | Acacia spp. | Wattle | | | | | | | | | | | | | | | | |
| Geraniaceae | Erodium crinitum | Blue Crowfoot | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia fascicularis | Mallee Goodenia | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pinnatifida | Scrambles Eggs | | | | | | | | | | | | | | | | |
| Goodeniaceae | Goodenia pusilliflora | - | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Hypoxidaceae | Hypoxis glabella var. glabella | Tiny Star | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Juncaceae | Juncus flavidus | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Teucrium racemosum | Grey Germander | | | | | | | | | | | | | | | | | | | | | | | | |
| Linaceae | Linum marginale | Native Flax | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Lomandraceae | Lomandra effusa | Scented Mat-rush | | | | | | | | | | | | | | | | | | | | | | | | |
| Loranthaceae | Amyema quandang | Grey Mistletoe | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida ammophila | Sand Sida | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida corrugata | Corrugated Sida | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida cunninghamii | Ridge Sida | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida intricata | - | | | | | | | | | 0.1 | 1 | | | | | | | | | | | | | | |
| Marsileaceae | Marsilea drummondii | Common Nardoo | | | | | | | | | | | | | | | | | 1 | 100 | | | 0.5 | 100 | | |
| Myrtaceae | Eucalyptus dumosa | White Mallee | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus gracilis | Snap and Rattle | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus largiflorens | Black Box | 30 | 5 | | | 15 | 7 | | | | | 30 | 8 | 7 | 4 | 15 | 2 | 5 | 2 | 10 | 3 | 20 | 4 | 35 | 5 |
| Myrtaceae | Eucalyptus oleosa subsp. oleosa | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus socialis | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | | |
| Nitrariaceae | Nitraria billardierei | Dillon Bush | 0.5 | 5 | 0.5 | 2 | | | 20 | 20 | 5 | 2 | | | | | | | 1 | 1 | 0.5 | 1 | 0.2 | 2 | 2 | 5 |
| Oxalidaceae | Oxalis perennans | - | | | | | | | | | | | | | | | | | | | 0.4 | 20 | | | | |
| Pittosporaceae | Pittosporum angustifolium | Butterbush | | | | | | | | | 0.5 | 1 | 0.2 | 1 | | | | | | | | | | | 0.2 | 2 |
| Plantaginaceae | Plantago cunninghamii | Sago-weed | | | | | | | 0.1 | 10 | | | 0.1 | 2 | | | | | 2 | 100 | | | | | | |
| Plantaginaceae | Plantago turrifera | Small Sago-weed | | | 0.2 | 200 | | | 0.1 | 100 | | | | | | | | | | | 0.1 | 100 | | | | |
| Poaceae | Aristida behriana | Bunch Wiregrass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida nitidula | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa elegantissima | Feather Speargrass | | | | | | | 2 | 100 | | | | | | | | | | | | | | | 0.1 | 5 |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Hypoxidaceae | Hypoxis glabella var. glabella | Tiny Star | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | |
| Juncaceae | Juncus flavidus | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Teucrium racemosum | Grey Germander | | | | | | | | | | | | | | | | | | | | | | | | |
| Linaceae | Linum marginale | Native Flax | | | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | |
| Lomandraceae | Lomandra effusa | Scented Mat-rush | | | | | | | | | | | | | | | | | | | | | | | | |
| Loranthaceae | Amyema quandang | Grey Mistletoe | | | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida ammophila | Sand Sida | | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | |
| Malvaceae | Sida corrugata | Corrugated Sida | | | | | | | | | 0.1 | 50 | | | | | 2 | 200 | | | | | | | | |
| Malvaceae | Sida cunninghamii | Ridge Sida | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida intricata | - | | | | | | | | | | | 0.1 | 1 | | | | | | | | | | | | |
| Marsileaceae | Marsilea drummondii | Common Nardoo | 2 | 500 | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus dumosa | White Mallee | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus gracilis | Snap and Rattle | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus largiflorens | Black Box | 15 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus oleosa subsp. oleosa | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus socialis | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | | |
| Nitrariaceae | Nitraria billardierei | Dillon Bush | | | | | | | 1 | 1 | | | 0.5 | 3 | 0.2 | 1 | | | 0.2 | 1 | 0.5 | 1 | 1 | 1 | 1 | 3 |
| Oxalidaceae | Oxalis perennans | - | | | | | | | | | | | | | | | 0.1 | 20 | | | | | | | | |
| Pittosporaceae | Pittosporum angustifolium | Butterbush | | | | | | | | | | | | | | | | | | | | | | | | |
| Plantaginaceae | Plantago cunninghamii | Sago-weed | 0.1 | 10 | | | | | | | | | 0.1 | 20 | | | 0.1 | 5 | | | | | | | | |
| Plantaginaceae | Plantago turrifera | Small Sago-weed | | | | | | | 0.1 | 20 | | | | | | | 0.1 | 5 | | | | | | | | |
| Poaceae | Aristida behriana | Bunch Wiregrass | | | | | | | | | | | | | | | 0.5 | 20 | | | | | | | | |
| Poaceae | Aristida nitidula | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa elegantissima | Feather Speargrass | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Hypoxidaceae | Hypoxis glabella var. glabella | Tiny Star | | | | | | | | | | | | | | | | | | | | | | | |
| Juncaceae | Juncus flavidus | - | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Teucrium racemosum | Grey Germander | | | | | | | | | | | | | | | | | | | | | | | |
| Linaceae | Linum marginale | Native Flax | | | | | | | | | | | | | | | | | | | | | | | |
| Lomandraceae | Lomandra effusa | Scented Mat-rush | | | | | | | | | | | | | | | | | | | | | | | |
| Loranthaceae | Amyema quandang | Grey Mistletoe | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida ammophila | Sand Sida | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida corrugata | Corrugated Sida | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida cunninghamii | Ridge Sida | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | | |
| Malvaceae | Sida intricata | - | | | | | | | | | | | 0.1 | 2 | | | | | | | | | | | |
| Marsileaceae | Marsilea drummondii | Common Nardoo | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus dumosa | White Mallee | | | | | | | | | | | | | 25 | 6 | | | | | | | | | |
| Myrtaceae | Eucalyptus gracilis | Snap and Rattle | | | | | | | | | | | | | 5 | 1 | | | | | | | | | 10 |
| Myrtaceae | Eucalyptus largiflorens | Black Box | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus oleosa subsp. oleosa | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus socialis | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | |
| Nitrariaceae | Nitraria billardierei | Dillon Bush | 1 | 3 | 0.2 | 1 | | | 30 | 50 | 2 | 5 | 2 | 4 | | | 15 | 8 | 0.2 | 1 | 5 | 1 | 15 | 20 | |
| Oxalidaceae | Oxalis perennans | - | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | |
| Pittosporaceae | Pittosporum angustifolium | Butterbush | | | | | 0.1 | 1 | | | 0.2 | 1 | | | | | | | | | | | | | |
| Plantaginaceae | Plantago cunninghamii | Sago-weed | | | | | | | | | | | | | | | | | | | 0.1 | 3 | | | |
| Plantaginaceae | Plantago turrifera | Small Sago-weed | | | | | 0.1 | 20 | | | 0.1 | 50 | 0.2 | 100 | | | 0.1 | 100 | | | 0.1 | 20 | 0.2 | 100 | |
| Poaceae | Aristida behriana | Bunch Wiregrass | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida nitidula | - | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa elegantissima | Feather Speargrass | 0.1 | 10 | | | | | 0.5 | 100 | | | | | | | | | | | 0.5 | 10 | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Hypoxidaceae | Hypoxis glabella var. glabella | Tiny Star | | | | | | | | | | | | | | | | | | | | | | | | | |
| Juncaceae | Juncus flavidus | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Teucrium racemosum | Grey Germander | | | | | | | | | | | | | 0.1 | 20 | | | 0.1 | 10 | | | | | 0.1 | 10 | |
| Linaceae | Linum marginale | Native Flax | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lomandraceae | Lomandra effusa | Scented Mat-rush | | | | | | | | | | | | | | | | | | | | | | | | | |
| Loranthaceae | Amyema quandang | Grey Mistletoe | | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida ammophila | Sand Sida | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 5 | |
| Malvaceae | Sida corrugata | Corrugated Sida | | | | | | | | | | | 0.1 | 20 | | | | | | | | | 0.1 | 20 | | | 0.5 |
| Malvaceae | Sida cunninghamii | Ridge Sida | | | | | | | | | | | | | | | | | 0.1 | 20 | | | | | 0.1 | 10 | |
| Malvaceae | Sida intricata | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Marsileaceae | Marsilea drummondii | Common Nardoo | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 30 | |
| Myrtaceae | Eucalyptus dumosa | White Mallee | | 5 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus gracilis | Snap and Rattle | 4 | 5 | 3 | 25 | 20 | 25 | 9 | 10 | 5 | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus largiflorens | Black Box | | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus oleosa subsp. oleosa | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus socialis | Red Mallee | | 30 | 4 | 5 | 3 | | | 10 | 3 | | | | | | | | | | | | | | | | |
| Nitrariaceae | Nitraria billardierei | Dillon Bush | | | | | | | | | | | | | | | 2 | 10 | 1 | 5 | | | 2 | 1 | | | |
| Oxalidaceae | Oxalis perennans | - | | | | | | | | 0.1 | 5 | 0.1 | 20 | 0.1 | 20 | 0.1 | 20 | 0.1 | 50 | | | | | 0.5 | 50 | |
| Pittosporaceae | Pittosporum angustifolium | Butterbush | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plantaginaceae | Plantago cunninghamii | Sago-weed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plantaginaceae | Plantago turrifera | Small Sago-weed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida behriana | Bunch Wiregrass | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida nitidula | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa elegantissima | Feather Speargrass | | | | | | | | | | | | | | | | | 0.1 | 5 | | | 0.1 | 1 | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Hypoxidaceae | Hypoxis glabella var. glabella | Tiny Star | | | | | | | | | | | | | | | | | 0.1 | 10 | | | | | | | | |
| Juncaceae | Juncus flavidus | - | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Teucrium racemosum | Grey Germander | | | | | | | | | | | | | 0.1 | 20 | | | | | 5 | | | | | | 0.1 | 10 |
| Linaceae | Linum marginale | Native Flax | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lomandraceae | Lomandra effusa | Scented Mat-rush | | | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | |
| Loranthaceae | Amyema quandang | Grey Mistletoe | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida ammophila | Sand Sida | | 0.1 | 1 | 0.1 | 1 | | | | | | | | | | | | | | | | 0.1 | 5 | | | | |
| Malvaceae | Sida corrugata | Corrugated Sida | 50 | | | 0.5 | 100 | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida cunninghamii | Ridge Sida | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Sida intricata | - | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Marsileaceae | Marsilea drummondii | Common Nardoo | | | | | | | | | | | | | | | | | | | | | | | | | 3 | 100 |
| Myrtaceae | Eucalyptus dumosa | White Mallee | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus gracilis | Snap and Rattle | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus largiflorens | Black Box | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus oleosa subsp. oleosa | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | 20 | 1 | | |
| Myrtaceae | Eucalyptus socialis | Red Mallee | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nitrariaceae | Nitraria billardierei | Dillon Bush | | | | | | | 8 | 10 | 15 | 10 | 10 | 5 | 0.5 | 1 | | | | | | | | | | | 0.2 | 1 |
| Oxalidaceae | Oxalis perennans | - | | | | | 0.1 | 2 | 0.2 | 50 | | | | | | | | | | | 0.2 | 5 | | | | | 0.1 | 20 |
| Pittosporaceae | Pittosporum angustifolium | Butterbush | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plantaginaceae | Plantago cunninghamii | Sago-weed | | | | | | | | | 0.1 | 5 | 0.1 | 20 | | | | | | | 0.1 | 10 | | | | | | |
| Plantaginaceae | Plantago turrifera | Small Sago-weed | | | | | 0.1 | 20 | | | | | | | | | 0.1 | 20 | | | | | 0.1 | 10 | | | | |
| Poaceae | Aristida behriana | Bunch Wiregrass | | | | | 0.1 | 5 | | | | | | | | | | | | | | | 0.1 | 1 | | | | |
| Poaceae | Aristida nitidula | - | | 0.2 | 10 | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Aristida spp. | - | | | | | | | | | | | | | 0.5 | 20 | | | | | | | | | | | | |
| Poaceae | Austrostipa elegantissima | Feather Speargrass | | | | | | | 0.2 | 10 | 0.1 | 5 | 0.2 | 10 | | | | | | | | | 2 | 20 | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Hypoxidaceae | Hypoxis glabella var. glabella | Tiny Star | | | | | | | | | | | | | | | | |
| Juncaceae | Juncus flavidus | - | | | | | | | | | | | | | | | | |
| Lamiaceae | Teucrium racemosum | Grey Germander | | | | | | | | | | | | | | | | |
| Linaceae | Linum marginale | Native Flax | | | | | | | | | | | | | | | | |
| Lomandraceae | Lomandra effusa | Scented Mat-rush | | | | | | | | | | | | | | | | |
| Loranthaceae | Amyema quandang | Grey Mistletoe | | | | | | | | | | | | | | | | |
| Malvaceae | Sida ammophila | Sand Sida | | | | | | | | | | | | | | | | |
| Malvaceae | Sida corrugata | Corrugated Sida | 0.1 | 20 | | | | | | | 0.1 | 10 | | | | | | |
| Malvaceae | Sida cunninghamii | Ridge Sida | | | | | | | | | | | | | | | | |
| Malvaceae | Sida intricata | - | | | | | | | | | | | | | | | | |
| Marsileaceae | Marsilea drummondii | Common Nardoo | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus dumosa | White Mallee | | | 10 | 1 | | | | | | | 25 | 6 | | | | |
| Myrtaceae | Eucalyptus gracilis | Snap and Rattle | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus largiflorens | Black Box | | | | | | | | | | | | | 4 | 2 | | |
| Myrtaceae | Eucalyptus oleosa subsp. oleosa | Red Mallee | | | | | | | | | | | | | | | | |
| Myrtaceae | Eucalyptus socialis | Red Mallee | | | | | | | | | | | | | | | | |
| Nitrariaceae | Nitraria billardierei | Dillon Bush | | | 2 | 10 | 2 | 5 | | | | | | | 3 | 3 | | |
| Oxalidaceae | Oxalis perennans | - | | | | | 0.1 | 1 | | | | | | | | | | |
| Pittosporaceae | Pittosporum angustifolium | Butterbush | | | | | | | | | 1 | 4 | 0.1 | 1 | | | | |
| Plantaginaceae | Plantago cunninghamii | Sago-weed | | | | | | | | | | | | | | | | |
| Plantaginaceae | Plantago turrifera | Small Sago-weed | | | | | | | | | | | | | | | | |
| Poaceae | Aristida behriana | Bunch Wiregrass | | | | | | | | | | | | | | | | |
| Poaceae | Aristida nitidula | - | | | | | | | | | | | | | | | | |
| Poaceae | Aristida spp. | - | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa elegantissima | Feather Speargrass | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Poaceae | Austrostipa eremophila | - | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 50 |
| Poaceae | Austrostipa nitida | - | 0.1 | 5 | 0.2 | 20 | | | | | 1 | 50 | 0.2 | 5 | | | | | | | | | 0.2 | 10 | | |
| Poaceae | Austrostipa nodosa | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa scabra | Speargrass | | | | | | | | | 0.1 | 10 | | | | | | | | | 0.1 | 5 | | | | |
| Poaceae | Chloris truncata | Windmill Grass | | | | | | | | | | | | | | | | | | | | | 2 | 40 | | |
| Poaceae | Digitaria ammophila | Silky Umbrella Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Enneapogon avenaceus | Bottle Washers | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Enteropogon acicularis | Curly Windmill Grass | | | | | | | 0.1 | 10 | | | 1 | 40 | | | | | | | 0.2 | 20 | 5 | 50 | | |
| Poaceae | Eragrostis dielsii | Mallee Lovegrass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium jubiflorum | Warrego Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma caespitosum | Ringed Wallaby Grass | | | | | | | 5 | 500 | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma duttonianum | Brown-back Wallaby Grass | | | | | | | | | | | | | | | | | 0.5 | 10 | | | | | | |
| Poaceae | Rytidosperma setaceum | Small-flowered Wallaby-grass | | | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | |
| Poaceae | Sporobolus caroli | Fairy Grass | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Poaceae | Walwhalleya proluta | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Duma florulenta | Lignum | 0.1 | 1 | | | | | | | | | | | | | | | | | 0.1 | 1 | | | 2 | 10 |
| Portulacaceae | Calandrinia eremaea | Small Purslane | | | 0.1 | 20 | | | | | | | 0.1 | 5 | | | | | | | 0.1 | 100 | | | | |
| Rubiaceae | Asperula conferta | Common Woodruff | 0.1 | 2 | | | | | | | | | | | | | | | | | | | | | | |
| Santalaceae | Exocarpos aphyllus | Leafless Ballart | | | | | | | | | | | | | | | | | | | | | | | | |
| Sapindaceae | Alectryon oleifolius | Western Rosewood | | | 3 | 1 | | | | | | | | | | | | | | | | | 0.1 | 1 | | |
| Sapindaceae | Dodonaea viscosa subsp. angustissima | Narrow-leaf Hop-bush | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Poaceae | Austrostipa eremophila | - | | | | | | | 0.1 | 3 | | | 40 | 500 | | | | | 35 | 200 | | | | | | |
| Poaceae | Austrostipa nitida | - | | | 0.7 | 50 | | | 1 | 200 | | | 10 | 200 | 15 | 200 | 50 | 200 | 40 | 200 | | | 1 | 20 | | |
| Poaceae | Austrostipa nodosa | - | | | | | | | | | 5 | 100 | | | | | | | | | | | | | 0.1 | 20 |
| Poaceae | Austrostipa scabra | Speargrass | | | | | | | | | | | | | | | 2 | 50 | | | 5 | 300 | | | | |
| Poaceae | Chloris truncata | Windmill Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Digitaria ammophila | Silky Umbrella Grass | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | |
| Poaceae | Enneapogon avenaceus | Bottle Washers | | | | | | | | | | | | | | | 0.2 | 20 | | | | | 0.1 | 1 | | |
| Poaceae | Enteropogon acicularis | Curly Windmill Grass | | | 0.5 | 20 | 0.1 | 5 | 0.5 | 20 | 0.5 | 20 | | | 10 | 100 | 20 | 100 | 1 | 50 | 2 | 300 | 1 | 20 | | |
| Poaceae | Eragrostis dielsii | Mallee Lovegrass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium jubiflorum | Warrego Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium spp. | - | | | 1 | 50 | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma caespitosum | Ringed Wallaby Grass | | | | | | | | | | | 1 | 50 | 0.1 | 5 | | | | | | | | | | |
| Poaceae | Rytidosperma duttonianum | Brown-back Wallaby Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma setaceum | Small-flowered Wallaby-grass | | | | | | | 0.5 | 40 | 0.5 | 20 | 0.5 | 50 | | | 1 | 50 | 3 | 100 | 1 | 100 | | | | |
| Poaceae | Sporobolus caroli | Fairy Grass | | | | | | | | | | | | | | | 1 | 50 | | | | | | | | |
| Poaceae | Walwhalleya proluta | - | | | | | | | | | | | | | 5 | 50 | | | | | | | | | | |
| Polygonaceae | Duma florulenta | Lignum | | | | | | | | | | | | | | | | | | | | | | | | |
| Portulacaceae | Calandrinia eremaea | Small Purslane | | | | | 0.1 | 20 | | | | | | | | | | | | | | | | | | |
| Rubiaceae | Asperula conferta | Common Woodruff | | | | | | | | | | | | | | | | | | | | | | | | |
| Santalaceae | Exocarpos aphyllus | Leafless Ballart | | | | | | | | | | | | | | | | | | | | | | | | |
| Sapindaceae | Alectryon oleifolius | Western Rosewood | | | | | | | | | | | | | | | 0.1 | 2 | | | | | 5 | 4 | | |
| Sapindaceae | Dodonaea viscosa subsp. angustissima | Narrow-leaf Hop-bush | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Poaceae | Austrostipa eremophila | - | | | | | 1 | 30 | | | | | | | | | | | | | | | 0.5 | 10 | |
| Poaceae | Austrostipa nitida | - | | | 0.1 | 10 | | | 2 | 300 | | | 3 | 200 | | | | | 3 | 200 | 15 | 300 | 0.2 | 10 | 25 |
| Poaceae | Austrostipa nodosa | - | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa scabra | Speargrass | | | | | | | | | 0.1 | 50 | | | | | 5 | 500 | 1 | 50 | | | | | |
| Poaceae | Chloris truncata | Windmill Grass | | | | | | | | | | | | | | | | | | | 0.2 | 5 | | | |
| Poaceae | Digitaria ammophila | Silky Umbrella Grass | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Enneapogon avenaceus | Bottle Washers | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Enteropogon acicularis | Curly Windmill Grass | | | 0.1 | 5 | 1 | 30 | | | | | 0.3 | 5 | | | | | 0.5 | 30 | 2 | 50 | 2 | 50 | |
| Poaceae | Eragrostis dielsii | Mallee Lovegrass | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium jubiflorum | Warrego Grass | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma caespitosum | Ringed Wallaby Grass | | | | | | | 0.1 | 10 | | | | | | | | | | | 1 | 50 | 2 | 100 | |
| Poaceae | Rytidosperma duttonianum | Brown-back Wallaby Grass | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma setaceum | Small-flowered Wallaby-grass | | | | | | | | | | | 2 | 200 | | | 1 | 100 | | | 0.5 | 50 | | | |
| Poaceae | Sporobolus caroli | Fairy Grass | | | | | | | | | 0.1 | 5 | | | | | | | | | 0.2 | 10 | | | |
| Poaceae | Walwhalleya proluta | - | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Duma florulenta | Lignum | | | | | | | | | | | | | | | | | | | | | | | |
| Portulacaceae | Calandrinia eremaea | Small Purslane | 0.1 | 50 | | | 0.1 | 10 | 0.1 | 50 | 0.5 | 500 | | | | | | | | | | | | | |
| Rubiaceae | Asperula conferta | Common Woodruff | | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | |
| Santalaceae | Exocarpos aphyllus | Leafless Ballart | | | | | | | 0.1 | 1 | | | | | | | | | | | | | | | |
| Sapindaceae | Alectryon oleifolius | Western Rosewood | | | 10 | 6 | | | | | 1 | 3 | 3 | 1 | | | | | | | | | | | |
| Sapindaceae | Dodonaea viscosa subsp. angustissima | Narrow-leaf Hop-bush | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Poaceae | Austrostipa eremophila | - | | | | | | | | | | | | | | | | | 1 | 40 | | | | | | | | |
| Poaceae | Austrostipa nitida | - | 300 | | | 0.1 | 10 | | | 0.1 | 10 | 40 | 200 | 70 | 500 | 5 | 50 | 20 | 100 | 2 | 20 | | | | | | |
| Poaceae | Austrostipa nodosa | - | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Poaceae | Austrostipa scabra | Speargrass | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Poaceae | Chloris truncata | Windmill Grass | | | | | | | | | | | | | | 0.1 | 2 | | | | | | | | | | |
| Poaceae | Digitaria ammophila | Silky Umbrella Grass | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Poaceae | Enneapogon avenaceus | Bottle Washers | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Poaceae | Enteropogon acicularis | Curly Windmill Grass | | | | | | | | | | 1 | 20 | 2 | 50 | 10 | 100 | 15 | 100 | 1 | 20 | 0.1 | 6 | 2 | 30 | 0.2 | |
| Poaceae | Eragrostis dielsii | Mallee Lovegrass | | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | | |
| Poaceae | Paspalidium jubiflorum | Warrego Grass | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma caespitosum | Ringed Wallaby Grass | | | | | | | | | | | | 0.2 | 10 | 0.1 | 20 | 5 | 100 | | | | | | | | |
| Poaceae | Rytidosperma duttonianum | Brown-back Wallaby Grass | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma setaceum | Small-flowered Wallaby-grass | | | | | | | | | | 4 | 40 | 5 | 50 | 2 | 40 | 60 | 500 | | | | | 15 | 200 | | |
| Poaceae | Sporobolus caroli | Fairy Grass | | | | | | | | | | | | | | 2 | 20 | 5 | 60 | | | | | 1 | 30 | | |
| Poaceae | Walwhalleya proluta | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Duma florulenta | Lignum | | | | | | | | | | 10 | 20 | 2 | 10 | | | | | | | | | | | | |
| Portulacaceae | Calandrinia eremaea | Small Purslane | | | | | | | | 0.1 | 50 | | | | | | | | | | | | | | | | |
| Rubiaceae | Asperula conferta | Common Woodruff | | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | |
| Santalaceae | Exocarpos aphyllus | Leafless Ballart | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Sapindaceae | Alectryon oleifolius | Western Rosewood | | | | | | | | | | | | | | | | | | | | | | | | | 60 |
| Sapindaceae | Dodonaea viscosa subsp. angustissima | Narrow-leaf Hop-bush | | | | | | | | | | | | | | | | | | | | 20 | 5 | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Poaceae | Austrostipa eremophila | - | | | | | | | | | 0.1 | 10 | 1 | 20 | | | 0.1 | 2 | 10 | 300 | | | | | | | | |
| Poaceae | Austrostipa nitida | - | | | | 20 | 100 | 10 | 100 | 40 | 500 | 10 | 100 | 1 | 50 | | | 20 | 400 | 15 | 50 | 70 | 500 | 0.5 | 20 | 10 | 50 |
| Poaceae | Austrostipa nodosa | - | 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa scabra | Speargrass | 4 | | | 1 | 20 | | | | | 0.2 | 20 | | | 0.5 | 20 | | | | | 5 | 50 | | | | |
| Poaceae | Chloris truncata | Windmill Grass | | | | | | 2 | 50 | | | | | | | | | | | | | | | | | 0.2 | 10 |
| Poaceae | Digitaria ammophila | Silky Umbrella Grass | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Enneapogon avenaceus | Bottle Washers | 20 | | | 2 | 100 | | | | | | | | | | | | | | | 0.5 | 10 | | | | |
| Poaceae | Enteropogon acicularis | Curly Windmill Grass | 30 | 5 | 20 | 20 | 50 | 50 | 100 | 1 | 20 | 30 | 100 | 5 | 100 | 0.1 | 5 | | | 0.2 | 5 | 0.1 | 1 | | | 50 | 100 |
| Poaceae | Eragrostis dielsii | Mallee Lovegrass | | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 10 |
| Poaceae | Paspalidium jubiflorum | Warrego Grass | | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma caespitosum | Ringed Wallaby Grass | | | | | | | | | | | | 5 | 200 | 0.1 | 10 | | | 2 | 50 | | | | | | |
| Poaceae | Rytidosperma duttonianum | Brown-back Wallaby Grass | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma setaceum | Small-flowered Wallaby-grass | | | | | | 20 | 200 | 40 | 500 | 5 | 50 | | | | | 0.5 | 30 | 5 | 50 | 1 | 40 | | | 15 | 100 |
| Poaceae | Sporobolus caroli | Fairy Grass | | | | | | 1 | 20 | 0.2 | 20 | 5 | 100 | | | | | | | | | 2 | 20 | | | 0.5 | 20 |
| Poaceae | Walwhalleya proluta | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Duma florulenta | Lignum | | | | | | | | | | | | | | | | | | 5 | 5 | | | | | 10 | 10 |
| Portulacaceae | Calandrinia eremaea | Small Purslane | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rubiaceae | Asperula conferta | Common Woodruff | | | | | | | | | | | | 0.2 | 100 | | | | | | | | | | | | |
| Santalaceae | Exocarpos aphyllus | Leafless Ballart | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sapindaceae | Alectryon oleifolius | Western Rosewood | 40 | 0.2 | 1 | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 |
| Sapindaceae | Dodonaea viscosa subsp. angustissima | Narrow-leaf Hop-bush | | | | | | | | | | | | 0.2 | 1 | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Poaceae | Austrostipa eremophila | - | 50 | 5000 | | | | | | | | | | | | | | |
| Poaceae | Austrostipa nitida | - | 40 | 4000 | | | 0.1 | 10 | 0.3 | 20 | 0.2 | 10 | 0.5 | 20 | 0.1 | 2 | | |
| Poaceae | Austrostipa nodosa | - | | | | | | | | | | | | | | | | |
| Poaceae | Austrostipa scabra | Speargrass | | | 0.5 | 30 | | | 0.2 | 10 | 0.5 | 20 | | | | | | |
| Poaceae | Chloris truncata | Windmill Grass | | | | | | | | | | | | | | | | |
| Poaceae | Digitaria ammophila | Silky Umbrella Grass | | | | | | | | | | | | | | | | |
| Poaceae | Enneapogon avenaceus | Bottle Washers | | | | | | | | | | | | | | | | |
| Poaceae | Enteropogon acicularis | Curly Windmill Grass | 0.1 | 20 | 3 | 80 | 0.5 | 30 | 0.1 | 5 | 0.1 | 8 | | | 0.1 | 1 | | |
| Poaceae | Eragrostis dielsii | Mallee Lovegrass | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium jubiflorum | Warrego Grass | | | | | | | | | | | | | | | | |
| Poaceae | Paspalidium spp. | - | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma caespitosum | Ringed Wallaby Grass | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma duttonianum | Brown-back Wallaby Grass | | | | | | | | | | | | | | | | |
| Poaceae | Rytidosperma setaceum | Small-flowered Wallaby-grass | 0.4 | 400 | | | | | | | | | | | | | | |
| Poaceae | Sporobolus caroli | Fairy Grass | | | | | 0.1 | 5 | | | | | | | | | | |
| Poaceae | Walwhalleya proluta | - | | | | | | | | | | | | | | | | |
| Polygonaceae | Duma florulenta | Lignum | | | | | | | | | | | | | | | | |
| Portulacaceae | Calandrinia eremaea | Small Purslane | | | | | | | | | | | | | | | | |
| Rubiaceae | Asperula conferta | Common Woodruff | | | | | | | | | | | | | | | | |
| Santalaceae | Exocarpos aphyllus | Leafless Ballart | | | | | | | | | | | | | | | | |
| Sapindaceae | Alectryon oleifolius | Western Rosewood | | | | | 25 | 10 | 4 | 2 | | | | | | | | |
| Sapindaceae | Dodonaea viscosa subsp. angustissima | Narrow-leaf Hop-bush | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Scrophulariaceae | Eremophila longifolia | Emubush | | | | | | | | | | | | | | | 0.2 | 1 | | | | | | | | |
| Scrophulariaceae | Myoporum montanum | Western Boobialla | | | | | | | | | | | | | | | | | | | | | | | 5 | 4 |
| Solanaceae | Solanum esuriale | Quena | | | | | | | | | | | | | | | | | | | 0.1 | 20 | 0.1 | 20 | | |
| Urticaceae | Parietaria debilis | Native Pellitory | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera ammophila | | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 5 |
| Zygophyllaceae | Roepera crenata | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera glauca | | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 |
| Zygophyllaceae | Roepera iodocarpa | | 0.1 | 5 | 0.1 | 5 | | | 0.1 | 10 | | | 0.5 | 10 | | | | | | | 1 | 100 | | | | |
| Zygophyllaceae | Roepera spp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| Introduced species | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Mesembryanthemum nodiflorum | Small Ice Plant | 5 | 1000 | 0.5 | 200 | | | | | | | | | | | 0.5 | 100 | | | | | | | 0.1 | 20 |
| Aizoaceae | Psilocaulon tenue | Wiry Noon-flower | 50 | 1000 | 5 | 700 | 15 | 1000 | | | | | 1 | 30 | 60 | 2000 | 25 | 300 | 1 | 40 | 0.5 | 20 | 1 | 20 | 5 | 100 |
| Asphodelaceae | Asphodelus fistulosus | Onion Weed | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | |
| Asteraceae | Arctotheca calendula | Capeweed | | | | | | | | | | | | | 0.5 | 30 | | | 0.2 | 5 | | | | | | |
| Asteraceae | Carthamus lanatus | Saffron Thistle | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Centaurea melitensis | Maltese Cockspur | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane | | | | | 0.1 | 5 | | | | | 0.1 | 20 | | | | | 0.5 | 50 | 0.1 | 5 | | | | |
| Asteraceae | Cotula bipinnata | Ferny Cotula | | | | | | | | | | | | | | | | | 5 | 200 | | | | | | |
| Asteraceae | Hypochaeris glabra | Smooth Catsear | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris radicata | Catsear | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Lactuca serriola | Prickly Lettuce | | | | | 0.1 | 10 | | | | | 0.1 | 3 | 0.1 | 5 | | | | | | | 0.1 | 5 | | |
| Asteraceae | Leontodon rhagadioloides | Cretan Weed | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Asteraceae | Onopordum acaulon | Stemless Thistle | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | | | |
| Asteraceae | Reichardia tingitana | False Sowthistle | | | | | | | | | 0.1 | 5 | 0.1 | 1 | | | | | | | | | | | | |
| Asteraceae | Sonchus asper | Prickly Sowthistle | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Scrophulariaceae | Eremophila longifolia | Emubush | | | | | | | | | | | | | | | | | | | | | | | | |
| Scrophulariaceae | Myoporum montanum | Western Boobialla | | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Solanum esuriale | Quena | | | | | | | | | | | | | | | 2 | 200 | | | | | | | | |
| Urticaceae | Parietaria debilis | Native Pellitory | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera ammophila | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera crenata | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera glauca | | | | | | | | 0.1 | 1 | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera iodocarpa | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera spp. | | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 10 |
| Introduced species | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Mesembryanthemum nodiflorum | Small Ice Plant | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 50 |
| Aizoaceae | Psilocaulon tenue | Wiry Noon-flower | | | 1 | 30 | 50 | 500 | | | 0.5 | 50 | | | 0.2 | 10 | | | | | | | 20 | 100 | 40 | 500 |
| Asphodelaceae | Asphodelus fistulosus | Onion Weed | | | | | | | | | | | | | 20 | 200 | | | | | | | | | | |
| Asteraceae | Arctotheca calendula | Capeweed | | | 0.5 | 20 | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Carthamus lanatus | Saffron Thistle | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Centaurea melitensis | Maltese Cockspur | | | | | | | | | | | 0.1 | 10 | 0.5 | 10 | | | | | | | | | | |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane | | | | | | | | | | | | | 0.1 | 2 | 0.1 | 20 | 0.1 | 20 | | | 0.1 | 20 | | |
| Asteraceae | Cotula bipinnata | Ferny Cotula | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris glabra | Smooth Catsear | | | | | | | 0.1 | 5 | 0.1 | 10 | 0.1 | 10 | | | | | | | | | | | | |
| Asteraceae | Hypochaeris radicata | Catsear | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Lactuca serriola | Prickly Lettuce | 0.1 | 10 | 0.1 | 5 | | | | | 0.1 | 5 | | | | | 0.1 | 10 | | | | | | | | |
| Asteraceae | Leontodon rhagadioloides | Cretan Weed | | | | | | | 0.1 | 5 | | | 5 | 500 | | | 20 | 500 | | | 0.5 | 20 | | | | |
| Asteraceae | Onopordum acaulon | Stemless Thistle | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Reichardia tingitana | False Sowthistle | | | 0.1 | 1 | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Sonchus asper | Prickly Sowthistle | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Scrophulariaceae | Eremophila longifolia | Emubush | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | | |
| Scrophulariaceae | Myoporum montanum | Western Boobialla | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Solanum esuriale | Quena | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | |
| Urticaceae | Parietaria debilis | Native Pellitory | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | |
| Zygophyllaceae | Roepera ammophila | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera crenata | | | | | | | | | | | | | | | | | | 0.1 | 2 | | | | | 1 |
| Zygophyllaceae | Roepera glauca | | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | | |
| Zygophyllaceae | Roepera iodocarpa | | | | | | 2 | 50 | 0.1 | 5 | 0.4 | 10 | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera spp. | | | | 0.1 | 20 | | | | | | | | | | | | | | | | | | | |
| Introduced species | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Mesembryanthemum nodiflorum | Small Ice Plant | 0.1 | 20 | | | | | | | | | 10 | 300 | | | | | | | | | | | |
| Aizoaceae | Psilocaulon tenue | Wiry Noon-flower | 5 | 300 | 50 | 2000 | 1 | 20 | | | 0.5 | 20 | | | 60 | 1000 | | | | | | | | | |
| Asphodelaceae | Asphodelus fistulosus | Onion Weed | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Asteraceae | Arctotheca calendula | Capeweed | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Carthamus lanatus | Saffron Thistle | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Centaurea melitensis | Maltese Cockspur | | | | | | | | | | | | | | | | | | | | | 0.2 | 20 | 0.1 |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | |
| Asteraceae | Cotula bipinnata | Ferny Cotula | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris glabra | Smooth Catsear | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris radicata | Catsear | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Lactuca serriola | Prickly Lettuce | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Leontodon rhagadioloides | Cretan Weed | | | | | | | | | | | | | | | | | | | 0.2 | 5 | 0.2 | 20 | |
| Asteraceae | Onopordum acaulon | Stemless Thistle | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Reichardia tingitana | False Sowthistle | | | | | 0.1 | 1 | | | | | | | | | | | | | | | 0.1 | 5 | 0.1 |
| Asteraceae | Sonchus asper | Prickly Sowthistle | | | | | | | | | | | | | | | | | | | | | 0.5 | 50 | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Scrophulariaceae | Eremophila longifolia | Emubush | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | | |
| Scrophulariaceae | Myoporum montanum | Western Boobialla | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Solanum esuriale | Quena | | | | | | | | | | | 0.1 | 30 | 0.2 | 40 | | | 0.1 | 20 | | | 0.1 | 4 | 0.2 | 20 | |
| Urticaceae | Parietaria debilis | Native Pellitory | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera ammophila | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera crenata | | 50 | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera glauca | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera iodocarpa | | | | | | 2 | 200 | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera spp. | | | 0.2 | 20 | | | 0.2 | 100 | | | | | | | | | | | | | | | | | | |
| Introduced species | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Mesembryanthemum nodiflorum | Small Ice Plant | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | | |
| Aizoaceae | Psilocaulon tenue | Wiry Noon-flower | | 55 | 500 | 5 | 500 | 40 | 300 | 0.1 | 5 | | | | | | | | | | 10 | 100 | | | | | 10 |
| Asphodelaceae | Asphodelus fistulosus | Onion Weed | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Arctotheca calendula | Capeweed | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | 0.1 | 10 | 0.1 |
| Asteraceae | Carthamus lanatus | Saffron Thistle | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Centaurea melitensis | Maltese Cockspur | 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane | | | | | | | | | | | 0.1 | 5 | | | 0.1 | 20 | | | 0.5 | 20 | | | | | |
| Asteraceae | Cotula bipinnata | Ferny Cotula | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris glabra | Smooth Catsear | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris radicata | Catsear | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Lactuca serriola | Prickly Lettuce | | | | | | | | | | | 0.1 | 10 | 0.1 | 5 | | | 0.1 | 40 | 0.1 | 5 | 0.1 | 3 | | | |
| Asteraceae | Leontodon rhagadioloides | Cretan Weed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Onopordum acaulon | Stemless Thistle | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Reichardia tingitana | False Sowthistle | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Sonchus asper | Prickly Sowthistle | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Scrophulariaceae | Eremophila longifolia | Emubush | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Scrophulariaceae | Myoporum montanum | Western Boobialla | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Solanum esuriale | Quena | | | | 2 | 500 | 0.2 | 100 | 0.2 | 100 | | | | | | | | | 0.5 | 100 | 0.2 | 50 | 0.1 | 5 | 0.1 | 10 | |
| Urticaceae | Parietaria debilis | Native Pellitory | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera ammophila | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera crenata | | | | | | | | | | | | | | | | | | 0.2 | 20 | | | | | 0.2 | 10 | | |
| Zygophyllaceae | Roepera glauca | | | | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 1 | | | | | | | | |
| Zygophyllaceae | Roepera iodocarpa | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Zygophyllaceae | Roepera spp. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Introduced species | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Mesembryanthemum nodiflorum | Small Ice Plant | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Psilocaulon tenue | Wiry Noon-flower | 500 | 40 | 100 | | | | | | | | | | | | | | | | | | | | 50 | 500 | | |
| Asphodelaceae | Asphodelus fistulosus | Onion Weed | | | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | | | |
| Asteraceae | Arctotheca calendula | Capeweed | 1 | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Carthamus lanatus | Saffron Thistle | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 5 |
| Asteraceae | Centaurea melitensis | Maltese Cockspur | | | | | | | | | | 5 | 50 | 0.1 | 5 | | | | | | | | | | | | | |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane | | 10 | 100 | 0.1 | 5 | 0.1 | 10 | 0.1 | 5 | 2 | 50 | | | | | | | | | 0.1 | 20 | 0.1 | 20 | | | |
| Asteraceae | Cotula bipinnata | Ferny Cotula | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris glabra | Smooth Catsear | | | | | | | | | | | | 0.1 | 20 | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris radicata | Catsear | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | |
| Asteraceae | Lactuca serriola | Prickly Lettuce | | 0.1 | 5 | | | 0.1 | 10 | | | 0.2 | 20 | | | | | | | 0.1 | 10 | | | 0.1 | 10 | | | |
| Asteraceae | Leontodon rhagadioloides | Cretan Weed | | | | 0.2 | 10 | 0.5 | 50 | | | 5 | 100 | | | | | | | | | | | | | | | |
| Asteraceae | Onopordum acaulon | Stemless Thistle | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Reichardia tingitana | False Sowthistle | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Sonchus asper | Prickly Sowthistle | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Scrophulariaceae | Eremophila longifolia | Emubush | | | | | | | | | | | | | | | | |
| Scrophulariaceae | Myoporum montanum | Western Boobialla | | | | | | | | | | | | | | | | |
| Solanaceae | Solanum esuriale | Quena | 0.1 | 2 | | | | | | | | | | | | | | |
| Urticaceae | Parietaria debilis | Native Pellitory | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera ammophila | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera crenata | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera glauca | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera iodocarpa | | | | | | | | | | | | | | | | | |
| Zygophyllaceae | Roepera spp. | | | | | | | | | | | | | | | | | |
| Introduced species | | | | | | | | | | | | | | | | | | |
| Aizoaceae | Mesembryanthemum nodiflorum | Small Ice Plant | | | | | | | | | | | | | | | | |
| Aizoaceae | Psilocaulon tenue | Wiry Noon-flower | | | 20 | 300 | 2 | 100 | 1 | 50 | 35 | 800 | 4 | 80 | 60 | 2000 | 10 | 500 |
| Asphodelaceae | Asphodelus fistulosus | Onion Weed | | | | | | | | | | | | | | | | |
| Asteraceae | Arctotheca calendula | Capeweed | | | | | | | | | | | | | | | | |
| Asteraceae | Carthamus lanatus | Saffron Thistle | 0.1 | 10 | | | | | | | | | | | | | | |
| Asteraceae | Centaurea melitensis | Maltese Cockspur | | | | | | | | | | | | | | | | |
| Asteraceae | Conyza bonariensis | Flaxleaf Fleabane | 0.1 | 20 | 0.3 | 20 | 2 | 30 | 2 | 50 | 0.2 | 20 | 0.2 | 10 | 0.1 | 10 | 0.2 | 20 |
| Asteraceae | Cotula bipinnata | Ferny Cotula | | | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris glabra | Smooth Catsear | 0.1 | 1 | | | | | | | | | | | | | | |
| Asteraceae | Hypochaeris radicata | Catsear | | | | | | | | | | | | | | | | |
| Asteraceae | Lactuca serriola | Prickly Lettuce | 0.1 | 3 | | | 0.1 | 1 | | | | | | | | | | |
| Asteraceae | Leontodon rhagadioloides | Cretan Weed | 0.1 | 3 | | | | | | | | | | | | | | |
| Asteraceae | Onopordum acaulon | Stemless Thistle | | | | | | | | | | | | | | | | |
| Asteraceae | Reichardia tingitana | False Sowthistle | | | | | | | | | | | | | | | | |
| Asteraceae | Sonchus asper | Prickly Sowthistle | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Sonchus oleraceus | Common Sowthistle | | | 0.1 | 5 | 1 | 100 | 0.2 | 100 | 0.5 | 50 | 1 | 40 | 2 | 100 | 0.2 | 20 | 1 | 50 | 0.2 | 10 | 0.2 | 20 | 0.1 | 30 |
| Asteraceae | Taraxacum officinale | Dandelion | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Xanthium spinosum | Bathurst Burr | | | | | | | | | | | | | | | | | | | | | | | | |
| Boraginaceae | Echium plantagineum | Patterson's Curse | | | 0.1 | 10 | 0.1 | 10 | | | 0.1 | 5 | 0.1 | 1 | | | | | | | | | 0.1 | 5 | | |
| Brassicaceae | Alyssum linifolium | Flax-leaf Alyssum | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | 0.1 | 5 |
| Brassicaceae | Carrichtera annua | Ward's Weed | 0.1 | 20 | 0.1 | 5 | 3 | 300 | 0.5 | 200 | 5 | 1000 | | | | | | | | | | | 10 | 200 | | |
| Brassicaceae | Sisymbrium erysimoides | Smooth Mustard | 0.5 | 50 | 10 | 500 | 2 | 500 | | | 10 | 700 | | | 15 | 1000 | 30 | 2000 | | | 2 | 100 | | | 5 | 1000 |
| Brassicaceae | Sisymbrium irio | London Rocket | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium officinale | Hedge Mustard | | | | | 0.2 | 100 | | | | | 15 | 300 | | | | | | | | | 10 | 500 | | |
| Brassicaceae | Sisymbrium orientale | Indian Hedge Mustard | | | 0.1 | 10 | | | | | 0.1 | 10 | 1 | 30 | | | | | | | 0.1 | 5 | | | | |
| Brassicaceae | Sisymbrium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Silene gallica | French Catchfly | | | 0.1 | 5 | | | | | | | 0.1 | 5 | | | | | | | 0.1 | 1 | | | 0.1 | 20 |
| Caryophyllaceae | Spergula spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium murale | Nettle-leaf Goosefoot | | | | | | | | | | | 1 | 1 | 0.5 | 10 | | | | | | | | | | |
| Cucurbitaceae | Cucumis myriocarpus subsp. myriocarpus | Paddy Melon | | | | | | | | | | | | | 0.1 | 1 | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago laciniata | Cut-leaved Medic | 0.1 | 50 | 65 | 5000 | 20 | 3000 | | | | | | | 0.5 | 100 | 0.1 | 100 | 1 | 100 | 15 | 5000 | | | 1 | 500 |
| Fabaceae (Faboideae) | Medicago minima | Woolly Burr Medic | 0.1 | 100 | | | 2 | 500 | 10 | 3000 | 2 | 200 | | | | | | | | | 0.5 | 200 | | | | |
| Fabaceae (Faboideae) | Medicago polymorpha | Burr Medic | 0.1 | 50 | | | 1 | 200 | 0.5 | 500 | | | 0.5 | 100 | 1 | 200 | | | 5 | 200 | | | | | | |
| Fabaceae (Faboideae) | Medicago truncatula | Barrel Medic | | | | | | | | | 40 | 500 | 1 | 50 | | | 1 | 200 | | | 2 | 500 | | | 0.5 | 100 |
| Fabaceae (Faboideae) | Trifolium tomentosum | Woolly Clover | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Vicia spp. | Vetch | | | | | | | | | | | | | 1 | 100 | | | | | | | | | 0.1 | 1 |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Sonchus oleraceus | Common Sowthistle | 1 | 100 | | | 0.1 | 20 | 0.1 | 5 | 0.1 | 20 | 0.1 | 10 | 0.1 | 10 | 0.1 | 20 | 0.1 | 20 | 0.1 | 5 | 0.2 | 20 | 0.1 | 5 |
| Asteraceae | Taraxacum officinale | Dandelion | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Xanthium spinosum | Bathurst Burr | | | | | | | | | | | | | | | | | | | | | | | | |
| Boraginaceae | Echium plantagineum | Patterson's Curse | | | 3 | 40 | | | | | | | | | 2 | 30 | 0.1 | 5 | | | | | 1 | 20 | | |
| Brassicaceae | Alyssum linifolium | Flax-leaf Alyssum | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | | |
| Brassicaceae | Carrichtera annua | Ward's Weed | | | | | 0.1 | 20 | 20 | 2000 | 1 | 500 | 5 | 500 | 0.5 | 300 | 40 | 1000 | 40 | 1000 | 35 | 3000 | | | 5 | 1000 |
| Brassicaceae | Sisymbrium erysimoides | Smooth Mustard | | | | | 0.2 | 100 | 1 | 50 | 0.5 | 100 | | | | | | | | | 0.2 | 10 | | | | |
| Brassicaceae | Sisymbrium irio | London Rocket | | | | | | | | | | | | | | | | | | | | | | | 15 | 500 |
| Brassicaceae | Sisymbrium officinale | Hedge Mustard | | | | | | | | | | | | | 0.1 | 10 | | | | | | | | | | |
| Brassicaceae | Sisymbrium orientale | Indian Hedge Mustard | | | 0.5 | 30 | | | | | 0.1 | 5 | | | | | | | | | | | 2 | 20 | 0.1 | 5 |
| Brassicaceae | Sisymbrium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Silene gallica | French Catchfly | | | | | | | | | 0.1 | 20 | 0.1 | 50 | | | | | | | 0.5 | 100 | | | | |
| Caryophyllaceae | Spergula spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium murale | Nettle-leaf Goosefoot | | | 0.2 | 5 | | | | | | | | | | | | | | | | | 2 | 20 | | |
| Cucurbitaceae | Cucumis myriocarpus subsp. myriocarpus | Paddy Melon | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago laciniata | Cut-leaved Medic | 2 | 300 | | | 0.5 | 100 | 0.5 | 100 | 10 | 1000 | 0.5 | 500 | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago minima | Woolly Burr Medic | | | 20 | 2000 | | | 10 | 1000 | 1 | 200 | 50 | 5000 | | | 5 | 100 | | | 60 | 5000 | | | | |
| Fabaceae (Faboideae) | Medicago polymorpha | Burr Medic | 20 | 700 | | | | | | | | | | | 25 | 700 | 30 | 200 | 10 | 100 | | | 15 | 100 | | |
| Fabaceae (Faboideae) | Medicago truncatula | Barrel Medic | | | | | | | | | 0.1 | 50 | 0.5 | 500 | | | | | | | 2 | 300 | | | 1 | 500 |
| Fabaceae (Faboideae) | Trifolium tomentosum | Woolly Clover | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Vicia spp. | Vetch | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Asteraceae | Sonchus oleraceus | Common Sowthistle | 0.2 | 50 | 0.1 | 10 | 0.2 | 10 | 0.2 | 50 | 0.1 | 20 | | | 0.5 | 50 | 0.2 | 30 | 0.1 | 2 | 0.1 | 2 | | | 0.2 |
| Asteraceae | Taraxacum officinale | Dandelion | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Xanthium spinosum | Bathurst Burr | | | | | | | | | | | | | | | | | | | | | | | |
| Boraginaceae | Echium plantagineum | Patterson's Curse | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Brassicaceae | Alyssum linifolium | Flax-leaf Alyssum | | | | | | | | | 0.1 | 10 | | | | | | | | | | | | | |
| Brassicaceae | Carrichtera annua | Ward's Weed | 2 | 1000 | | | 0.5 | 30 | 25 | 2000 | 5 | 500 | 25 | 2000 | 5 | 1000 | | | 15 | 2000 | 10 | 1000 | 5 | 500 | 15 |
| Brassicaceae | Sisymbrium erysimoides | Smooth Mustard | | | 2 | 200 | 5 | 200 | 0.1 | 50 | 5 | 400 | 10 | 300 | 15 | 500 | 1 | 50 | 0.2 | 5 | 0.2 | 5 | | | 0.5 |
| Brassicaceae | Sisymbrium irio | London Rocket | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium officinale | Hedge Mustard | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium orientale | Indian Hedge Mustard | | | | | 0.2 | 20 | | | | | | | | | | | | | | | 0.1 | 5 | 0.1 |
| Brassicaceae | Sisymbrium spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Silene gallica | French Catchfly | 0.2 | 100 | | | | | 0.2 | 100 | 0.1 | 50 | | | | | 0.1 | 30 | 0.2 | 20 | | | 0.2 | 100 | 0.1 |
| Caryophyllaceae | Spergula spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium murale | Nettle-leaf Goosefoot | | | | | | | | | | | | | | | | | | | | | | | |
| Cucurbitaceae | Cucumis myriocarpus subsp. myriocarpus | Paddy Melon | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago laciniata | Cut-leaved Medic | | | | | 2 | 300 | | | 5 | 1000 | | | | | | | | | | | | | 15 |
| Fabaceae (Faboideae) | Medicago minima | Woolly Burr Medic | 5 | 1000 | 0.1 | 100 | 0.5 | 50 | | | 0.4 | 100 | 45 | 3000 | 0.5 | 300 | 70 | 3000 | 65 | 4000 | 40 | 3000 | 60 | 5000 | 5 |
| Fabaceae (Faboideae) | Medicago polymorpha | Burr Medic | 0.1 | 10 | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago truncatula | Barrel Medic | | | | | | | 30 | 2000 | 0.4 | 50 | | | | | 5 | 300 | | | 0.1 | 20 | | | |
| Fabaceae (Faboideae) | Trifolium tomentosum | Woolly Clover | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Vicia spp. | Vetch | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Asteraceae | Sonchus oleraceus | Common Sowthistle | 10 | 0.1 | 10 | 0.1 | 1 | 0.1 | 10 | 0.1 | 5 | 0.5 | 50 | 0.2 | 40 | 1 | 50 | 0.1 | 20 | 10 | 100 | 0.1 | 20 | 0.2 | 20 | 0.5 |
| Asteraceae | Taraxacum officinale | Dandelion | | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | | |
| Asteraceae | Xanthium spinosum | Bathurst Burr | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Boraginaceae | Echium plantagineum | Patterson's Curse | 10 | | | | | | | 0.1 | 5 | | | | | | | | | | | 0.1 | 1 | 0.2 | 10 | 0.1 |
| Brassicaceae | Alyssum linifolium | Flax-leaf Alyssum | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Carrichtera annua | Ward's Weed | 2000 | | | 0.1 | 100 | | | | | | | 5 | 100 | | | 30 | 1000 | | | | | 10 | 100 | |
| Brassicaceae | Sisymbrium erysimoides | Smooth Mustard | 100 | 25 | 500 | 10 | 1000 | 5 | 300 | 0.5 | 100 | 0.5 | 50 | | | 0.1 | 20 | | | | | | | | | |
| Brassicaceae | Sisymbrium irio | London Rocket | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium officinale | Hedge Mustard | | | | | | | | | | | | | | | | | | 30 | 100 | | | | | 0.1 |
| Brassicaceae | Sisymbrium orientale | Indian Hedge Mustard | 20 | | | 0.1 | 10 | | | 0.1 | 10 | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium spp. | - | | | | | | | | | | | | | | | | | | | | 0.1 | 3 | | | |
| Caryophyllaceae | Silene gallica | French Catchfly | 20 | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergula spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium murale | Nettle-leaf Goosefoot | | | | | | | | | | | | | | | | | | | | | | | | |
| Cucurbitaceae | Cucumis myriocarpus subsp. myriocarpus | Paddy Melon | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago laciniata | Cut-leaved Medic | 500 | 0.1 | 5 | | | | | 0.5 | 100 | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago minima | Woolly Burr Medic | 200 | | | | | | | | | 70 | 1000 | 10 | 500 | 2 | 50 | 0.5 | 40 | 10 | 100 | 0.1 | 5 | 10 | 50 | 0.1 |
| Fabaceae (Faboideae) | Medicago polymorpha | Burr Medic | | | | | | | | | | | | | | 2 | 40 | | | 20 | 500 | | | 20 | 200 | |
| Fabaceae (Faboideae) | Medicago truncatula | Barrel Medic | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Trifolium tomentosum | Woolly Clover | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Vicia spp. | Vetch | | | | | | | | 0.1 | 5 | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Sonchus oleraceus | Common Sowthistle | 90 | 5 | 50 | 0.2 | 20 | 0.1 | 5 | 0.1 | 20 | 2 | 50 | 0.1 | 5 | 0.1 | 5 | 0.1 | 3 | 0.1 | 10 | 0.2 | 20 | 0.2 | 50 | 0.1 | 10 |
| Asteraceae | Taraxacum officinale | Dandelion | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Asteraceae | Xanthium spinosum | Bathurst Burr | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Boraginaceae | Echium plantagineum | Patterson's Curse | 10 | 1 | 50 | | | | | | | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 10 |
| Brassicaceae | Alyssum linifolium | Flax-leaf Alyssum | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | |
| Brassicaceae | Carrichtera annua | Ward's Weed | | | | 1 | 50 | 20 | 500 | | | 30 | 500 | 5 | 1000 | 15 | 1000 | 35 | 3000 | | | | | | | | |
| Brassicaceae | Sisymbrium erysimoides | Smooth Mustard | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium irio | London Rocket | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium officinale | Hedge Mustard | 3 | 0.2 | 20 | | | | | | | | | 0.2 | 30 | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium orientale | Indian Hedge Mustard | | | | 0.2 | 10 | | | | | 0.2 | 20 | | | 0.1 | 5 | | | 0.1 | 10 | | | 0.2 | 20 | | |
| Brassicaceae | Sisymbrium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Silene gallica | French Catchfly | | | | | | | | | | | | 0.1 | 20 | 0.1 | 10 | | | | | | | | | | |
| Caryophyllaceae | Spergula spp. | - | | | | | | | | 0.1 | 50 | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium murale | Nettle-leaf Goosefoot | | | | | | | | | | | | | | | | | | | | | | 0.1 | 2 | | |
| Cucurbitaceae | Cucumis myriocarpus subsp. myriocarpus | Paddy Melon | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago laciniata | Cut-leaved Medic | | | | | | | | | | | | 0.5 | 300 | | | | | | | 5 | 50 | | | | |
| Fabaceae (Faboideae) | Medicago minima | Woolly Burr Medic | 6 | | | | | | | 0.5 | 50 | 5 | 200 | 30 | 2000 | 0.1 | 100 | 30 | 1000 | | | | | 0.5 | 20 | | |
| Fabaceae (Faboideae) | Medicago polymorpha | Burr Medic | | 5 | 50 | 40 | 200 | 10 | 200 | | | 10 | 200 | 0.5 | 100 | | | | | 1 | 50 | 60 | 500 | | | 20 | 100 |
| Fabaceae (Faboideae) | Medicago truncatula | Barrel Medic | | 5 | 100 | 10 | 200 | | | 5 | 100 | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Trifolium tomentosum | Woolly Clover | | | | | | | | 1 | 10 | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Vicia spp. | Vetch | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Asteraceae | Sonchus oleraceus | Common Sowthistle | 0.5 | 50 | | | | | | | | | | | | | | |
| Asteraceae | Taraxacum officinale | Dandelion | | | | | | | | | | | | | | | | |
| Asteraceae | Xanthium spinosum | Bathurst Burr | 0.1 | 1 | | | | | | | | | | | | | | |
| Boraginaceae | Echium plantagineum | Patterson's Curse | 0.1 | 1 | | | | | | | | | | | | | | |
| Brassicaceae | Alyssum linifolium | Flax-leaf Alyssum | | | | | | | | | | | | | | | | |
| Brassicaceae | Carrichtera annua | Ward's Weed | 5 | 2000 | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium erysimoides | Smooth Mustard | | | | | | | | | | | 0.2 | 20 | | | | |
| Brassicaceae | Sisymbrium irio | London Rocket | | | | | | | | | | | | | | | | |
| Brassicaceae | Sisymbrium officinale | Hedge Mustard | | | | | 0.5 | 20 | | | | | | | | | | |
| Brassicaceae | Sisymbrium orientale | Indian Hedge Mustard | | | 1 | 20 | | | 2 | 50 | 0.3 | 20 | | | | | | |
| Brassicaceae | Sisymbrium spp. | - | | | | | | | | | | | | | 0.1 | 10 | 0.1 | 8 |
| Caryophyllaceae | Silene gallica | French Catchfly | | | | | | | | | | | | | | | | |
| Caryophyllaceae | Spergula spp. | - | | | | | | | | | | | | | | | | |
| Chenopodiaceae | Chenopodium murale | Nettle-leaf Goosefoot | | | | | | | | | | | | | | | | |
| Cucurbitaceae | Cucumis myriocarpus subsp. myriocarpus | Paddy Melon | | | | | 0.3 | 10 | | | 0.1 | 4 | | | | | | |
| Fabaceae (Faboideae) | Medicago laciniata | Cut-leaved Medic | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Medicago minima | Woolly Burr Medic | 0.1 | 10 | | | | | | | | | | | | | 2 | 90 |
| Fabaceae (Faboideae) | Medicago polymorpha | Burr Medic | | | 40 | 1000 | 5 | 200 | 20 | 300 | | | | | | | 20 | 800 |
| Fabaceae (Faboideae) | Medicago truncatula | Barrel Medic | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Trifolium tomentosum | Woolly Clover | | | | | | | | | | | | | | | | |
| Fabaceae (Faboideae) | Vicia spp. | Vetch | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Geraniaceae | Erodium cicutarium | Common Crowfoot | | | | | | | 0.1 | 10 | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium vulgare | White Horehound | | | | | 0.1 | 2 | | | | | | | | | | | | | 0.1 | 1 | | | | |
| Lamiaceae | Salvia verbenaca | Vervain | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva nicaeensis | Mallow of Nice | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva parviflora | Small-flowered Mallow | | | 0.1 | 5 | | | | | | | 0.2 | 5 | 0.5 | 20 | 0.1 | 5 | | | 0.2 | 50 | | | | |
| Papaveraceae | Papaver hybridum | Rough Poppy | | | | | | | | | | | 0.1 | 1 | 0.1 | 5 | | | | | | | | | | |
| Plumbaginaceae | Limonium lobatum | Winged Sea Lavender | | | | | | | | | | | | | 0.1 | 5 | 0.1 | 5 | | | | | 0.1 | 5 | 0.1 | 5 |
| Poaceae | Alopecurus geniculatus | Marsh Foxtail | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena barbata | Bearded Oats | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena fatua | Wild Oats | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena spp. | Oats | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus diandrus | Great Brome | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus rubens | Red Brome | | | 0.2 | 50 | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Poaceae | Hordeum leporinum | Barley Grass | 7 | 2000 | 3 | 500 | 40 | 2000 | | | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum spp. | - | | | | | | | | | 15 | 1000 | 0.5 | 100 | 5 | 1000 | 10 | 2000 | 10 | 500 | 20 | 3000 | | | 5 | 2000 |
| Poaceae | Lamarckia aurea | Goldentop | | | 0.1 | 50 | | | | | | | | | | | 0.1 | 20 | | | | | | | | |
| Poaceae | Lolium rigidum | Wimmera Ryegrass | 0.2 | 200 | | | | | | | 3 | 700 | 1 | 200 | 0.2 | 200 | 0.2 | 200 | 0.5 | 100 | 0.2 | 100 | | | 0.5 | 200 |
| Poaceae | Parapholis incurva | Coast Barb Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Schismus barbatus | Arabian Grass | 0.1 | 50 | 1 | 20 | 1 | 1000 | | | 3 | 1000 | 5 | 400 | 2 | 1000 | 35 | 3000 | 1 | 200 | 15 | 5000 | 20 | 500 | 25 | 3000 |
| Poaceae | Vulpia bromoides | Squirrel Tail Fesque | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia myuros | Rat's Tail Fescue | | | | | 1 | 300 | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia spp. | Rat's-tail Fescue | | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Emex australis | Spiny Emex | | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Polygonum aviculare | Wireweed | | | | | | | | | | | | | | | | | 0.2 | 5 | | | | | | |
| Solanaceae | Lycium ferocissimum | African Boxthorn | 0.5 | 1 | | | | | | | | | 2 | 2 | | | 0.5 | 5 | | | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Geraniaceae | Erodium cicutarium | Common Crowfoot | | | | | | | | | | | 0.1 | 20 | | | | | | | | | | | | |
| Lamiaceae | Marrubium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium vulgare | White Horehound | | | 0.5 | 3 | | | | | | | | | 2 | 20 | | | | | | | 0.1 | 20 | | |
| Lamiaceae | Salvia verbenaca | Vervain | | | | | | | | | | | | | 0.2 | 10 | | | | | | | | | | |
| Malvaceae | Malva nicaeensis | Mallow of Nice | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva parviflora | Small-flowered Mallow | | | | | 0.1 | 2 | | | | | | | 0.5 | 20 | | | | | | | | | | |
| Papaveraceae | Papaver hybridum | Rough Poppy | | | | | | | | | | | | | | | | | | | | | | | | |
| Plumbaginaceae | Limonium lobatum | Winged Sea Lavender | 0.5 | 50 | | | | | | | 0.1 | 20 | | | | | 0.1 | 20 | 0.1 | 1 | | | | | | |
| Poaceae | Alopecurus geniculatus | Marsh Foxtail | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena barbata | Bearded Oats | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena fatua | Wild Oats | | | | | | | | | | | 0.2 | 50 | | | | | | | | | | | | |
| Poaceae | Avena spp. | Oats | | | | | | | | | | | | | 2 | 200 | | | | | | | | | | |
| Poaceae | Bromus diandrus | Great Brome | | | | | | | | | | | | | 5 | 300 | | | | | | | | | | |
| Poaceae | Bromus rubens | Red Brome | | | 0.2 | 30 | | | | | 0.1 | 10 | 1 | 100 | 1 | 200 | | | | | 0.1 | 5 | | | | |
| Poaceae | Hordeum leporinum | Barley Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum spp. | - | 35 | 2000 | 60 | 5000 | 5 | 500 | | | 0.1 | 50 | 0.1 | 50 | 10 | 500 | | | 0.5 | 20 | 1 | 300 | 0.1 | 20 | 2 | 500 |
| Poaceae | Lamarckia aurea | Goldentop | 0.2 | 100 | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Lolium rigidum | Wimmera Ryegrass | 0.1 | 10 | 0.2 | 50 | 0.1 | 10 | | | 0.1 | 20 | 0.5 | 100 | | | | | | | | | 0.1 | 20 | 30 | 2000 |
| Poaceae | Parapholis incurva | Coast Barb Grass | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Schismus barbatus | Arabian Grass | | | 2 | 700 | 5 | 1000 | | | 5 | 1000 | | | | | 5 | 100 | | | | | 10 | 100 | 25 | 2000 |
| Poaceae | Vulpia bromoides | Squirrel Tail Fesque | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia myuros | Rat's Tail Fescue | | | | | | | | | | | | | | | 1 | 200 | | | | | | | | |
| Poaceae | Vulpia spp. | Rat's-tail Fescue | | | | | | | 0.5 | 100 | | | | | | | | | | | | | | | | |
| Polygonaceae | Emex australis | Spiny Emex | | | | | | | | | | | | | | | | | | | | | 0.1 | 20 | | |
| Polygonaceae | Polygonum aviculare | Wireweed | | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Lycium ferocissimum | African Boxthorn | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 1 |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Geraniaceae | Erodium cicutarium | Common Crowfoot | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium spp. | - | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium vulgare | White Horehound | | | | | | | | | | | | | | | | | | | | | | | 0.5 |
| Lamiaceae | Salvia verbenaca | Vervain | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva nicaeensis | Mallow of Nice | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva parviflora | Small-flowered Mallow | 0.1 | 1 | | | 0.2 | 5 | | | | | 0.1 | 2 | | | | | 0.1 | 3 | | | | | |
| Papaveraceae | Papaver hybridum | Rough Poppy | | | | | | | | | | | | | | | | | | | | | | | |
| Plumbaginaceae | Limonium lobatum | Winged Sea Lavender | | | | | | | | | | | | | | | 5 | 200 | | | | | | | |
| Poaceae | Alopecurus geniculatus | Marsh Foxtail | | | | | 0.2 | 20 | 0.1 | 5 | | | | | | | | | | | | | | | |
| Poaceae | Avena barbata | Bearded Oats | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena fatua | Wild Oats | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena spp. | Oats | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus diandrus | Great Brome | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus rubens | Red Brome | 1 | 200 | | | | | 0.2 | 200 | | | | | | | | | | | | | 1 | 300 | |
| Poaceae | Hordeum leporinum | Barley Grass | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum spp. | - | 10 | 1000 | 2 | 500 | | | | | 2 | 2000 | 2 | 300 | 5 | 1000 | 5 | 400 | 15 | 1000 | 0.2 | 40 | | | 2 |
| Poaceae | Lamarckia aurea | Goldentop | | | 1 | 400 | | | | | | | | | | | | | | | | | | | |
| Poaceae | Lolium rigidum | Wimmera Ryegrass | 0.1 | 50 | 0.1 | 50 | 0.1 | 10 | 0.1 | 50 | 0.1 | 5 | | | 0.1 | 20 | | | | | | | 5 | 1000 | |
| Poaceae | Parapholis incurva | Coast Barb Grass | | | | | | | | | | | | | | | | | | | 0.1 | 10 | | | |
| Poaceae | Schismus barbatus | Arabian Grass | 2 | 1000 | 15 | 2000 | 20 | 2000 | 0.2 | 300 | 30 | 5000 | 0.1 | 10 | 0.5 | 200 | | | | | | | | | |
| Poaceae | Vulpia bromoides | Squirrel Tail Fesque | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia myuros | Rat's Tail Fescue | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia spp. | Rat's-tail Fescue | | | | | | | | | 0.2 | 1000 | | | | | | | | | 1 | 500 | | | |
| Polygonaceae | Emex australis | Spiny Emex | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Polygonum aviculare | Wireweed | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Lycium ferocissimum | African Boxthorn | | | 1 | 1 | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Cvr% |
| Geraniaceae | Erodium cicutarium | Common Crowfoot | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium spp. | - | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Lamiaceae | Marrubium vulgare | White Horehound | 20 | | | | | | | | | | | | | | | | | | 0.1 | 5 | | | | | |
| Lamiaceae | Salvia verbenaca | Vervain | | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva nicaeensis | Mallow of Nice | | | | | | | | | | | | | | | | | | | 2 | 20 | | | | | |
| Malvaceae | Malva parviflora | Small-flowered Mallow | | | | | | | | | | | | | | | | | | | | | | | | | 0.1 |
| Papaveraceae | Papaver hybridum | Rough Poppy | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plumbaginaceae | Limonium lobatum | Winged Sea Lavender | | | | | | | | | 0.2 | 20 | | | | | 10 | 50 | | | | | 20 | 1000 | | | |
| Poaceae | Alopecurus geniculatus | Marsh Foxtail | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena barbata | Bearded Oats | | | | | | | | | | | | | | | | | | | 0.2 | 20 | | | | | |
| Poaceae | Avena fatua | Wild Oats | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena spp. | Oats | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus diandrus | Great Brome | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus rubens | Red Brome | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum leporinum | Barley Grass | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum spp. | - | 200 | 0.2 | 100 | | | | | | 15 | 1000 | | | 0.2 | 20 | 5 | 20 | | | 10 | 500 | 0.1 | 10 | | | 0.1 |
| Poaceae | Lamarckia aurea | Goldentop | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Lolium rigidum | Wimmera Ryegrass | | 0.1 | 20 | 0.1 | 10 | | | | | | | | | | 2 | 3 | | | | | | | 20 | 200 | 2 |
| Poaceae | Parapholis incurva | Coast Barb Grass | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Schismus barbatus | Arabian Grass | | 15 | 2000 | | | 10 | 1000 | 20 | 2000 | | | | | | 5 | 100 | | | 50 | 1000 | 40 | 5000 | 5 | 10 | 30 |
| Poaceae | Vulpia bromoides | Squirrel Tail Fesque | | | | | | | | | | | | | | | | | | | | | 0.2 | 200 | | | |
| Poaceae | Vulpia myuros | Rat's Tail Fescue | | | | | | | | | | | | | | | | | | | | | | | 0.2 | 10 | |
| Poaceae | Vulpia spp. | Rat's-tail Fescue | | | | | | | | 0.2 | 100 | | | | | | | | | | | | | | | | |
| Polygonaceae | Emex australis | Spiny Emex | | | | | | | | | | | | | | | | | | | 0.1 | 10 | | | | | |
| Polygonaceae | Polygonum aviculare | Wireweed | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Lycium ferocissimum | African Boxthorn | | | | | | | | | | | | | | | | | | | 0.1 | 2 | | | | | |

| Family | Scientific name | Common name | 2_B57 | | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Geraniaceae | Erodium cicutarium | Common Crowfoot | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Lamiaceae | Marrubium spp. | - | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium vulgare | White Horehound | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae | Salvia verbenaca | Vervain | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Malvaceae | Malva nicaeensis | Mallow of Nice | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Malvaceae | Malva parviflora | Small-flowered Mallow | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Papaveraceae | Papaver hybridum | Rough Poppy | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Plumbaginaceae | Limonium lobatum | Winged Sea Lavender | | | | 0.5 | 20 | | | 0.2 | 20 | 0.5 | 20 | | | | | | | | | | | | | | | 2 | 50 |
| Poaceae | Alopecurus geniculatus | Marsh Foxtail | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena barbata | Bearded Oats | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena fatua | Wild Oats | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Avena spp. | Oats | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus diandrus | Great Brome | | | | 5 | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Bromus rubens | Red Brome | | | | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Poaceae | Hordeum leporinum | Barley Grass | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum spp. | - | 10 | 2 | 100 | 2 | 100 | | | | | | | | | | | | | | | | | | | 0.5 | 50 | | |
| Poaceae | Lamarckia aurea | Goldentop | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Lolium rigidum | Wimmera Ryegrass | 200 | | | 0.1 | 10 | 0.1 | 10 | 1 | 10 | | | | | | | 0.1 | 10 | | | | | | | | | 10 | 100 |
| Poaceae | Parapholis incurva | Coast Barb Grass | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Schismus barbatus | Arabian Grass | 3000 | 40 | 500 | 0.5 | 50 | | | 5 | 500 | | | | | | | 1 | 300 | | | | | | | 1 | 50 | 10 | 100 |
| Poaceae | Vulpia bromoides | Squirrel Tail Fesque | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia myuros | Rat's Tail Fescue | | | | 20 | | 5 | | | | | | | | | | | | | | | | | | | | | |
| Poaceae | Vulpia spp. | Rat's-tail Fescue | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Emex australis | Spiny Emex | | | | 0.1 | 5 | | | | | | | | | | | | | | | | | | | | | | |
| Polygonaceae | Polygonum aviculare | Wireweed | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solanaceae | Lycium ferocissimum | African Boxthorn | | | | | | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Geraniaceae | Erodium cicutarium | Common Crowfoot | | | | | | | | | | | | | | | | |
| Lamiaceae | Marrubium spp. | - | | | | | 0.1 | 10 | | | | | 0.1 | 5 | | | | |
| Lamiaceae | Marrubium vulgare | White Horehound | | | | | | | | | | | | | | | | |
| Lamiaceae | Salvia verbenaca | Vervain | | | | | 1 | 20 | 0.2 | 5 | | | | | | | | |
| Malvaceae | Malva nicaeensis | Mallow of Nice | | | | | | | | | | | | | | | | |
| Malvaceae | Malva parviflora | Small-flowered Mallow | | | | | | | | | | | | | | | | |
| Papaveraceae | Papaver hybridum | Rough Poppy | | | | | | | | | | | | | | | | |
| Plumbaginaceae | Limonium lobatum | Winged Sea Lavender | | | 25 | 500 | | | | | | | | | | | | |
| Poaceae | Alopecurus geniculatus | Marsh Foxtail | | | | | | | | | | | | | | | | |
| Poaceae | Avena barbata | Bearded Oats | | | | | | | | | | | | | | | | |
| Poaceae | Avena fatua | Wild Oats | | | | | | | | | | | | | | | | |
| Poaceae | Avena spp. | Oats | | | | | | | | | | | 0.1 | 1 | | | | |
| Poaceae | Bromus diandrus | Great Brome | | | | | | | | | | | | | | | | |
| Poaceae | Bromus rubens | Red Brome | | | 20 | 2000 | 5 | 100 | | | | | | | 0.2 | 50 | 1 | 80 |
| Poaceae | Hordeum leporinum | Barley Grass | | | | | | | | | | | | | | | | |
| Poaceae | Hordeum spp. | - | | | 0.3 | 50 | 15 | 1000 | 1 | 100 | 1 | 50 | 10 | 500 | 0.2 | 20 | 5 | 500 |
| Poaceae | Lamarckia aurea | Goldentop | | | | | 0.5 | 50 | 0.2 | 20 | 0.1 | 20 | | | | | | |
| Poaceae | Lolium rigidum | Wimmera Ryegrass | | | 10 | 500 | | | | | | | | | 0.1 | 20 | 3 | 100 |
| Poaceae | Parapholis incurva | Coast Barb Grass | | | | | | | | | | | | | | | | |
| Poaceae | Schismus barbatus | Arabian Grass | | | 1 | 100 | | | 20 | 1000 | 10 | 1000 | | | 25 | 1000 | 15 | 1000 |
| Poaceae | Vulpia bromoides | Squirrel Tail Fesque | 0.1 | 5 | | | | | | | | | | | | | | |
| Poaceae | Vulpia myuros | Rat's Tail Fescue | | | | | | | | | | | | | 0.1 | 5 | | |
| Poaceae | Vulpia spp. | Rat's-tail Fescue | | | | | | | | | | | | | | | | |
| Polygonaceae | Emex australis | Spiny Emex | | | | | | | | | | | | | | | | |
| Polygonaceae | Polygonum aviculare | Wireweed | | | | | | | | | | | | | | | | |
| Solanaceae | Lycium ferocissimum | African Boxthorn | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502.P.02 | | 37502.P.04 | | 37502.P.05 | | 37502.P.06 | | 37502_B04 | | 37502_B06 | | 37502_B07 | | 37502_B08 | | 37502_B09 | | 37502_B10 | | 37502_B11 | | 37502_B12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Solanaceae | Solanum nigrum | Black-berry Nightshade | | | | | | | | | | | 0.1 | 5 | | | | | | | | | | | | |
| Urticaceae | Urtica urens | Small Nettle | | | | | | | | | | | | | 0.5 | 50 | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B13 | | 37502_B15 | | 37502_B17 | | 37502_B18 | | 37502_B19 | | 37502_B20 | | 37502_B21 | | 37502_B25 | | 37502_B26 | | 37502_B27 | | 37502_B28 | | 37502_B29 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Solanaceae | Solanum nigrum | Black-berry Nightshade | | | 0.1 | 2 | | | | | | | | | | | | | | | | | 0.1 | 1 | | |
| Urticaceae | Urtica urens | Small Nettle | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B30 | | 37502_B31 | | 37502_B32 | | 37502_B33 | | 37502_B35 | | 37502_B37 | | 37502_B38 | | 37502_B39 | | 37502_B40 | | 37502_B41 | | 37502_B42 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Solanaceae | Solanum nigrum | Black-berry Nightshade | | | | | | | | | | | | | | | | | | | | | | | |
| Urticaceae | Urtica urens | Small Nettle | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B43 | | 37502_B44 | | 37502_B45 | | 37502_B46 | | 37502_B47 | | 37502_B50 | | 37502_B51 | | 37502_B52 | | 37502_B53 | | 37502_B54 | | 37502_B55 | | 37502_B56 | | 3750 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% |
| Solanaceae | Solanum nigrum | Black-berry Nightshade | | | | | | | | | | | | | | | | | | | 20 | 0.1 | | | | | |
| Urticaceae | Urtica urens | Small Nettle | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 2_B57 | | 37502_B58 | | 37502_B60 | | 37502_B63 | | 37502_B64 | | 37502_B65 | | 37502_B901 | | 37502_B902 | | 37502_B903 | | 37502_B904 | | 37502_B905 | | 37502_B906 | | 37502_B907 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Solanaceae | Solanum nigrum | Black-berry Nightshade | | | 0.1 | 10 | | | | | | | | | | | | | | | | | | | 0.1 | 1 | | |
| Urticaceae | Urtica urens | Small Nettle | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Family | Scientific name | Common name | 37502_B908 | | 37502_B909 | | 37502_B910 | | 37502_B911 | | 37502_B912 | | 37502_B913 | | 37502_B914 | | 37502_B915 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. | Cvr% | Abund. |
| Solanaceae | Solanum nigrum | Black-berry Nightshade | | | | | | | | | | | | | | | | |
| Urticaceae | Urtica urens | Small Nettle | | | | | | | | | | | | | | | | |

| Plot ID | PCT | Area (Ha) | Patch size | Condition | Zone | Easting | Northing | Bearing | Comp. Tree | Comp. Shrub | Comp. Grass | Comp. Forbs | Comp. Ferns | Comp. Other | Struc. Tree | Struc. Shrub | Struc. Grass | Struc. Forbs | Stuc. Ferns | Stuc. Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37502_B50 | 16 | 2.78 | 101 | DNG | 54 | 746396 | 6131810 | 8 | 0 | 5 | 3 | 7 | 0 | 2 | 0.0 | 10.8 | 45.0 | 0.8 | 0.0 | 0.2 |
| 37502_B51 | 16 | 2.78 | 101 | DNG | 54 | 746334 | 6131531 | 31 | 0 | 10 | 4 | 8 | 0 | 2 | 0.0 | 3.0 | 77.2 | 1.3 | 0.0 | 0.2 |
| 37502_B904 | 16 | 2.78 | 101 | DNG | 54 | 745864 | 6132908 | 46 | 0 | 3 | 4 | 7 | 0 | 1 | 0.0 | 5.6 | 22.2 | 8.1 | 0.0 | 0.5 |
| 37502_B907 | 16 | 2.78 | 101 | DNG | 54 | 738208 | 6137419 | 298 | 1 | 7 | 8 | 7 | 1 | 1 | 0.1 | 10.8 | 77.1 | 1.0 | 3.0 | 0.1 |
| 37502.P.02 | 16 | 0.36 | 101 | Low | 54 | 732645 | 6144869 | 280 | 1 | 8 | 1 | 10 | 0 | 0 | 30.0 | 9.4 | 0.1 | 1.1 | 0.0 | 0.0 |
| 37502_B07 | 16 | 0.36 | 101 | Low | 54 | 729635 | 6140499 | 139 | 1 | 3 | 0 | 4 | 0 | 0 | 7.0 | 0.8 | 0.0 | 0.9 | 0.0 | 0.0 |
| 37502_B08 | 16 | 0.36 | 101 | Low | 54 | 734098 | 6139650 | 0 | 1 | 8 | 0 | 4 | 0 | 0 | 15.0 | 1.6 | 0.0 | 0.8 | 0.0 | 0.0 |
| 37502_B09 | 16 | 0.36 | 101 | Low | 54 | 747230 | 6133641 | 81 | 1 | 7 | 1 | 17 | 1 | 0 | 5.0 | 19.3 | 0.5 | 14.2 | 1.0 | 0.0 |
| 37502_B13 | 16 | 0.36 | 101 | Low | 54 | 730589 | 6143330 | 132 | 1 | 7 | 0 | 8 | 1 | 0 | 15.0 | 16.8 | 0.0 | 1.4 | 2.0 | 0.0 |
| 37502_B06 | 16 | 3.8 | 101 | Moderate | 54 | 746728 | 6134962 | 250 | 1 | 7 | 2 | 12 | 0 | 1 | 30.0 | 17.9 | 1.2 | 13.2 | 0.0 | 0.1 |
| 37502_B10 | 16 | 3.8 | 101 | Moderate | 54 | 743620 | 6132784 | 205 | 1 | 11 | 3 | 19 | 0 | 0 | 10.0 | 11.5 | 0.4 | 8.1 | 0.0 | 0.0 |
| 37502_B11 | 16 | 3.8 | 101 | Moderate | 54 | 741144 | 6138505 | 172 | 2 | 10 | 3 | 6 | 1 | 0 | 20.1 | 19.9 | 7.2 | 14.4 | 0.5 | 0.0 |
| 37502_B12 | 16 | 3.8 | 101 | Moderate | 54 | 733400 | 6140345 | 258 | 1 | 12 | 2 | 11 | 0 | 0 | 35.0 | 25.3 | 0.3 | 2.9 | 0.0 | 0.0 |
| 37502_B914 | 16 | 0.21 | 5 | Paddock trees | 54 | 736478 | 6142281 | 21 | 1 | 10 | 2 | 4 | 0 | 0 | 4.0 | 10.4 | 0.2 | 0.6 | 0.0 | 0.0 |
| 37502_B15 | 21 | 1.17 | 101 | Moderate | 54 | 737149 | 6137913 | 344 | 1 | 5 | 3 | 2 | 0 | 0 | 25.0 | 6.3 | 2.2 | 0.6 | 0.0 | 0.0 |
| 37502_B28 | 21 | 1.17 | 101 | Moderate | 54 | 744329 | 6136008 | 265 | 2 | 6 | 3 | 6 | 0 | 2 | 10.0 | 6.5 | 2.1 | 0.8 | 0.0 | 0.4 |
| 37502_B54 | 21 | 1.17 | 101 | Moderate | 54 | 743478 | 6132202 | 113 | 1 | 3 | 2 | 2 | 0 | 2 | 15.0 | 6.0 | 3.0 | 0.2 | 0.0 | 1.1 |
| 37502_B911 | 21 | 1.17 | 101 | Moderate | 54 | 743963 | 6136003 | 182 | 2 | 6 | 3 | 3 | 0 | 0 | 19.0 | 9.5 | 0.6 | 0.3 | 0.0 | 0.0 |
| 37502_B17 | 23 | 2.03 | 101 | Moderate | 54 | 731870 | 6147773 | 186 | 1 | 4 | 1 | 4 | 0 | 1 | 25.0 | 15.6 | 0.1 | 0.4 | 0.0 | 0.1 |
| 37502_B18 | 23 | 2.03 | 101 | Moderate | 54 | 743389 | 6137790 | 74 | 1 | 9 | 4 | 14 | 0 | 0 | 30.0 | 18.1 | 2.1 | 2.1 | 0.0 | 0.0 |
| 37502_B19 | 23 | 2.03 | 101 | Moderate | 54 | 737941 | 6141869 | 104 | 1 | 7 | 3 | 10 | 0 | 0 | 25.0 | 27.3 | 6.0 | 1.0 | 0.0 | 0.0 |
| 37502_B55 | 23 | 2.03 | 101 | Moderate | 54 | 733665 | 6140311 | 274 | 2 | 8 | 2 | 12 | 0 | 0 | 14.0 | 26.6 | 0.2 | 1.3 | 0.0 | 0.0 |
| 37502_B902 | 23 | 2.03 | 101 | Moderate | 54 | 746310 | 6133007 | 155 | 1 | 6 | 4 | 8 | 0 | 0 | 35.0 | 9.3 | 0.8 | 0.9 | 0.0 | 0.0 |
| 37502_B57 | 57 | 0.19 | 101 | Moderate | 54 | 737149 | 6138078 | 180 | 1 | 12 | 5 | 4 | 0 | 1 | 60.0 | 14.0 | 0.6 | 1.8 | 0.0 | 0.1 |
| 37502_B20 | 58 | 30.01 | 101 | DNG | 54 | 735200 | 6144997 | 138 | 0 | 7 | 4 | 12 | 0 | 1 | 0.0 | 1.6 | 51.5 | 3.1 | 0.0 | 0.1 |
| 37502_B25 | 58 | 30.01 | 101 | DNG | 54 | 740688 | 6138732 | 150 | 1 | 5 | 8 | 12 | 0 | 1 | 0.1 | 10.4 | 74.8 | 7.7 | 0.0 | 0.5 |
| 37502_B26 | 58 | 30.01 | 101 | DNG | 54 | 741019 | 6137335 | 348 | 0 | 8 | 4 | 8 | 0 | 2 | 0.0 | 3.1 | 79.0 | 0.8 | 0.0 | 0.2 |
| 37502_B27 | 58 | 30.01 | 101 | DNG | 54 | 742953 | 6138173 | 124 | 0 | 8 | 3 | 10 | 0 | 1 | 0.0 | 4.9 | 8.0 | 1.4 | 0.0 | 0.1 |
| 37502_B40 | 58 | 30.01 | 101 | DNG | 54 | 743137 | 6137998 | 44 | 0 | 7 | 3 | 11 | 0 | 0 | 0.0 | 4.5 | 4.5 | 1.3 | 0.0 | 0.0 |
| 37502_B41 | 58 | 30.01 | 101 | DNG | 54 | 743330 | 6137424 | 1 | 0 | 5 | 7 | 14 | 0 | 0 | 0.0 | 9.3 | 19.4 | 29.2 | 0.0 | 0.0 |
| 37502_B53 | 58 | 30.01 | 101 | DNG | 54 | 744905 | 6136744 | 191 | 0 | 5 | 7 | 10 | 0 | 1 | 0.0 | 1.7 | 106.1 | 35.9 | 0.0 | 0.1 |
| 37502_B60 | 58 | 30.01 | 101 | DNG | 54 | 739900 | 6138931 | 317 | 0 | 8 | 7 | 15 | 0 | 1 | 0.0 | 17.2 | 43.3 | 4.7 | 0.0 | 0.5 |
| 37502_B903 | 58 | 30.01 | 101 | DNG | 54 | 743379 | 6137594 | 189 | 1 | 5 | 3 | 10 | 0 | 0 | 5.0 | 0.9 | 30.5 | 1.1 | 0.0 | 0.0 |
| 37502_B32 | 58 | 0.85 | 101 | High | 54 | 746992 | 6134577 | 189 | 1 | 9 | 2 | 9 | 0 | 1 | 15.0 | 18.3 | 2.0 | 10.6 | 0.0 | 0.1 |
| 37502_B33 | 58 | 0.85 | 101 | High | 54 | 735359 | 6144910 | 136 | 1 | 9 | 3 | 8 | 0 | 0 | 15.0 | 38.3 | 2.6 | 0.9 | 0.0 | 0.0 |
| 37502_B04 | 58 | 20.91 | 101 | Moderate | 54 | 737188 | 6138324 | 170 | 2 | 11 | 2 | 4 | 0 | 0 | 8.0 | 22.0 | 1.1 | 0.8 | 0.0 | 0.0 |
| 37502_B29 | 58 | 20.91 | 101 | Moderate | 54 | 735539 | 6144318 | 283 | 1 | 7 | 1 | 5 | 0 | 0 | 20.0 | 22.5 | 0.1 | 1.4 | 0.0 | 0.0 |

| Plot ID | PCT | Area (Ha) | Patch size | Condition | Zone | Easting | Northing | Bearing | Comp. Tree | Comp. Shrub | Comp. Grass | Comp. Forbs | Comp. Ferns | Comp. Other | Struc. Tree | Struc. Shrub | Struc. Grass | Struc. Forbs | Stuc. Ferns | Stuc. Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37502_B30 | 58 | 20.91 | 101 | Moderate | 54 | 738052 | 6142265 | 92 | 1 | 7 | 1 | 10 | 0 | 0 | 15.0 | 13.4 | 0.1 | 1.0 | 0.0 | 0.0 |
| 37502_B31 | 58 | 20.91 | 101 | Moderate | 54 | 736421 | 6142865 | 181 | 2 | 9 | 2 | 8 | 0 | 0 | 45.0 | 19.0 | 0.2 | 1.7 | 0.0 | 0.0 |
| 37502_B35 | 58 | 20.91 | 101 | Moderate | 54 | 739879 | 6137310 | 105 | 2 | 15 | 2 | 19 | 0 | 0 | 6.0 | 36.3 | 0.2 | 5.9 | 0.0 | 0.0 |
| 37502_B37 | 58 | 20.91 | 101 | Moderate | 54 | 742680 | 6138358 | 284 | 2 | 8 | 3 | 11 | 0 | 0 | 23.0 | 15.1 | 5.3 | 2.6 | 0.0 | 0.0 |
| 37502_B58 | 58 | 20.91 | 101 | Moderate | 54 | 747305 | 6133868 | 330 | 2 | 6 | 2 | 6 | 0 | 0 | 15.2 | 13.3 | 5.2 | 26.0 | 0.0 | 0.0 |
| 37502_B912 | 58 | 20.91 | 101 | Moderate | 54 | 746382 | 6135821 | 123 | 1 | 7 | 3 | 5 | 0 | 0 | 30.0 | 18.2 | 0.8 | 1.0 | 0.0 | 0.0 |
| 37502_B910 | 58 | 0.07 | 5 | Paddock trees | 54 | 745021 | 6131905 | 272 | 1 | 7 | 3 | 3 | 0 | 0 | 25.0 | 7.2 | 0.7 | 0.4 | 0.0 | 0.0 |
| 37502_B915 | 58 | 0.07 | 5 | Paddock trees | 54 | 735951 | 6142845 | 142 | 1 | 5 | 0 | 1 | 0 | 0 | 4.0 | 42.2 | 0.0 | 0.1 | 0.0 | 0.0 |
| 37502.P.06 | 163 | 3.58 | 101 | Moderate | 54 | 744295 | 6137130 | 160 | 0 | 7 | 4 | 14 | 0 | 0 | 0.0 | 21.5 | 7.2 | 26.3 | 0.0 | 0.0 |
| 37502_B39 | 163 | 3.58 | 101 | Moderate | 54 | 745806 | 6133121 | 252 | 0 | 5 | 2 | 11 | 0 | 0 | 0.0 | 16.2 | 6.0 | 2.7 | 0.0 | 0.0 |
| 37502_B42 | 163 | 3.58 | 101 | Moderate | 54 | 746273 | 6133069 | 295 | 0 | 2 | 4 | 11 | 0 | 0 | 0.0 | 15.1 | 4.7 | 3.6 | 0.0 | 0.0 |
| 37502_B63 | 163 | 3.58 | 101 | Moderate | 54 | 741379 | 6138330 | 65 | 0 | 11 | 7 | 8 | 0 | 1 | 0.0 | 19.2 | 83.3 | 5.9 | 0.0 | 0.2 |
| 37502_B64 | 163 | 3.58 | 101 | Moderate | 54 | 745679 | 6132979 | 348 | 0 | 9 | 6 | 12 | 0 | 2 | 0.0 | 21.6 | 81.4 | 3.1 | 0.0 | 0.6 |
| 37502_B65 | 163 | 3.58 | 101 | Moderate | 54 | 746032 | 6133317 | 302 | 0 | 6 | 7 | 14 | 0 | 1 | 0.0 | 17.2 | 51.4 | 9.0 | 0.0 | 0.2 |
| 37502_B21 | 170 | 3.5 | 101 | DNG | 54 | 737689 | 6141047 | 0 | 0 | 5 | 4 | 3 | 0 | 1 | 0.0 | 12.2 | 30.1 | 0.4 | 0.0 | 0.1 |
| 37502_B52 | 170 | 3.5 | 101 | DNG | 54 | 746287 | 6131177 | 80 | 0 | 5 | 6 | 13 | 0 | 0 | 0.0 | 2.5 | 19.2 | 3.9 | 0.0 | 0.0 |
| 37502_B56 | 170 | 3.5 | 101 | DNG | 54 | 739243 | 6137337 | 70 | 0 | 11 | 4 | 9 | 1 | 1 | 0.0 | 10.4 | 18.1 | 1.4 | 0.2 | 0.1 |
| 37502_B905 | 170 | 3.5 | 101 | DNG | 54 | 743653 | 6132953 | 1 | 0 | 3 | 8 | 9 | 0 | 1 | 0.0 | 0.3 | 80.7 | 1.1 | 0.0 | 0.1 |
| 37502_B908 | 170 | 3.5 | 101 | DNG | 54 | 737017 | 6143169 | 336 | 0 | 2 | 4 | 7 | 0 | 1 | 0.0 | 2.1 | 90.5 | 0.7 | 0.0 | 0.2 |
| 37502_B906 | 170 | 0.56 | 101 | Low | 54 | 743756 | 6132974 | 73 | 1 | 3 | 1 | 4 | 0 | 0 | 20.0 | 7.1 | 0.5 | 0.5 | 0.0 | 0.0 |
| 37502_B909 | 170 | 0.56 | 101 | Low | 54 | 746337 | 6130832 | 352 | 1 | 7 | 2 | 4 | 0 | 0 | 10.0 | 9.8 | 3.5 | 1.1 | 0.0 | 0.0 |
| 37502_B38 | 170 | 4.67 | 101 | Moderate | 54 | 738052 | 6142416 | 136 | 2 | 5 | 0 | 6 | 0 | 0 | 30.0 | 3.3 | 0.0 | 2.5 | 0.0 | 0.0 |
| 37502_B43 | 170 | 4.67 | 101 | Moderate | 54 | 747651 | 6132866 | 258 | 1 | 5 | 1 | 5 | 0 | 0 | 10.0 | 9.2 | 25.0 | 1.8 | 0.0 | 0.0 |
| 37502_B44 | 170 | 4.67 | 101 | Moderate | 54 | 736941 | 6140612 | 94 | 3 | 8 | 0 | 3 | 0 | 0 | 40.0 | 2.3 | 0.0 | 1.3 | 0.0 | 0.0 |
| 37502_B46 | 170 | 4.67 | 101 | Moderate | 54 | 729389 | 6139369 | 350 | 1 | 2 | 0 | 2 | 0 | 0 | 25.0 | 8.0 | 0.0 | 0.4 | 0.0 | 0.0 |
| 37502_B47 | 170 | 4.67 | 101 | Moderate | 54 | 728907 | 6139206 | 79 | 2 | 6 | 1 | 11 | 0 | 0 | 20.0 | 15.4 | 0.1 | 2.4 | 0.0 | 0.0 |

| Plot ID | PCT | Area (Ha) | Patch size | Condition | Zone | Easting | Northing | Bearing | Funn. Large Trees | Fun. Hollow Trees | Fun. Litter Cover | Fun Len. Fallen | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree50to79 | Fun. Tree Regen | Fun. High Threat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37502_B50 | 16 | 2.78 | 101 | DNG | 54 | 746396 | 6131810 | 8 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 37502_B51 | 16 | 2.78 | 101 | DNG | 54 | 746334 | 6131531 | 31 | 0 | 0 | 4.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.0 |
| 37502_B904 | 16 | 2.78 | 101 | DNG | 54 | 745864 | 6132908 | 46 | 0 | 0 | 36.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 37502_B907 | 16 | 2.78 | 101 | DNG | 54 | 738208 | 6137419 | 298 | 0 | 0 | 20.6 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0.1 |
| 37502.P.02 | 16 | 0.36 | 101 | Low | 54 | 732645 | 6144869 | 280 | 1 | 2 | 7.8 | 34 | 0 | 1 | 1 | 0 | 1 | 0 | 0.6 |
| 37502_B07 | 16 | 0.36 | 101 | Low | 54 | 729635 | 6140499 | 139 | 1 | 1 | 34 | 64 | 0 | 0 | 1 | 0 | 1 | 0 | 0.0 |
| 37502_B08 | 16 | 0.36 | 101 | Low | 54 | 734098 | 6139650 | 0 | 2 | 1 | 31 | 33 | 0 | 0 | 0 | 0 | 1 | 0 | 0.5 |
| 37502_B09 | 16 | 0.36 | 101 | Low | 54 | 747230 | 6133641 | 81 | 0 | 1 | 12 | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0.0 |

| Plot ID | PCT | Area (Ha) | Patch size | Condition | Zone | Easting | Northing | Bearing | Funn. Large Trees | Fun. Hollow Trees | Fun. Litter Cover | Fun Len. Fallen | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree50to79 | Fun. Tree Regen | Fun. High Threat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37502_B13 | 16 | 0.36 | 101 | Low | 54 | 730589 | 6143330 | 132 | 1 | 1 | 12.4 | 12 | 0 | 0 | 0 | 0 | 1 | 0 | 0.0 |
| 37502_B06 | 16 | 3.8 | 101 | Moderate | 54 | 746728 | 6134962 | 250 | 3 | 1 | 48 | 45 | 1 | 1 | 1 | 0 | 1 | 1 | 2.0 |
| 37502_B10 | 16 | 3.8 | 101 | Moderate | 54 | 743620 | 6132784 | 205 | 2 | 2 | 41 | 42 | 0 | 0 | 0 | 0 | 1 | 0 | 0.0 |
| 37502_B11 | 16 | 3.8 | 101 | Moderate | 54 | 741144 | 6138505 | 172 | 1 | 4 | 35.2 | 70 | 0 | 1 | 1 | 0 | 1 | 0 | 10.0 |
| 37502_B12 | 16 | 3.8 | 101 | Moderate | 54 | 733400 | 6140345 | 258 | 0 | 0 | 16.4 | 17 | 0 | 1 | 1 | 0 | 0 | 1 | 0.0 |
| 37502_B914 | 16 | 0.21 | 5 | Paddock trees | 54 | 736478 | 6142281 | 21 | 0 | 3 | 8.4 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 0.0 |
| 37502_B15 | 21 | 1.17 | 101 | Moderate | 54 | 737149 | 6137913 | 344 | 2 | 0 | 33.6 | 10 | 0 | 0 | 0 | 0 | 1 | 0 | 0.1 |
| 37502_B28 | 21 | 1.17 | 101 | Moderate | 54 | 744329 | 6136008 | 265 | 2 | 1 | 73 | 5 | 0 | 0 | 0 | 0 | 1 | 1 | 0.0 |
| 37502_B54 | 21 | 1.17 | 101 | Moderate | 54 | 743478 | 6132202 | 113 | 1 | 1 | 38 | 14 | 0 | 0 | 0 | 0 | 1 | 0 | 0.1 |
| 37502_B911 | 21 | 1.17 | 101 | Moderate | 54 | 743963 | 6136003 | 182 | 0 | 2 | 65 | 14 | 0 | 0 | 0 | 1 | 1 | 0 | 0.0 |
| 37502_B17 | 23 | 2.03 | 101 | Moderate | 54 | 731870 | 6147773 | 186 | 2 | 0 | 6 | 13 | 0 | 1 | 1 | 0 | 1 | 0 | 0.1 |
| 37502_B18 | 23 | 2.03 | 101 | Moderate | 54 | 743389 | 6137790 | 74 | 0 | 0 | 68 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 20.0 |
| 37502_B19 | 23 | 2.03 | 101 | Moderate | 54 | 737941 | 6141869 | 104 | 0 | 0 | 53 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 1.0 |
| 37502_B55 | 23 | 2.03 | 101 | Moderate | 54 | 733665 | 6140311 | 274 | 1 | 0 | 60 | 10 | 0 | 0 | 0 | 0 | 1 | 0 | 0.0 |
| 37502_B902 | 23 | 2.03 | 101 | Moderate | 54 | 746310 | 6133007 | 155 | 0 | 0 | 36 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 15.0 |
| 37502_B57 | 57 | 0.19 | 101 | Moderate | 54 | 737149 | 6138078 | 180 | 1 | 0 | 55 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0.1 |
| 37502_B20 | 58 | 30.01 | 101 | DNG | 54 | 735200 | 6144997 | 138 | 0 | 0 | 7.4 | 0.5 | 0 | 0 | 0 | 1 | 1 | 0 | 5.0 |
| 37502_B25 | 58 | 30.01 | 101 | DNG | 54 | 740688 | 6138732 | 150 | 0 | 0 | 18.6 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 40.0 |
| 37502_B26 | 58 | 30.01 | 101 | DNG | 54 | 741019 | 6137335 | 348 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40.0 |
| 37502_B27 | 58 | 30.01 | 101 | DNG | 54 | 742953 | 6138173 | 124 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35.0 |
| 37502_B40 | 58 | 30.01 | 101 | DNG | 54 | 743137 | 6137998 | 44 | 0 | 0 | 35 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 15.0 |
| 37502_B41 | 58 | 30.01 | 101 | DNG | 54 | 743330 | 6137424 | 1 | 0 | 0 | 17.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.0 |
| 37502_B53 | 58 | 30.01 | 101 | DNG | 54 | 744905 | 6136744 | 191 | 0 | 0 | 4.4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 30.0 |
| 37502_B60 | 58 | 30.01 | 101 | DNG | 54 | 739900 | 6138931 | 317 | 0 | 0 | 19.6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 6.0 |
| 37502_B903 | 58 | 30.01 | 101 | DNG | 54 | 743379 | 6137594 | 189 | 0 | 0 | 26 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 35.0 |
| 37502_B32 | 58 | 0.85 | 101 | High | 54 | 746992 | 6134577 | 189 | 7 | 1 | 29 | 24 | 1 | 1 | 1 | 0 | 1 | 1 | 0.5 |
| 37502_B33 | 58 | 0.85 | 101 | High | 54 | 735359 | 6144910 | 136 | 4 | 1 | 27 | 29 | 1 | 1 | 1 | 0 | 1 | 1 | 25.0 |
| 37502_B04 | 58 | 20.91 | 101 | Moderate | 54 | 737188 | 6138324 | 170 | 1 | 0 | 31.4 | 11 | 1 | 1 | 0 | 0 | 1 | 0 | 5.0 |
| 37502_B29 | 58 | 20.91 | 101 | Moderate | 54 | 735539 | 6144318 | 283 | 5 | 1 | 17 | 45 | 1 | 1 | 1 | 0 | 1 | 0 | 5.2 |
| 37502_B30 | 58 | 20.91 | 101 | Moderate | 54 | 738052 | 6142265 | 92 | 1 | 0 | 30.4 | 44 | 1 | 1 | 1 | 0 | 1 | 0 | 2.0 |
| 37502_B31 | 58 | 20.91 | 101 | Moderate | 54 | 736421 | 6142865 | 181 | 1 | 1 | 27 | 15 | 1 | 1 | 1 | 0 | 1 | 1 | 1.0 |
| 37502_B35 | 58 | 20.91 | 101 | Moderate | 54 | 739879 | 6137310 | 105 | 2 | 0 | 39.2 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 5.0 |
| 37502_B37 | 58 | 20.91 | 101 | Moderate | 54 | 742680 | 6138358 | 284 | 1 | 0 | 21.4 | 28 | 0 | 1 | 0 | 0 | 1 | 0 | 25.0 |
| 37502_B58 | 58 | 20.91 | 101 | Moderate | 54 | 747305 | 6133868 | 330 | 3 | 5 | 85 | 18 | 1 | 1 | 1 | 0 | 1 | 0 | 0.0 |
| 37502_B912 | 58 | 20.91 | 101 | Moderate | 54 | 746382 | 6135821 | 123 | 1 | 1 | 52 | 10 | 1 | 1 | 0 | 1 | 1 | 1 | 0.0 |
| 37502_B910 | 58 | 0.07 | 5 | Paddock trees | 54 | 745021 | 6131905 | 272 | 0 | 0 | 64 | 4 | 0 | 0 | 1 | 1 | 1 | 1 | 0.0 |

| Plot ID | PCT | Area (Ha) | Patch size | Condition | Zone | Easting | Northing | Bearing | Funn. Large Trees | Fun. Hollow Trees | Fun. Litter Cover | Fun Len. Fallen | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree Stem | Fun. Tree50to79 | Fun. Tree Regen | Fun. High Threat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37502_B915 | 58 | 0.07 | 5 | Paddock trees | 54 | 735951 | 6142845 | 142 | 0 | 2 | 37 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0.0 |
| 37502.P.06 | 163 | 3.58 | 101 | Moderate | 54 | 744295 | 6137130 | 160 | 0 | 0 | 2.4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0.5 |
| 37502_B39 | 163 | 3.58 | 101 | Moderate | 54 | 745806 | 6133121 | 252 | 0 | 0 | 28.4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0.0 |
| 37502_B42 | 163 | 3.58 | 101 | Moderate | 54 | 746273 | 6133069 | 295 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 5.0 |
| 37502_B63 | 163 | 3.58 | 101 | Moderate | 54 | 741379 | 6138330 | 65 | 0 | 0 | 12.4 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 20.0 |
| 37502_B64 | 163 | 3.58 | 101 | Moderate | 54 | 745679 | 6132979 | 348 | 0 | 0 | 9.2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0.0 |
| 37502_B65 | 163 | 3.58 | 101 | Moderate | 54 | 746032 | 6133317 | 302 | 0 | 0 | 44.6 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 30.0 |
| 37502_B21 | 170 | 3.5 | 101 | DNG | 54 | 737689 | 6141047 | 0 | 0 | 0 | 40 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 5.5 |
| 37502_B52 | 170 | 3.5 | 101 | DNG | 54 | 746287 | 6131177 | 80 | 0 | 0 | 4.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 37502_B56 | 170 | 3.5 | 101 | DNG | 54 | 739243 | 6137337 | 70 | 0 | 0 | 5.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10.0 |
| 37502_B905 | 170 | 3.5 | 101 | DNG | 54 | 743653 | 6132953 | 1 | 0 | 0 | 16.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| 37502_B908 | 170 | 3.5 | 101 | DNG | 54 | 737017 | 6143169 | 336 | 0 | 0 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.2 |
| 37502_B906 | 170 | 0.56 | 101 | Low | 54 | 743756 | 6132974 | 73 | 1 | 1 | 22.2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0.1 |
| 37502_B909 | 170 | 0.56 | 101 | Low | 54 | 746337 | 6130832 | 352 | 0 | 1 | 65 | 2 | 0 | 0 | 1 | 1 | 1 | 0 | 0.0 |
| 37502_B38 | 170 | 4.67 | 101 | Moderate | 54 | 738052 | 6142416 | 136 | 1 | 0 | 13 | 55 | 1 | 1 | 1 | 0 | 1 | 0 | 5.0 |
| 37502_B43 | 170 | 4.67 | 101 | Moderate | 54 | 747651 | 6132866 | 258 | 2 | 1 | 23 | 120 | 0 | 1 | 1 | 0 | 1 | 1 | 15.0 |
| 37502_B44 | 170 | 4.67 | 101 | Moderate | 54 | 736941 | 6140612 | 94 | 5 | 1 | 27 | 55 | 1 | 0 | 1 | 0 | 1 | 0 | 0.0 |
| 37502_B46 | 170 | 4.67 | 101 | Moderate | 54 | 729389 | 6139369 | 350 | 0 | 0 | 25 | 46 | 1 | 1 | 1 | 0 | 0 | 1 | 0.0 |
| 37502_B47 | 170 | 4.67 | 101 | Moderate | 54 | 728907 | 6139206 | 79 | 0 | 1 | 40 | 68 | 0 | 1 | 1 | 0 | 0 | 1 | 0.0 |

## Appendix 3.2. BAM plot data sheets

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| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 01/09/2022 | Burrawong windfarm | | Low | MJAL NL | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502.P.02 | Plot dimensions | 50x20 | Orientation of middle | 280 | |
| Easting 732645 | Northing 6144870 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 8 |
| | Grasses etc. | 1 |
| | Forbs | 10 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 30 |
| | Shrubs | 9.4 |
| | Grasses etc. | 0.1 |
| | Forbs | 1.1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0.6 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 34 |
| No. trees with hollows | 2 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 25 | 1 | 1 | 2 |
| Average of the 5 subplots | 7.8 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay loam |
|---|---|---|---|---|---|
| Soil Colour | Brown grey | Site Drainage | Seasonally wet | Distance to nearest water | 400m |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 01/09/2022 | Burrawong windfarm prelim | 37502.P.02 | MJAL NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Asperula conferta | N | 0.1 | 2 | Ground |
| SG | Atriplex eardleyae | N | 0.1 | 5 | Ground |
| SG | Atriplex leptocarpa | N | 0.1 | 5 | Ground |
| FG | Atriplex lindleyi | N | 0.1 | 1 | Ground |
| GG | Austrostipa nitida | N | 0.1 | 5 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 10 | Ground |
| FG | Calotis hispidula | N | 0.1 | 10 | Ground |
| | Carrichtera annua | HTE | 0.1 | 20 | Ground |
| FG | Crassula colorata | N | 0.2 | 1000 | Ground |
| SG | Duma florulenta | N | 0.1 | 1 | Mid Storey |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 7 | 100 | Ground |
| TG | Eucalyptus largiflorens | N | 30 | 5 | Canopy |
| FG | Goodenia pusilliflora | N | 0.1 | 50 | Ground |
| | Hordeum leporinum | E | 7 | 2000 | Ground |
| | Lolium rigidum | E | 0.2 | 200 | Ground |
| | Lycium ferocissimum | HTE | 0.5 | 1 | Mid Storey |
| SG | Maireana decalvans | N | 0.1 | 1 | Mid Storey |
| FG | Maireana pentagona | N | 0.1 | 50 | Ground |
| | Medicago laciniata | E | 0.1 | 50 | Ground |
| | Medicago minima | E | 0.1 | 100 | Ground |
| | Medicago polymorpha | E | 0.1 | 50 | Ground |
| | Mesembryanthemum | E | 5 | 1000 | Ground |
| SG | Nitraria billardierei | N | 0.5 | 5 | Ground |
| | Psilocaulon tenue | E | 50 | 1000 | Ground |
| SG | Rhagodia spinescens | N | 0.5 | 5 | Mid Storey |
| FG | Roepera iodocarpa | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 0.1 | 50 | Ground |
| SG | Sclerolaena obliquicuspis | N | 1 | 50 | Ground |
| | Sisymbrium erysimoides | E | 0.5 | 50 | Ground |
| FG | Tetragonia eremaea | N | 0.1 | 10 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 01/09/2022 | Burrawong wind farm | | Moderate | MJAL NL | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502.P.06 | Plot dimensions | 50x20 | Orientation of middle | 160 | |
| Easting 744295 | Northing 6137131 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_163 | | | | EEC: No | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 7 |
| | Grasses etc. | 4 |
| | Forbs | 14 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 21.5 |
| | Grasses etc. | 7.2 |
| | Forbs | 26.3 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0.5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 1 | 6 | 2 | 2 | 1 |
| Average of the 5 subplots | 2.4 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay loam |
|---|---|---|---|---|---|
| Soil Colour | Grey | Site Drainage | Seasonally wet | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 01/09/2022 | Burrawong wind farm | 37502.P.06 | MJAL NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Alyssum linifolium | E | 0.1 | 10 | Ground |
| FG | Arabidella nasturtium | N | 0.2 | 1000 | Ground |
| GG | Austrostipa elegantissima | N | 2 | 100 | Ground |
| SG | Calotis erinacea | N | 0.1 | 10 | Ground |
| | Carrichtera annua | HTE | 0.5 | 200 | Ground |
| SG | Enchylaena tomentosa | N | 0.1 | 5 | Ground |
| GG | Enteropogon acicularis | N | 0.1 | 10 | Ground |
| | Erodium cicutarium | E | 0.1 | 10 | Ground |
| FG | Goodenia pusilliflora | N | 5 | 2000 | Ground |
| | Hypochaeris glabra | E | 0.1 | 10 | Ground |
| FG | Hypoxis glabella var. glabella | N | 0.1 | 10 | Ground |
| FG | Leiocarpa tomentosa | N | 0.1 | 5 | Ground |
| | Leontodon rhagadioloides | E | 0.1 | 10 | Ground |
| FG | Linum marginale | N | 0.1 | 10 | Ground |
| | Medicago minima | E | 10 | 3000 | Ground |
| | Medicago polymorpha | E | 0.5 | 500 | Ground |
| FG | Minuria leptophylla | N | 10 | 1000 | Ground |
| SG | Nitraria billardierei | N | 20 | 20 | Mid Storey |
| FG | Omphalolappula concava | N | 0.1 | 20 | Ground |
| FG | Plantago cunninghamii | N | 0.1 | 10 | Ground |
| FG | Plantago turrifera | N | 0.1 | 100 | Ground |
| SG | Rhagodia spinescens | N | 0.1 | 1 | Ground |
| FG | Rhodanthe corymbiflora | N | 10 | 100 | Ground |
| FG | Rhodanthe floribunda | N | 0.1 | 5 | Ground |
| FG | Rhodanthe pygmaea | N | 0.2 | 500 | Ground |
| FG | Roepera iodocarpa | N | 0.1 | 10 | Ground |
| GG | Rytidosperma caespitosum | N | 5 | 500 | Ground |
| SG | Salsola tragus | N | 0.1 | 5 | Mid Storey |
| SG | Sclerolaena brachyptera | N | 1 | 100 | Ground |
| SG | Sclerolaena diacantha | N | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 0.2 | 100 | Ground |
| GG | Sporobolus caroli | N | 0.1 | 10 | Ground |
| FG | Vittadinia cervicularis var. | N | 0.1 | 10 | Ground |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 27/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B04 | Plot dimensions | 20x50 | Orientation of middle | 170 |
| Easting 737188 | Northing 6138324 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 11 |
| | Grasses etc. | 2 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 8 |
| | Shrubs | 22 |
| | Grasses etc. | 1.1 |
| | Forbs | 0.8 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 11 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 90 | 2 | 5 | 50 |
| Average of the 5 subplots | 31.4 | | | | |

| Notes | Moderate. lower end of moderate, sparse canopy, restricted nat8ves surrounding, exotic dominated grasses surrounding that |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight depressi9n | Soil Surface Texture | Sand clay loam |
|---|---|---|---|---|---|
| Soil Colour | Chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B04 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Acacia homalophylla | N | 1 | 1 | Mid Storey |
| | Asphodelus fistulosus | E | 0.1 | 10 | Ground |
| SG | Atriplex eardleyae | N | 0.1 | 2 | Ground |
| SG | Atriplex semibaccata | N | 0.1 | 3 | Ground |
| GG | Austrostipa nitida | N | 1 | 50 | Ground |
| GG | Austrostipa scabra | N | 0.1 | 10 | Ground |
| | Carrichtera annua | HTE | 5 | 1000 | Ground |
| TG | Casuarina pauper | N | 7 | 3 | Canopy |
| SG | Dissocarpus paradoxus | N | 1 | 30 | Ground |
| | Echium plantagineum | E | 0.1 | 5 | Ground |
| FG | Einadia nutans | N | 0.5 | 10 | Ground |
| SG | Enchylaena tomentosa | N | 2 | 30 | Ground |
| FG | Goodenia fascicularis | N | 0.1 | 10 | Ground |
| | Hordeum spp. | E | 15 | 1000 | Ground |
| | Lolium rigidum | E | 3 | 700 | Ground |
| SG | Maireana aphylla | N | 0.2 | 1 | Ground |
| SG | Maireana decalvans | N | 3 | 20 | Ground |
| | Medicago minima | E | 2 | 200 | Ground |
| | Medicago truncatula | E | 40 | 500 | Ground |
| SG | Nitraria billardierei | N | 5 | 2 | Mid Storey |
| SG | Pittosporum angustifolium | N | 0.5 | 1 | Ground |
| | Reichardia tingitana | E | 0.1 | 5 | Ground |
| SG | Rhagodia spinescens | N | 5 | 10 | Ground |
| | Schismus barbatus | E | 3 | 1000 | Ground |
| SG | Sclerolaena diacantha | N | 5 | 200 | Ground |
| SG | Sida intricata | N | 0.1 | 1 | Ground |
| | Sisymbrium erysimoides | E | 10 | 700 | Ground |
| | Sisymbrium orientale | E | 0.1 | 10 | Ground |
| | Sonchus oleraceus | E | 0.5 | 50 | Ground |
| FG | Tetragonia moorei | N | 0.1 | 10 | Ground |
| FG | Vittadinia spp. | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B06 | Plot dimensions | 20x50 | Orientation of middle | 250 | |
| Easting 746728 | Northing 6134962 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 2 |
| | Forbs | 12 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 30 |
| | Shrubs | 17.9 |
| | Grasses etc. | 1.2 |
| | Forbs | 13.2 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 2 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 3 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 45 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 50 | 40 | 30 | 60 |
| Average of the 5 subplots | 48 | | | | |

| Notes | Low. upper end of low, patches have solid nwtive grass cover, but heavily edge effected and high annual weed cover |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Depression | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Grey brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B06 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.2 | 5 | Ground |
| FG | Atriplex lindleyi | N | 0.5 | 5 | Ground |
| GG | Austrostipa nitida | N | 0.2 | 5 | Ground |
| | Bromus rubens | E | 0.1 | 5 | Ground |
| FG | Calandrinia eremaea | N | 0.1 | 5 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| | Chenopodium murale | E | 1 | 1 | Ground |
| OG | Convolvulus spp. | N | 0.1 | 5 | Ground |
| | Conyza bonariensis | E | 0.1 | 20 | Ground |
| FG | Craspedia haplorrhiza | N | 0.1 | 5 | Ground |
| FG | Crassula colorata | N | 0.1 | 50 | Ground |
| SG | Dissocarpus paradoxus | N | 0.2 | 3 | Ground |
| | Echium plantagineum | E | 0.1 | 1 | Ground |
| FG | Einadia nutans | N | 1 | 20 | Ground |
| SG | Enchylaena tomentosa | N | 2 | 10 | Ground |
| GG | Enteropogon acicularis | N | 1 | 40 | Ground |
| TG | Eucalyptus largiflorens | N | 30 | 8 | Canopy |
| | Hordeum spp. | E | 0.5 | 100 | Ground |
| | Lactuca serriola | E | 0.1 | 3 | Ground |
| | Lolium rigidum | E | 1 | 200 | Ground |
| | Lycium ferocissimum | HTE | 2 | 2 | Mid Storey |
| SG | Maireana decalvans | N | 0.2 | 3 | Ground |
| | Malva parviflora | E | 0.2 | 5 | Ground |
| | Medicago polymorpha | E | 0.5 | 100 | Ground |
| | Medicago truncatula | E | 1 | 50 | Ground |
| FG | Minuria cunninghamii | N | 0.5 | 2 | Ground |
| | Papaver hybridum | E | 0.1 | 1 | Ground |
| SG | Pittosporum angustifolium | N | 0.2 | 1 | Mid Storey |
| FG | Plantago cunninghamii | N | 0.1 | 2 | Ground |
| | Psilocaulon tenue | E | 1 | 30 | Ground |
| | Reichardia tingitana | E | 0.1 | 1 | Ground |
| SG | Rhagodia spinescens | N | 15 | 20 | Mid Storey |
| FG | Rhodanthe corymbiflora | N | 0.1 | 5 | Ground |
| FG | Roepera iodocarpa | N | 0.5 | 10 | Ground |
| SG | Salsola tragus | N | 0.1 | 1 | Ground |
| | Schismus barbatus | E | 5 | 400 | Ground |
| FG | Senecio glossanthus | N | 0.1 | 5 | Ground |
| | Silene gallica | E | 0.1 | 5 | Ground |
| | Sisymbrium officinale | E | 15 | 300 | Ground |
| | Sisymbrium orientale | E | 1 | 30 | Ground |
| | Solanum nigrum | E | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 1 | 40 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Low | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B07 | Plot dimensions | 20x50 | Orientation of middle | 139 | |
| Easting 729636 | Northing 6140499 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 3 |
| | Grasses etc. | 0 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 7 |
| | Shrubs | 0.8 |
| | Grasses etc. | 0 |
| | Forbs | 0.9 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 64 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 15 | 70 | 60 | 15 |
| Average of the 5 subplots | 34 | | | | |

| Notes | Low. very hign weed cover i ground / understorey, low native cover, native canopy also pretty low. lowest conditipn so far today |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight depressio | Soil Surface Texture | Clayey |
|---|---|---|---|---|---|
| Soil Colour | Dark brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B07 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Arctotheca calendula | E | 0.5 | 30 | Ground |
| SG | Atriplex leptocarpa | N | 0.1 | 10 | Ground |
| FG | Atriplex lindleyi | N | 0.2 | 20 | Ground |
| FG | Bulbine semibarbata | N | 0.1 | 5 | Ground |
| | Chenopodium murale | E | 0.5 | 10 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| | Cucumis myriocarpus subsp. | E | 0.1 | 1 | Ground |
| SG | Enchylaena tomentosa | N | 0.2 | 10 | Ground |
| TG | Eucalyptus largiflorens | N | 7 | 4 | Canopy |
| | Hordeum spp. | E | 5 | 1000 | Ground |
| | Lactuca serriola | E | 0.1 | 5 | Ground |
| | Limonium lobatum | E | 0.1 | 5 | Ground |
| | Lolium rigidum | E | 0.2 | 200 | Ground |
| SG | Maireana decalvans | N | 0.5 | 10 | Ground |
| | Malva parviflora | E | 0.5 | 20 | Ground |
| | Medicago laciniata | E | 0.5 | 100 | Ground |
| | Medicago polymorpha | E | 1 | 200 | Ground |
| | Papaver hybridum | E | 0.1 | 5 | Ground |
| | Psilocaulon tenue | E | 60 | 2000 | Ground |
| | Schismus barbatus | E | 2 | 1000 | Ground |
| | Sisymbrium erysimoides | E | 15 | 1000 | Ground |
| | Sonchus asper | E | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 2 | 100 | Ground |
| FG | Tetragonia moorei | N | 0.5 | 20 | Ground |
| | Urtica urens | E | 0.5 | 50 | Ground |
| | Vicia spp. | E | 1 | 100 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Low | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B08 | Plot dimensions | 20x50 | Orientation of middle | 0 | |
| Easting 734099 | Northing 6139650 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 8 |
| | Grasses etc. | 0 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15 |
| | Shrubs | 1.6 |
| | Grasses etc. | 0 |
| | Forbs | 0.8 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0.5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 33 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 50 | 30 | 10 | 5 |
| Average of the 5 subplots | 31 | | | | |

| Notes | Moderate. heavily infested with annual weeds, some native understorey, lower end of moderate, could be low, and will probably score much lower than plot12 |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight dpression | Soil Surface Texture | Clayey loam |
|---|---|---|---|---|---|
| Soil Colour | Chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B08 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Acacia spp. | N | 0.1 | 3 | Ground |
| SG | Atriplex eardleyae | N | 0.2 | 20 | Ground |
| SG | Atriplex leptocarpa | N | 0.5 | 30 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 0.1 | 5 | Ground |
| SG | Eremophila longifolia | N | 0.2 | 1 | Mid Storey |
| TG | Eucalyptus largiflorens | N | 15 | 2 | Canopy |
| | Hordeum spp. | E | 10 | 2000 | Ground |
| | Lamarckia aurea | E | 0.1 | 20 | Ground |
| | Limonium lobatum | E | 0.1 | 5 | Ground |
| | Lolium rigidum | E | 0.2 | 200 | Ground |
| | Lycium ferocissimum | HTE | 0.5 | 5 | Mid Storey |
| SG | Maireana aphylla | N | 0.1 | 1 | Ground |
| SG | Maireana decalvans | N | 0.2 | 5 | Ground |
| | Malva parviflora | E | 0.1 | 5 | Ground |
| | Medicago laciniata | E | 0.1 | 100 | Ground |
| | Medicago truncatula | E | 1 | 200 | Ground |
| | Mesembryanthemum | E | 0.5 | 100 | Ground |
| | Psilocaulon tenue | E | 25 | 300 | Ground |
| SG | Rhagodia spinescens | N | 0.2 | 3 | Ground |
| | Schismus barbatus | E | 35 | 3000 | Ground |
| | Sisymbrium erysimoides | E | 30 | 2000 | Ground |
| | Sonchus oleraceus | E | 0.2 | 20 | Ground |
| FG | Tetragonia moorei | N | 0.5 | 200 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | Low | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B09 | Plot dimensions | 20x50 | Orientation of middle | 81 | |
| Easting 747231 | Northing 6133642 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 1 |
| | Forbs | 17 |
| | Ferns | 1 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 5 |
| | Shrubs | 19.3 |
| | Grasses etc. | 0.5 |
| | Forbs | 14.2 |
| | Ferns | 1 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 6 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 30 | 10 | 5 | 5 |
| Average of the 5 subplots | 12 | | | | |

| Notes | Low. tree cover very sparse, lots of weed cover, some 9k patches of native groundcover, no midstorey |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Depression | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Grey | Site Drainage | Swamp | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B09 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Alternanthera denticulata | N | 0.2 | 5 | Ground |
| | Arctotheca calendula | E | 0.2 | 5 | Ground |
| SG | Atriplex leptocarpa | N | 3 | 50 | Ground |
| FG | Atriplex lindleyi | N | 1 | 20 | Ground |
| FG | Brachyscome lineariloba | N | 0.5 | 200 | Ground |
| FG | Bulbine semibarbata | N | 0.2 | 5 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| | Conyza bonariensis | E | 0.5 | 50 | Ground |
| | Cotula bipinnata | E | 5 | 200 | Ground |
| FG | Crassula colorata | N | 2 | 3000 | Ground |
| FG | Einadia nutans | N | 1 | 10 | Ground |
| TG | Eucalyptus largiflorens | N | 5 | 2 | Canopy |
| FG | Euphorbia drummondii | N | 0.1 | 2 | Ground |
| | Hordeum spp. | E | 10 | 500 | Ground |
| FG | Hyalosperma demissum | N | 0.2 | 50 | Ground |
| FG | Hyalosperma semisterile | N | 0.1 | 5 | Ground |
| | Lolium rigidum | E | 0.5 | 100 | Ground |
| FG | Maireana pentagona | N | 0.1 | 1 | Ground |
| EG | Marsilea drummondii | N | 1 | 100 | Ground |
| | Medicago laciniata | E | 1 | 100 | Ground |
| | Medicago polymorpha | E | 5 | 200 | Ground |
| SG | Nitraria billardierei | N | 1 | 1 | Ground |
| SG | Osteocarpum acropterum | N | 0.1 | 2 | Ground |
| FG | Plantago cunninghamii | N | 2 | 100 | Ground |
| | Polygonum aviculare | E | 0.2 | 5 | Ground |
| | Psilocaulon tenue | E | 1 | 40 | Ground |
| SG | Rhagodia spinescens | N | 5 | 20 | Ground |
| FG | Rhodanthe corymbiflora | N | 1 | 200 | Ground |
| GG | Rytidosperma duttonianum | N | 0.5 | 10 | Ground |
| SG | Salsola tragus | N | 0.2 | 5 | Ground |
| | Schismus barbatus | E | 1 | 200 | Ground |
| SG | Sclerolaena brachyptera | N | 5 | 50 | Ground |
| SG | Sclerolaena muricata var. | N | 5 | 10 | Ground |
| FG | Senecio glossanthus | N | 0.1 | 2 | Ground |
| | Sonchus oleraceus | E | 1 | 50 | Ground |
| FG | Spergularia spp. | N | 0.5 | 200 | Ground |
| FG | Tetragonia tetragonioides | N | 5 | 30 | Ground |
| FG | Wahlenbergia spp. | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 30/09/2022 | Burrawong WF | | Moderate | NL & GZ | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B10 | Plot dimensions | 20x50 | Orientation of middle | 205 | |
| Easting 743621 | Northing 6132784 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 11 |
| | Grasses etc. | 3 |
| | Forbs | 19 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 10 |
| | Shrubs | 11.5 |
| | Grasses etc. | 0.4 |
| | Forbs | 8.1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 42 |
| No. trees with hollows | 2 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 70 | 25 | 15 | 70 | 25 |
| Average of the 5 subplots | 41 | | | | |

| Notes | Moderate. Moderate annual exotic load. Some native understory, ok tree cover. |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight depression | Soil Surface Texture | Slight depression |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Creekline | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 30/09/2022 | Burrawong WF | 37502_B10 | NL & GZ |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Alternanthera denticulata | N | 0.1 | | Ground |
| SG | Atriplex eardleyae | N | 1 | 100 | Ground |
| SG | Atriplex leptocarpa | N | 0.5 | 20 | Ground |
| FG | Atriplex lindleyi | N | 1 | 30 | Ground |
| GG | Austrostipa scabra | N | 0.1 | 5 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 100 | Ground |
| FG | Bulbine semibarbata | N | 0.2 | 100 | Ground |
| FG | Calandrinia eremaea | N | 0.1 | 100 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| FG | Centipeda cunninghamii | N | 0.1 | 1 | Ground |
| | Conyza bonariensis | E | 0.1 | 5 | Ground |
| FG | Craspedia haplorrhiza | N | 0.1 | 20 | Ground |
| FG | Crassula colorata | N | 1 | 3000 | Ground |
| SG | Duma florulenta | N | 0.1 | 1 | Mid Storey |
| FG | Einadia nutans | N | 2 | 40 | Ground |
| GG | Enteropogon acicularis | N | 0.2 | 20 | Ground |
| TG | Eucalyptus largiflorens | N | 10 | 3 | Canopy |
| FG | Euphorbia drummondii | N | 0.1 | 1 | Ground |
| | Hordeum spp. | E | 20 | 3000 | Ground |
| | Lolium rigidum | E | 0.2 | 100 | Ground |
| | Malva parviflora | E | 0.2 | 50 | Ground |
| | Marrubium vulgare | E | 0.1 | 1 | Ground |
| | Medicago laciniata | E | 15 | 5000 | Ground |
| | Medicago minima | E | 0.5 | 200 | Ground |
| | Medicago truncatula | E | 2 | 500 | Ground |
| SG | Nitraria billardierei | N | 0.5 | 1 | Ground |
| | Onopordum acaulon | E | 0.1 | 1 | Ground |
| SG | Osteocarpum acropterum | N | 0.5 | 30 | Ground |
| FG | Oxalis perennans | N | 0.4 | 20 | Ground |
| FG | Plantago turrifera | N | 0.1 | 100 | Ground |
| | Psilocaulon tenue | E | 0.5 | 20 | Ground |
| SG | Rhagodia spinescens | N | 1 | 5 | Mid Storey |
| FG | Rhodanthe corymbiflora | N | 0.4 | 100 | Ground |
| FG | Rhodanthe floribunda | N | 0.1 | 20 | Ground |
| FG | Roepera iodocarpa | N | 1 | 100 | Ground |
| GG | Rytidosperma setaceum | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 15 | 5000 | Ground |
| SG | Sclerolaena brachyptera | N | 0.5 | 100 | Ground |
| SG | Sclerolaena diacantha | N | 7 | 100 | Ground |
| SG | Sclerolaena muricata var. | N | 0.1 | 3 | Ground |
| SG | Sclerolaena stelligera | N | 0.1 | 5 | Ground |
| SG | Sclerolaena tricuspis | N | 0.2 | 1 | Ground |
| | Silene gallica | E | 0.1 | 1 | Ground |

| | | | | | |
|---|---|---|---|---|---|
| | Sisymbrium erysimoides | E | 2 | 100 | Ground |
| | Sisymbrium orientale | E | 0.1 | 5 | Ground |
| FG | Solanum esuriale | N | 0.1 | 20 | Ground |
| | Sonchus oleraceus | E | 0.2 | 10 | Ground |
| FG | Spergularia spp. | N | 0.1 | 100 | Ground |
| FG | Tetragonia moorei | N | 1 | 50 | Ground |

| BAM Plot Data Sheet | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Site Sheet no:1 of 2 Recorders | | |
| Date | 07/12/2022 | 37502 plot B11 pct 16 | | Moderate | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B11 | Plot dimensions | 50x20 | Orientation of middle | 172 |
| Easting 741144 | Northing 6138506 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_16 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 10 |
| | Grasses etc. | 3 |
| | Forbs | 6 |
| | Ferns | 1 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 20.1 |
| | Shrubs | 19.9 |
| | Grasses etc. | 7.2 |
| | Forbs | 14.4 |
| | Ferns | 0.5 |
| | Other | 0 |
| High Threat Weed cover | | 10 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 70 |
| No. trees with hollows | 4 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 90 | 9 | 12 | 40 | 25 |
| Average of the 5 subplots | 35.2 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Black box depression drainage line | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B11 pct 16 | 37502_B11 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 0.1 | 1 | |
| FG | Alternanthera denticulata | N | 1 | 50 | |
| FG | Atriplex lindleyi | N | 3 | 50 | |
| GG | Austrostipa nitida | N | 0.2 | 10 | |
| | Carrichtera annua | HTE | 10 | 200 | |
| GG | Chloris truncata | N | 2 | 40 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 5 | |
| | Echium plantagineum | E | 0.1 | 5 | |
| FG | Einadia nutans | N | 10 | 50 | |
| SG | Enchylaena tomentosa | N | 1 | 20 | |
| GG | Enteropogon acicularis | N | 5 | 50 | |
| TG | Eucalyptus largiflorens | N | 20 | 4 | |
| FG | Goodenia fascicularis | N | 0.2 | 40 | |
| | Lactuca serriola | E | 0.1 | 5 | |
| | Limonium lobatum | E | 0.1 | 5 | |
| SG | Maireana aphylla | N | 0.3 | 1 | |
| SG | Maireana decalvans | N | 1 | 20 | |
| EG | Marsilea drummondii | N | 0.5 | 100 | |
| SG | Nitraria billardierei | N | 0.2 | 2 | |
| | Psilocaulon tenue | E | 1 | 20 | |
| SG | Rhagodia spinescens | N | 15 | 30 | |
| | Schismus barbatus | E | 20 | 500 | |
| SG | Sclerolaena bicornis | N | 0.1 | 20 | |
| SG | Sclerolaena brachyptera | N | 0.1 | 20 | |
| SG | Sclerolaena diacantha | N | 0.1 | 20 | |
| SG | Sclerolaena tricuspis | N | 2 | 20 | |
| | Sisymbrium officinale | E | 10 | 500 | |
| FG | Solanum esuriale | N | 0.1 | 20 | |
| | Sonchus oleraceus | E | 0.2 | 20 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 20 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B12 | Plot dimensions | 20x50 | Orientation of middle | 258 | |
| Easting 733401 | Northing 6140345 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 12 |
| | Grasses etc. | 2 |
| | Forbs | 11 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 35 |
| | Shrubs | 25.3 |
| | Grasses etc. | 0.3 |
| | Forbs | 2.9 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 17 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 2 | 5 | 5 | 10 |
| Average of the 5 subplots | 16.4 | | | | |

| Notes | Moderate. quite high cover of exotic grasses and annuals, mid canopy pretty good, possibly higher end of moderate |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat depression | Soil Surface Texture | Clayey |
|---|---|---|---|---|---|
| Soil Colour | Dark brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B12 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Alyssum linifolium | E | 0.1 | 5 | Ground |
| FG | Arthropodium minus | N | 0.1 | 1 | Ground |
| SG | Atriplex eardleyae | N | 0.1 | 5 | Mid Storey |
| SG | Atriplex leptocarpa | N | 0.1 | 5 | Ground |
| GG | Austrostipa elegantissima | N | 0.1 | 5 | Ground |
| GG | Austrostipa eremophila | N | 0.2 | 50 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 20 | Ground |
| FG | Carpobrotus spp. | N | 0.1 | 5 | Ground |
| FG | Crassula colorata | N | 1 | 5000 | Ground |
| SG | Duma florulenta | N | 2 | 10 | Mid Storey |
| FG | Einadia nutans | N | 0.1 | 10 | Ground |
| SG | Enchylaena tomentosa | N | 0.5 | 10 | Ground |
| TG | Eucalyptus largiflorens | N | 35 | 5 | Canopy |
| FG | Goodenia fascicularis | N | 0.1 | 5 | Ground |
| | Hordeum spp. | E | 5 | 2000 | Ground |
| FG | Hyalosperma semisterile | N | 0.1 | 5 | Ground |
| | Limonium lobatum | E | 0.1 | 5 | Mid Storey |
| | Lolium rigidum | E | 0.5 | 200 | Ground |
| SG | Maireana erioclada | N | 0.1 | 1 | Ground |
| | Medicago laciniata | E | 1 | 500 | Ground |
| | Medicago truncatula | E | 0.5 | 100 | Ground |
| | Mesembryanthemum | E | 0.1 | 20 | Ground |
| SG | Myoporum montanum | N | 5 | 4 | Mid Storey |
| SG | Nitraria billardierei | N | 2 | 5 | Ground |
| SG | Pittosporum angustifolium | N | 0.2 | 2 | Mid Storey |
| | Psilocaulon tenue | E | 5 | 100 | Ground |
| SG | Rhagodia spinescens | N | 15 | 40 | Mid Storey |
| FG | Rhodanthe corymbiflora | N | 0.1 | 5 | Ground |
| FG | Roepera ammophila | N | 0.1 | 5 | Ground |
| FG | Roepera glauca | N | 0.1 | 1 | Ground |
| | Schismus barbatus | E | 25 | 3000 | Ground |
| SG | Sclerolaena brachyptera | N | 0.1 | 5 | Ground |
| SG | Sclerolaena diacantha | N | 0.1 | 20 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.1 | 10 | Ground |
| | Silene gallica | E | 0.1 | 20 | Mid Storey |
| | Sisymbrium erysimoides | E | 5 | 1000 | Ground |
| | Sonchus oleraceus | E | 0.1 | 30 | Ground |
| FG | Tetragonia moorei | N | 1 | 100 | Ground |
| | Vicia spp. | E | 0.1 | 1 | Ground |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 26/09/2022 | Burrawong WF | | Low | MJAL, CW | | |
| Zone<br>54 | Datum<br>GDA94 | Plot ID | 37502_B13 | Plot dimensions | 20x50 | Orientation of middle | 132 |
| Easting<br>730589 | Northing<br>6143331 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_16 | | | | EEC: No | Confidence<br>M |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 0 |
| | Forbs | 8 |
| | Ferns | 1 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15 |
| | Shrubs | 16.8 |
| | Grasses etc. | 0 |
| | Forbs | 1.4 |
| | Ferns | 2 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 12 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 50 | 0 | 5 | 2 | 5 |
| Average of the 5 subplots | 12.4 | | | | |

| Notes | Low. high wedd cover, very kittle native understorey, sparse native canopy. water in plot |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Depression | Soil Surface Texture | Clayey |
|---|---|---|---|---|---|
| Soil Colour | Grey | Site Drainage | Swamp | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B13 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 2 | 100 | Ground |
| SG | Atriplex leptocarpa | N | 2 | 100 | Ground |
| FG | Brachyscome lineariloba | N | 0.2 | 200 | Ground |
| FG | Bulbine semibarbata | N | 0.5 | 100 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| FG | Crassula colorata | N | 0.2 | 1000 | Ground |
| FG | Einadia nutans | N | 0.1 | 10 | Ground |
| TG | Eucalyptus largiflorens | N | 15 | 2 | Canopy |
| | Hordeum spp. | E | 35 | 2000 | Ground |
| | Lactuca serriola | E | 0.1 | 10 | Ground |
| | Lamarckia aurea | E | 0.2 | 100 | Ground |
| | Limonium lobatum | E | 0.5 | 50 | Ground |
| | Lolium rigidum | E | 0.1 | 10 | Ground |
| SG | Maireana decalvans | N | 2 | 20 | Ground |
| EG | Marsilea drummondii | N | 2 | 500 | Ground |
| | Medicago laciniata | E | 2 | 300 | Ground |
| | Medicago polymorpha | E | 20 | 700 | Ground |
| FG | Plantago cunninghamii | N | 0.1 | 10 | Ground |
| SG | Rhagodia spinescens | N | 10 | 20 | Mid Storey |
| SG | Sclerolaena muricata | N | 0.2 | 5 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.5 | 40 | Ground |
| SG | Sclerolaena tricuspis | N | 0.1 | 5 | Ground |
| FG | Senecio glossanthus | N | 0.1 | 10 | Ground |
| | Sonchus oleraceus | E | 1 | 100 | Ground |
| FG | Spergularia spp. | N | 0.1 | 10 | Ground |
| | Vicia spp. | E | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 27/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B15 | Plot dimensions | 20x50 | Orientation of middle | 344 |
| Easting 737150 | Northing 6137914 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_21 | | | | EEC: Sandhill Pine (potential) | Confidence L |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 5 |
| | Grasses etc. | 3 |
| | Forbs | 2 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 25 |
| | Shrubs | 6.3 |
| | Grasses etc. | 2.2 |
| | Forbs | 0.6 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0.1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 10 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 2 | 70 | 5 | 90 | 1 |
| Average of the 5 subplots | 33.6 | | | | |

| Notes | Low. isolated pines, spares hardy natives in groundlayer, heavy exotic annual load, no midstorey |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Moerate rise | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B15 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Arctotheca calendula | E | 0.5 | 20 | Ground |
| GG | Austrostipa nitida | N | 0.7 | 50 | Ground |
| | Bromus rubens | E | 0.2 | 30 | Ground |
| TG | Callitris gracilis subsp. | N | 25 | 2 | Canopy |
| | Carthamus lanatus | HTE | 0.1 | 5 | Ground |
| | Chenopodium murale | E | 0.2 | 5 | Ground |
| FG | Crassula colorata | N | 0.1 | 50 | Ground |
| SG | Dissocarpus paradoxus | N | 0.1 | 3 | Ground |
| | Echium plantagineum | E | 3 | 40 | Ground |
| GG | Enteropogon acicularis | N | 0.5 | 20 | Ground |
| | Hordeum spp. | E | 60 | 5000 | Ground |
| | Lactuca serriola | E | 0.1 | 5 | Ground |
| | Lolium rigidum | E | 0.2 | 50 | Ground |
| SG | Maireana decalvans | N | 1 | 10 | Ground |
| | Marrubium vulgare | E | 0.5 | 3 | Ground |
| | Medicago minima | E | 20 | 2000 | Ground |
| GG | Paspalidium spp. | N | 1 | 50 | Ground |
| | Psilocaulon tenue | E | 1 | 30 | Ground |
| | Reichardia tingitana | E | 0.1 | 1 | Ground |
| SG | Rhagodia spinescens | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 2 | 700 | Ground |
| SG | Sclerolaena diacantha | N | 5 | 30 | Ground |
| SG | Sclerolaena muricata var. villosa | N | 0.1 | 1 | Ground |
| | Sisymbrium orientale | E | 0.5 | 30 | Ground |
| | Solanum nigrum | E | 0.1 | 2 | Ground |
| FG | Vittadinia spp. | N | 0.5 | 70 | Ground |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B17 | Plot dimensions | 20x50 | Orientation of middle | 186 |
| Easting 731871 | Northing 6147773 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_23 | | | | EEC: Acacia mellvilleii shrubland | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 4 |
| | Grasses etc. | 1 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 25 |
| | Shrubs | 15.6 |
| | Grasses etc. | 0.1 |
| | Forbs | 0.4 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 0.1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 13 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 5 | 10 | 5 | 5 | 5 |
| Average of the 5 subplots | 6 | | | | |

| Notes | Moderate. lower end of moderate. high weedy groundcover, native sparse in ground and mid strata |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy loam |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Moderafe | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B17 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Acacia melvillei | N | 25 | 10 | Canopy |
| OG | Amyema quandang | N | 0.1 | 1 | Canopy |
| FG | Calandrinia eremaea | N | 0.1 | 20 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| | Carrichtera annua | HTE | 0.1 | 20 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| SG | Dissocarpus paradoxus | N | 0.5 | 30 | Ground |
| GG | Enteropogon acicularis | N | 0.1 | 5 | Ground |
| | Hordeum spp. | E | 5 | 500 | Ground |
| | Lolium rigidum | E | 0.1 | 10 | Ground |
| SG | Maireana decalvans | N | 5 | 20 | Ground |
| | Malva parviflora | E | 0.1 | 2 | Ground |
| | Medicago laciniata | E | 0.5 | 100 | Ground |
| | Psilocaulon tenue | E | 50 | 500 | Ground |
| SG | Rhagodia spinescens | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 5 | 1000 | Ground |
| SG | Sclerolaena obliquicuspis | N | 10 | 200 | Ground |
| | Sisymbrium erysimoides | E | 0.2 | 100 | Ground |
| | Sonchus oleraceus | E | 0.1 | 20 | Ground |
| FG | Tetragonia moorei | N | 0.1 | 20 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B18 | Plot dimensions | 20x50 | Orientation of middle | 74 | |
| Easting 743389 | Northing 6137791 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_23 | | | | EEC: Acacia mellvillei shrubland | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 9 |
| | Grasses etc. | 4 |
| | Forbs | 14 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 30 |
| | Shrubs | 18.1 |
| | Grasses etc. | 2.1 |
| | Forbs | 2.1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 20 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 2 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 90 | 25 | 75 | 60 | 90 |
| Average of the 5 subplots | 68 | | | | |

| Notes | Moderate. Not too weedy, decent native cover |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy clay loam |
|---|---|---|---|---|---|
| Soil Colour | Milk chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B18 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Acacia melvillei | N | 30 | 5 | Canopy |
| FG | Alternanthera spp. | N | 0.1 | 1 | Ground |
| | Alyssum linifolium | E | 0.1 | 5 | Ground |
| SG | Atriplex eardleyae | N | 0.1 | 1 | Ground |
| SG | Atriplex leptocarpa | N | 0.1 | 3 | Ground |
| GG | Austrostipa eremophila | N | 0.1 | 3 | Ground |
| GG | Austrostipa nitida | N | 1 | 200 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 10 | Ground |
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| | Carrichtera annua | HTE | 20 | 2000 | Ground |
| FG | Crassula colorata | N | 0.2 | 300 | Ground |
| FG | Einadia nutans | N | 0.1 | 3 | Ground |
| SG | Enchylaena tomentosa | N | 0.5 | 10 | Ground |
| GG | Enteropogon acicularis | N | 0.5 | 20 | Ground |
| FG | Hyalosperma semisterile | N | 0.1 | 10 | Ground |
| | Hypochaeris glabra | E | 0.1 | 5 | Ground |
| FG | Leiocarpa leptolepis | N | 0.1 | 1 | Ground |
| | Leontodon rhagadioloides | E | 0.1 | 5 | Ground |
| FG | Lepidium phlebopetalum | N | 0.1 | 5 | Ground |
| SG | Maireana decalvans | N | 0.1 | 1 | Ground |
| SG | Maireana erioclada | N | 0.1 | 1 | Ground |
| | Medicago laciniata | E | 0.5 | 100 | Ground |
| | Medicago minima | E | 10 | 1000 | Ground |
| FG | Minuria leptophylla | N | 0.5 | 30 | Ground |
| SG | Nitraria billardierei | N | 1 | 1 | Ground |
| FG | Plantago turrifera | N | 0.1 | 20 | Ground |
| SG | Rhagodia spinescens | N | 15 | 40 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.2 | 20 | Ground |
| FG | Roepera glauca | N | 0.1 | 1 | Ground |
| GG | Rytidosperma setaceum | N | 0.5 | 40 | Ground |
| SG | Sclerolaena brachyptera | N | 0.2 | 10 | Ground |
| SG | Sclerolaena diacantha | N | 1 | 40 | Ground |
| FG | Senecio glossanthus | N | 0.1 | 2 | Ground |
| | Sisymbrium erysimoides | E | 1 | 50 | Ground |
| | Sonchus oleraceus | E | 0.1 | 5 | Ground |
| FG | Spergularia spp. | N | 0.2 | 20 | Ground |
| | Vulpia spp. | E | 0.5 | 100 | Ground |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 25/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B19 | Plot dimensions | 20x50 | Orientation of middle | 104 |
| Easting 737941 | Northing 6141870 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_23 | | | | EEC: Acacia mellvilleii shrubland | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 3 |
| | Forbs | 10 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 25 |
| | Shrubs | 27.3 |
| | Grasses etc. | 6 |
| | Forbs | 1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 3 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 5 | 30 | 80 | 90 | 60 |
| Average of the 5 subplots | 53 | | | | |

| Notes | High. good native diversity in allstrata. some weed cover in griund layer, possibky higher end of moderate as not perfct |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Moderate poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B19 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Acacia melvillei | N | 25 | 3 | Canopy |
| GG | Austrostipa nodosa | N | 5 | 100 | Ground |
| | Bromus rubens | E | 0.1 | 10 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| | Carrichtera annua | HTE | 1 | 500 | Ground |
| FG | Crassula colorata | N | 0.1 | 500 | Ground |
| SG | Dissocarpus paradoxus | N | 0.1 | 5 | Ground |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 1 | 50 | Ground |
| GG | Enteropogon acicularis | N | 0.5 | 20 | Ground |
| FG | Goodenia fascicularis | N | 0.1 | 20 | Ground |
| | Hordeum spp. | E | 0.1 | 50 | Ground |
| | Hypochaeris glabra | E | 0.1 | 10 | Ground |
| FG | Hypoxis glabella var. glabella | N | 0.1 | 5 | Ground |
| | Lactuca serriola | E | 0.1 | 5 | Ground |
| | Limonium lobatum | E | 0.1 | 20 | Ground |
| | Lolium rigidum | E | 0.1 | 20 | Ground |
| SG | Maireana decalvans | N | 0.2 | 5 | Ground |
| FG | Maireana pentagona | N | 0.1 | 10 | Ground |
| | Medicago laciniata | E | 10 | 1000 | Ground |
| | Medicago minima | E | 1 | 200 | Ground |
| | Medicago truncatula | E | 0.1 | 50 | Ground |
| FG | Minuria leptophylla | N | 0.1 | 10 | Ground |
| | Psilocaulon tenue | E | 0.5 | 50 | Ground |
| SG | Rhagodia spinescens | N | 15 | 30 | Mid Storey |
| GG | Rytidosperma setaceum | N | 0.5 | 20 | Ground |
| | Schismus barbatus | E | 5 | 1000 | Ground |
| SG | Sclerolaena diacantha | N | 1 | 40 | Ground |
| SG | Sclerolaena obliquicuspis | N | 5 | 300 | Ground |
| SG | Senna artemisioides subsp. filifolia | N | 5 | 10 | Mid Storey |
| FG | Sida corrugata | N | 0.1 | 50 | Ground |
| | Silene gallica | E | 0.1 | 20 | Ground |
| | Sisymbrium erysimoides | E | 0.5 | 100 | Ground |
| | Sisymbrium orientale | E | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 0.1 | 20 | Ground |
| FG | Vittadinia spp. | N | 0.1 | 10 | Ground |
| FG | Wurmbea dioica subsp. dioica | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 25/09/2022 | Burrawong WF | | DNG | MJAL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B20 | Plot dimensions | 20x50 | Orientation of middle | 138 |
| Easting 735200 | Northing 6144998 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence M |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 7 |
| | Grasses etc. | 4 |
| | Forbs | 12 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 1.6 |
| | Grasses etc. | 51.5 |
| | Forbs | 3.1 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0.5 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 5 | 5 | 7 | 10 |
| Average of the 5 subplots | 7.4 | | | | |

| Notes | Moderate is based on Weeds in groundcover, hordeum, medicago |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clayey |
|---|---|---|---|---|---|
| Soil Colour | Milk chocolate | Site Drainage | Poor | Distance to nearest water | unknown |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | 1 | R | Rabbit scats |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B20 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Arthropodium minus | N | 0.1 | 5 | Ground |
| GG | Austrostipa eremophila | N | 40 | 500 | Ground |
| GG | Austrostipa nitida | N | 10 | 200 | Ground |
| | Avena fatua | E | 0.2 | 50 | Ground |
| | Bromus rubens | E | 1 | 100 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| | Carrichtera annua | HTE | 5 | 500 | Ground |
| | Centaurea melitensis | E | 0.1 | 10 | Ground |
| OG | Convolvulus spp. | N | 0.1 | 5 | Ground |
| FG | Daucus glochidiatus | N | 0.1 | 10 | Ground |
| SG | Enchylaena tomentosa | N | 0.5 | 5 | Ground |
| | Erodium cicutarium | E | 0.1 | 20 | Ground |
| FG | Goodenia pusilliflora | N | 1 | 400 | Ground |
| | Hordeum spp. | E | 0.1 | 50 | Ground |
| | Hypochaeris glabra | E | 0.1 | 10 | Ground |
| | Leontodon rhagadioloides | E | 5 | 500 | Ground |
| FG | Linum marginale | N | 0.1 | 10 | Ground |
| | Lolium rigidum | E | 0.5 | 100 | Ground |
| SG | Maireana erioclada | N | 0.1 | 5 | Ground |
| | Medicago laciniata | E | 0.5 | 500 | Ground |
| | Medicago minima | E | 50 | 5000 | Ground |
| | Medicago truncatula | E | 0.5 | 500 | Ground |
| FG | Minuria leptophylla | N | 1 | 200 | Ground |
| SG | Nitraria billardierei | N | 0.5 | 3 | Ground |
| FG | Plantago cunninghamii | N | 0.1 | 20 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 10 | Ground |
| GG | Rytidosperma caespitosum | N | 1 | 50 | Ground |
| GG | Rytidosperma setaceum | N | 0.5 | 50 | Ground |
| SG | Salsola tragus | N | 0.1 | 1 | Ground |
| SG | Sclerolaena diacantha | N | 0.1 | 5 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.2 | 20 | Ground |
| FG | Senecio glossanthus | N | 0.1 | 5 | Ground |
| SG | Sida intricata | N | 0.1 | 1 | Ground |
| | Silene gallica | E | 0.1 | 50 | Ground |
| | Sonchus oleraceus | E | 0.1 | 10 | Ground |
| FG | Vittadinia cervicularis var. | N | 0.2 | 20 | Ground |
| FG | Vittadinia spp. | N | 0.1 | 5 | Ground |
| FG | Wurmbea dioica subsp. dioica | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | DNG | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B21 | Plot dimensions | 20x50 | Orientation of middle | 0 | |
| Easting 737690 | Northing 6141048 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 5 |
| | Grasses etc. | 4 |
| | Forbs | 3 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 12.2 |
| | Grasses etc. | 30.1 |
| | Forbs | 0.4 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 5.5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 20 | 80 | 40 | 40 | 20 |
| Average of the 5 subplots | 40 | | | | |

| Notes | Moderate. currently very high annual load, but decent native grass cover also pres3nt |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle rise | Soil Surface Texture | Sandy loam |
|---|---|---|---|---|---|
| Soil Colour | Orangey brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B21 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Asphodelus fistulosus | E | 20 | 200 | Ground |
| GG | Austrostipa nitida | N | 15 | 200 | Ground |
| | Avena spp. | E | 2 | 200 | Ground |
| | Bromus diandrus | HTE | 5 | 300 | Ground |
| | Bromus rubens | E | 1 | 200 | Ground |
| | Carrichtera annua | HTE | 0.5 | 300 | Ground |
| | Centaurea melitensis | E | 0.5 | 10 | Ground |
| OG | Convolvulus spp. | N | 0.1 | 10 | Ground |
| | Conyza bonariensis | E | 0.1 | 2 | Ground |
| SG | Dissocarpus paradoxus | N | 0.5 | 30 | Ground |
| | Echium plantagineum | E | 2 | 30 | Ground |
| FG | Einadia nutans | N | 0.2 | 10 | Ground |
| GG | Enteropogon acicularis | N | 10 | 100 | Ground |
| FG | Euphorbia drummondii | N | 0.1 | 5 | Ground |
| | Hordeum spp. | E | 10 | 500 | Ground |
| FG | Leiocarpa tomentosa | N | 0.1 | 2 | Ground |
| | Malva parviflora | E | 0.5 | 20 | Ground |
| | Marrubium vulgare | E | 2 | 20 | Ground |
| | Medicago polymorpha | E | 25 | 700 | Ground |
| SG | Nitraria billardierei | N | 0.2 | 1 | Ground |
| | Psilocaulon tenue | E | 0.2 | 10 | Ground |
| SG | Rhagodia spinescens | N | 0.5 | 10 | Ground |
| GG | Rytidosperma caespitosum | N | 0.1 | 5 | Ground |
| SG | Salsola tragus | N | 10 | 30 | Ground |
| | Salvia verbenaca | E | 0.2 | 10 | Ground |
| SG | Sclerolaena muricata | N | 1 | 5 | Ground |
| | Sisymbrium officinale | E | 0.1 | 10 | Ground |
| | Sonchus oleraceus | E | 0.1 | 10 | Ground |
| GG | Walwhalleya proluta | N | 5 | 50 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 07/12/2022 | 37502 plot B25 pct 58 | | DNG | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B25 | Plot dimensions | 50x20 | Orientation of middle | 150 | |
| Easting 740688 | Northing 6138733 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 5 |
| | Grasses etc. | 8 |
| | Forbs | 12 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0.1 |
| | Shrubs | 10.4 |
| | Grasses etc. | 74.8 |
| | Forbs | 7.7 |
| | Ferns | 0 |
| | Other | 0.5 |
| High Threat Weed cover | | 40 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 40 | 15 | 15 | 13 | 10 |
| Average of the 5 subplots | 18.6 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 1 degree east | Soil Surface Texture | Sand loam |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | Black box ephemeral wetland to the east | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B25 pct 58 | 37502_B25 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 0.1 | 2 | |
| GG | Aristida behriana | N | 0.5 | 20 | |
| FG | Arthropodium minus | N | 0.1 | 5 | |
| GG | Austrostipa nitida | N | 50 | 200 | |
| GG | Austrostipa scabra | N | 2 | 50 | |
| | Carrichtera annua | HTE | 40 | 1000 | |
| OG | Convolvulus erubescens | N | 0.5 | 100 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| GG | Digitaria ammophila | N | 0.1 | 1 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 5 | |
| | Echium plantagineum | E | 0.1 | 5 | |
| SG | Enchylaena tomentosa | N | 5 | 40 | |
| GG | Enneapogon avenaceus | N | 0.2 | 20 | |
| GG | Enteropogon acicularis | N | 20 | 100 | |
| FG | Goodenia fascicularis | N | 0.5 | 50 | |
| | Lactuca serriola | E | 0.1 | 10 | |
| FG | Leiocarpa leptolepis | N | 0.1 | 2 | |
| | Leontodon rhagadioloides | E | 20 | 500 | |
| | Limonium lobatum | E | 0.1 | 20 | |
| | Medicago minima | E | 5 | 100 | |
| | Medicago polymorpha | E | 30 | 200 | |
| FG | Minuria leptophylla | N | 2 | 100 | |
| FG | Oxalis perennans | N | 0.1 | 20 | |
| FG | Plantago cunninghamii | N | 0.1 | 5 | |
| FG | Plantago turrifera | N | 0.1 | 5 | |
| GG | Rytidosperma setaceum | N | 1 | 50 | |
| | Schismus barbatus | E | 5 | 100 | |
| SG | Sclerolaena bicornis | N | 0.2 | 20 | |
| SG | Sclerolaena diacantha | N | 5 | 100 | |
| SG | Sclerolaena muricata | N | 0.1 | 5 | |
| FG | Sida ammophila | N | 0.1 | 5 | |
| FG | Sida corrugata | N | 2 | 200 | |
| FG | Solanum esuriale | N | 2 | 200 | |
| | Sonchus oleraceus | E | 0.1 | 20 | |
| GG | Sporobolus caroli | N | 1 | 50 | |
| FG | Vittadinia cuneata | N | 0.5 | 50 | |
| | Vulpia myuros | E | 1 | 200 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 20 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 07/12/2022 | 37502 plot B26 pct 58 | | DNG | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B26 | Plot dimensions | 50x20 | Orientation of middle | 348 | |
| Easting 741019 | Northing 6137335 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 8 |
| | Grasses etc. | 4 |
| | Forbs | 8 |
| | Ferns | 0 |
| | Other | 2 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 3.1 |
| | Grasses etc. | 79 |
| | Forbs | 0.8 |
| | Ferns | 0 |
| | Other | 0.2 |
| High Threat Weed cover | | 40 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 25 | 15 | 35 | 55 |
| Average of the 5 subplots | 38 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat hilltop | Soil Surface Texture | Clay loam |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | Black bix ephemeral wetland to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B26 pct 58 dng | 37502_B26 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa eremophila | N | 35 | 200 | |
| GG | Austrostipa nitida | N | 40 | 200 | |
| FG | Bulbine semibarbata | N | 0.1 | 1 | |
| | Carrichtera annua | HTE | 40 | 1000 | |
| OG | Convolvulus clementii | N | 0.1 | 5 | |
| OG | Convolvulus erubescens | N | 0.1 | 20 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 5 | |
| FG | Einadia nutans | N | 0.1 | 5 | |
| SG | Enchylaena tomentosa | N | 0.5 | 20 | |
| GG | Enteropogon acicularis | N | 1 | 50 | |
| FG | Euphorbia drummondii | N | 0.1 | 5 | |
| FG | Goodenia fascicularis | N | 0.1 | 10 | |
| | Hordeum spp. | E | 0.5 | 20 | |
| | Limonium lobatum | E | 0.1 | 1 | |
| | Medicago polymorpha | E | 10 | 100 | |
| FG | Minuria leptophylla | N | 0.1 | 5 | |
| SG | Nitraria billardierei | N | 0.2 | 1 | |
| SG | Rhagodia spinescens | N | 0.1 | 1 | |
| GG | Rytidosperma setaceum | N | 3 | 100 | |
| SG | Salsola australis | N | 1 | 50 | |
| SG | Sclerolaena brachyptera | N | 0.1 | 1 | |
| SG | Sclerolaena diacantha | N | 1 | 50 | |
| SG | Sclerolaena divaricata | N | 0.1 | 5 | |
| | Sonchus oleraceus | E | 0.1 | 20 | |
| FG | Thysanotus baueri | N | 0.1 | 1 | |
| FG | Vittadinia cuneata | N | 0.1 | 10 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 20 | |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 27/09/2022 | Burrawong WF | | DNG | MJAL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B27 | Plot dimensions | 20x50 | Orientation of middle | 124 |
| Easting 742954 | Northing 6138174 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 8 |
| | Grasses etc. | 3 |
| | Forbs | 10 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 4.9 |
| | Grasses etc. | 8 |
| | Forbs | 1.4 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 35 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 30 | 40 | 15 | 15 | 20 |
| Average of the 5 subplots | 24 | | | | |

| Notes | Derived grassland. ground layer spp same as previous plot, evidence of histoical presence of trees |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sand clay loam |
|---|---|---|---|---|---|
| Soil Colour | Chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B27 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.1 | 5 | Ground |
| GG | Austrostipa scabra | N | 5 | 300 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 10 | Ground |
| | Bromus rubens | E | 0.1 | 5 | Ground |
| FG | Calotis hispidula | N | 0.2 | 100 | Ground |
| | Carrichtera annua | HTE | 35 | 3000 | Ground |
| OG | Convolvulus spp. | N | 0.1 | 2 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| FG | Daucus glochidiatus | N | 0.1 | 10 | Ground |
| SG | Dissocarpus paradoxus | N | 0.1 | 2 | Ground |
| SG | Enchylaena tomentosa | N | 1 | 5 | Ground |
| GG | Enteropogon acicularis | N | 2 | 300 | Ground |
| FG | Erodium crinitum | N | 0.2 | 20 | Ground |
| FG | Goodenia pusilliflora | N | 0.3 | 100 | Ground |
| | Hordeum spp. | E | 1 | 300 | Ground |
| FG | Hyalosperma semisterile | N | 0.1 | 10 | Ground |
| | Leontodon rhagadioloides | E | 0.5 | 20 | Ground |
| | Medicago minima | E | 60 | 5000 | Ground |
| | Medicago truncatula | E | 2 | 300 | Ground |
| FG | Myriocephalus rhizocephalus | N | 0.1 | 10 | Ground |
| SG | Nitraria billardierei | N | 0.5 | 1 | Ground |
| SG | Rhagodia spinescens | N | 1 | 5 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 10 | Ground |
| GG | Rytidosperma setaceum | N | 1 | 100 | Ground |
| SG | Sclerolaena brachyptera | N | 0.1 | 2 | Ground |
| SG | Sclerolaena diacantha | N | 2 | 100 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.1 | 5 | Ground |
| | Silene gallica | E | 0.5 | 100 | Ground |
| | Sisymbrium erysimoides | E | 0.2 | 10 | Ground |
| | Sonchus oleraceus | E | 0.1 | 5 | Ground |
| FG | Spergularia spp. | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 07/12/2022 | 37502 plot B28 pct 21 | | Moderate | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B28 | Plot dimensions | 50x20 | Orientation of middle | 265 | |
| Easting 744330 | Northing 6136008 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_21 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 6 |
| | Grasses etc. | 3 |
| | Forbs | 6 |
| | Ferns | 0 |
| | Other | 2 |
| Sum of Cover of native vascular plans by growth form group | Trees | 10 |
| | Shrubs | 6.5 |
| | Grasses etc. | 2.1 |
| | Forbs | 0.8 |
| | Ferns | 0 |
| | Other | 0.4 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 5 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 15 | 80 | 90 | 90 | 90 |
| Average of the 5 subplots | 73 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 8 degrees north | Soil Surface Texture | Sand |
|---|---|---|---|---|---|
| Soil Colour | Red | Site Drainage | Black box ephemeral wetland to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B28 pct 21 | 37502_B28 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 5 | 4 | |
| GG | Austrostipa nitida | N | 1 | 20 | |
| FG | Bulbine semibarbata | N | 0.1 | 20 | |
| TG | Callitris gracilis | N | 5 | 1 | |
| | Chenopodium murale | E | 2 | 20 | |
| OG | Convolvulus clementii | N | 0.2 | 20 | |
| OG | Convolvulus erubescens | N | 0.2 | 20 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| FG | Dysphania melanocarpa | N | 0.2 | 20 | |
| | Echium plantagineum | E | 1 | 20 | |
| | Emex australis | E | 0.1 | 20 | |
| SG | Enchylaena tomentosa | N | 5 | 20 | |
| GG | Enneapogon avenaceus | N | 0.1 | 1 | |
| GG | Enteropogon acicularis | N | 1 | 20 | |
| FG | Euchiton sphaericus | N | 0.1 | 20 | |
| | Hordeum spp. | E | 0.1 | 20 | |
| | Lolium rigidum | E | 0.1 | 20 | |
| SG | Maireana decalvans | N | 0.1 | 5 | |
| | Marrubium vulgare | E | 0.1 | 20 | |
| | Medicago polymorpha | E | 15 | 100 | |
| SG | Nitraria billardierei | N | 1 | 1 | |
| SG | Osteocarpum acropterum | N | 0.1 | 1 | |
| | Psilocaulon tenue | E | 20 | 100 | |
| SG | Rhagodia spinescens | N | 0.2 | 5 | |
| | Schismus barbatus | E | 10 | 100 | |
| SG | Sclerolaena diacantha | N | 0.1 | 5 | |
| | Sisymbrium orientale | E | 2 | 20 | |
| | Solanum nigrum | E | 0.1 | 1 | |
| | Sonchus oleraceus | E | 0.2 | 20 | |
| FG | Tetragonia tetragonioides | N | 0.2 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 5 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 20 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 25/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B29 | Plot dimensions | 20x50 | Orientation of middle | 283 | |
| Easting 735540 | Northing 6144318 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 1 |
| | Forbs | 5 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 20 |
| | Shrubs | 22.5 |
| | Grasses etc. | 0.1 |
| | Forbs | 1.4 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 5.2 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 5 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 45 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 5 | 10 | 5 | 50 | 15 |
| Average of the 5 subplots | 17 | | | | |

| Notes | Low conditi9n. heavyily weed infested, very edge effected, small isolated |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clayey |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B29 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.1 | 20 | Ground |
| FG | Atriplex lindleyi | N | 0.1 | 5 | Ground |
| GG | Austrostipa nodosa | N | 0.1 | 20 | Ground |
| | Carrichtera annua | HTE | 5 | 1000 | Ground |
| TG | Casuarina pauper | N | 20 | 10 | Canopy |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 10 | 100 | Ground |
| | Hordeum spp. | E | 2 | 500 | Ground |
| | Lolium rigidum | E | 30 | 2000 | Ground |
| | Lycium ferocissimum | HTE | 0.2 | 1 | Mid Storey |
| | Medicago truncatula | E | 1 | 500 | Ground |
| | Mesembryanthemum | E | 0.2 | 50 | Ground |
| SG | Nitraria billardierei | N | 1 | 3 | Ground |
| | Psilocaulon tenue | E | 40 | 500 | Ground |
| SG | Rhagodia spinescens | N | 1 | 5 | Ground |
| FG | Roepera spp. | N | 0.1 | 10 | Ground |
| | Schismus barbatus | E | 25 | 2000 | Ground |
| SG | Sclerolaena brachyptera | N | 0.2 | 100 | Ground |
| SG | Sclerolaena diacantha | N | 0.2 | 20 | Ground |
| SG | Sclerolaena obliquicuspis | N | 10 | 300 | Ground |
| | Sisymbrium irio | E | 15 | 500 | Ground |
| | Sisymbrium orientale | E | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 0.1 | 5 | Ground |
| FG | Spergularia spp. | N | 0.1 | 5 | Ground |
| FG | Tetragonia moorei | N | 1 | 100 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 25/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B30 | Plot dimensions | 20x50 | Orientation of middle | 92 | |
| Easting 738052 | Northing 6142266 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 1 |
| | Forbs | 10 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15 |
| | Shrubs | 13.4 |
| | Grasses etc. | 0.1 |
| | Forbs | 1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 2 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 44 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 2 | 10 | 60 | 40 | 40 |
| Average of the 5 subplots | 30.4 | | | | |

| Notes | Moderate. lower end of moderate, some patches heavily weed infested, some areas ok |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle rise | Soil Surface Texture | Sand clay loam |
|---|---|---|---|---|---|
| Soil Colour | Orangey brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B30 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Arthropodium minus | N | 0.1 | 5 | Ground |
| SG | Atriplex eardleyae | N | 0.2 | 50 | Ground |
| FG | Atriplex lindleyi | N | 0.1 | 10 | Ground |
| GG | Austrostipa elegantissima | N | 0.1 | 10 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 20 | Ground |
| | Bromus rubens | E | 1 | 200 | Ground |
| FG | Bulbine semibarbata | N | 0.1 | 1 | Ground |
| FG | Calandrinia eremaea | N | 0.1 | 50 | Ground |
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| | Carrichtera annua | HTE | 2 | 1000 | Ground |
| TG | Casuarina pauper | N | 15 | 3 | Canopy |
| FG | Crassula colorata | N | 0.1 | 500 | Ground |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 1 | 30 | Ground |
| FG | Goodenia fascicularis | N | 0.1 | 50 | Ground |
| | Hordeum spp. | E | 10 | 1000 | Ground |
| | Lolium rigidum | E | 0.1 | 50 | Ground |
| | Malva parviflora | E | 0.1 | 1 | Ground |
| | Medicago minima | E | 5 | 1000 | Ground |
| | Medicago polymorpha | E | 0.1 | 10 | Ground |
| | Mesembryanthemum | E | 0.1 | 20 | Ground |
| SG | Nitraria billardierei | N | 1 | 3 | Ground |
| SG | Osteocarpum acropterum var. | N | 0.1 | 5 | Ground |
| | Psilocaulon tenue | E | 5 | 300 | Ground |
| SG | Rhagodia spinescens | N | 10 | 20 | Mid Storey |
| FG | Rhodanthe corymbiflora | N | 0.1 | 10 | Ground |
| | Schismus barbatus | E | 2 | 1000 | Ground |
| SG | Sclerolaena brachyptera | N | 1 | 50 | Ground |
| SG | Sclerolaena divaricata | N | 0.1 | 1 | Ground |
| | Silene gallica | E | 0.2 | 100 | Ground |
| | Sonchus oleraceus | E | 0.2 | 50 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 25/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B31 | Plot dimensions | 20x50 | Orientation of middle | 181 | |
| Easting 736422 | Northing 6142866 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 9 |
| | Grasses etc. | 2 |
| | Forbs | 8 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 45 |
| | Shrubs | 19 |
| | Grasses etc. | 0.2 |
| | Forbs | 1.7 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 15 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 20 | 15 | 70 | 25 | 5 |
| Average of the 5 subplots | 27 | | | | |

| Notes | Moderate. lower end of moderate. ground layer pretty clapped out, but mid/canopy pretty good |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle rise | Soil Surface Texture | Bit sandier |
|---|---|---|---|---|---|
| Soil Colour | Bit more orange | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B31 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 10 | 6 | Canopy |
| SG | Atriplex eardleyae | N | 1 | 50 | Ground |
| FG | Atriplex lindleyi | N | 0.1 | 5 | Ground |
| GG | Austrostipa nitida | N | 0.1 | 10 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 20 | Ground |
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| TG | Casuarina pauper | N | 35 | 4 | Canopy |
| FG | Crassula colorata | N | 0.1 | 500 | Ground |
| SG | Dissocarpus paradoxus | N | 1 | 50 | Ground |
| FG | Einadia nutans | N | 0.1 | 10 | Ground |
| SG | Enchylaena tomentosa | N | 0.1 | 5 | Ground |
| GG | Enteropogon acicularis | N | 0.1 | 5 | Ground |
| | Hordeum spp. | E | 2 | 500 | Ground |
| | Lamarckia aurea | E | 1 | 400 | Ground |
| | Lolium rigidum | E | 0.1 | 50 | Ground |
| | Lycium ferocissimum | HTE | 1 | 1 | Mid Storey |
| SG | Maireana decalvans | N | 0.5 | 10 | Ground |
| | Medicago minima | E | 0.1 | 100 | Ground |
| SG | Nitraria billardierei | N | 0.2 | 1 | Ground |
| | Psilocaulon tenue | E | 50 | 2000 | Ground |
| SG | Rhagodia spinescens | N | 0.1 | 1 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 10 | Ground |
| FG | Roepera spp. | N | 0.1 | 20 | Ground |
| SG | Salsola tragus | N | 0.1 | 10 | Ground |
| | Schismus barbatus | E | 15 | 2000 | Ground |
| SG | Sclerolaena diacantha | N | 1 | 50 | Ground |
| SG | Sclerolaena obliquicuspis | N | 15 | 300 | Ground |
| | Sisymbrium erysimoides | E | 2 | 200 | Ground |
| | Sonchus oleraceus | E | 0.1 | 10 | Ground |
| FG | Tetragonia moorei | N | 1 | 100 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | High | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B32 | Plot dimensions | 20x50 | Orientation of middle | 189 | |
| Easting 746992 | Northing 6134577 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 9 |
| | Grasses etc. | 2 |
| | Forbs | 9 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15 |
| | Shrubs | 18.3 |
| | Grasses etc. | 2 |
| | Forbs | 10.6 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 0.5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 7 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 24 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 70 | 25 | 10 | 30 | 10 |
| Average of the 5 subplots | 29 | | | | |

| Notes | Moderare. quite a high cover of annual 2eeds, sparse mid storey, not too bad though |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sand clay loam |
|---|---|---|---|---|---|
| Soil Colour | Orange brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B32 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Alopecurus geniculatus | E | 0.2 | 20 | Ground |
| SG | Atriplex eardleyae | N | 1 | 20 | Ground |
| SG | Atriplex semibaccata | N | 0.2 | 5 | Ground |
| GG | Austrostipa eremophila | N | 1 | 30 | Ground |
| FG | Calandrinia eremaea | N | 0.1 | 10 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| | Carrichtera annua | HTE | 0.5 | 30 | Ground |
| TG | Casuarina pauper | N | 15 | 10 | Canopy |
| OG | Convolvulus spp. | N | 0.1 | 2 | Ground |
| FG | Craspedia haplorrhiza | N | 0.1 | 5 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| FG | Einadia nutans | N | 3 | 30 | Ground |
| SG | Enchylaena tomentosa | N | 5 | 40 | Ground |
| GG | Enteropogon acicularis | N | 1 | 30 | Ground |
| FG | Goodenia pinnatifida | N | 0.1 | 2 | Ground |
| | Lolium rigidum | E | 0.1 | 10 | Ground |
| SG | Maireana decalvans | N | 0.5 | 7 | Ground |
| | Malva parviflora | E | 0.2 | 5 | Ground |
| | Medicago laciniata | E | 2 | 300 | Ground |
| | Medicago minima | E | 0.5 | 50 | Ground |
| SG | Pittosporum angustifolium | N | 0.1 | 1 | Ground |
| FG | Plantago turrifera | N | 0.1 | 20 | Ground |
| | Psilocaulon tenue | E | 1 | 20 | Ground |
| | Reichardia tingitana | E | 0.1 | 1 | Ground |
| SG | Rhagodia spinescens | N | 5 | 30 | Ground |
| FG | Roepera iodocarpa | N | 2 | 50 | Ground |
| SG | Salsola tragus | N | 1 | 5 | Ground |
| | Schismus barbatus | E | 20 | 2000 | Ground |
| SG | Sclerolaena brachyptera | N | 5 | 40 | Ground |
| SG | Sclerolaena diacantha | N | 0.5 | 20 | Ground |
| | Sisymbrium erysimoides | E | 5 | 200 | Ground |
| | Sisymbrium orientale | E | 0.2 | 20 | Ground |
| | Sonchus oleraceus | E | 0.2 | 10 | Ground |
| FG | Tetragonia tetragonioides | N | 5 | 50 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 25/09/2022 | Burrawong WF | | High | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B33 | Plot dimensions | 20x50 | Orientation of middle | 136 | |
| Easting 735360 | Northing 6144910 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 9 |
| | Grasses etc. | 3 |
| | Forbs | 8 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15 |
| | Shrubs | 38.3 |
| | Grasses etc. | 2.6 |
| | Forbs | 0.9 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 25 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 4 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 29 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 15 | 60 | 30 | 20 | 10 |
| Average of the 5 subplots | 27 | | | | |

| Notes | Moderate due to weeds in ground layer potentially below BM cover in mid / upper stporey |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flatc | Soil Surface Texture | Clayey |
|---|---|---|---|---|---|
| Soil Colour | Choclate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B33 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Alopecurus geniculatus | E | 0.1 | 5 | Ground |
| GG | Austrostipa elegantissima | N | 0.5 | 100 | Ground |
| GG | Austrostipa nitida | N | 2 | 300 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 50 | Ground |
| | Bromus rubens | E | 0.2 | 200 | Ground |
| FG | Bulbine semibarbata | N | 0.1 | 10 | Ground |
| FG | Calandrinia eremaea | N | 0.1 | 50 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| | Carrichtera annua | HTE | 25 | 2000 | Ground |
| TG | Casuarina pauper | N | 15 | 4 | Canopy |
| FG | Crassula colorata | N | 0.2 | 500 | Ground |
| SG | Dissocarpus paradoxus | N | 0.5 | 100 | Ground |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 1 | 20 | Ground |
| SG | Exocarpos aphyllus | N | 0.1 | 1 | Ground |
| | Lolium rigidum | E | 0.1 | 50 | Ground |
| SG | Maireana sclerolaenoides | N | 0.1 | 5 | Ground |
| | Medicago truncatula | E | 30 | 2000 | Ground |
| SG | Nitraria billardierei | N | 30 | 50 | Ground |
| SG | Rhagodia spinescens | N | 0.5 | 2 | Ground |
| FG | Roepera iodocarpa | N | 0.1 | 5 | Ground |
| GG | Rytidosperma caespitosum | N | 0.1 | 10 | Ground |
| SG | Salsola tragus | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 0.2 | 300 | Ground |
| SG | Sclerolaena diacantha | N | 1 | 100 | Ground |
| SG | Sclerolaena obliquicuspis | N | 5 | 200 | Ground |
| | Silene gallica | E | 0.2 | 100 | Ground |
| | Sisymbrium erysimoides | E | 0.1 | 50 | Ground |
| | Sonchus oleraceus | E | 0.2 | 50 | Ground |
| FG | Tetragonia moorei | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 30/09/2022 | Burrawong WF | | Moderate | NL & GZ | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B35 | Plot dimensions | 50x20 | Orientation of middle | 105 | |
| Easting 739880 | Northing 6137310 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 15 |
| | Grasses etc. | 2 |
| | Forbs | 19 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 6 |
| | Shrubs | 36.3 |
| | Grasses etc. | 0.2 |
| | Forbs | 5.9 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 1 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 80 | 90 | 20 | 5 | 1 |
| Average of the 5 subplots | 39.2 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Plain/slight depression | Soil Surface Texture | Aolium |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Flat | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 30/09/2022 | Burrawong WF | 37502_B35 | NL & GZ |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 1 | 3 | Mid Storey |
| | Alyssum linifolium | E | 0.1 | 10 | Ground |
| SG | Atriplex eardleyae | N | 0.3 | 20 | Ground |
| SG | Atriplex leptocarpa | N | 0.2 | 20 | Ground |
| FG | Atriplex lindleyi | N | 0.2 | 20 | Ground |
| GG | Austrostipa scabra | N | 0.1 | 50 | Ground |
| FG | Brachyscome lineariloba | N | 0.2 | 200 | Ground |
| FG | Bulbine semibarbata | N | 0.1 | 50 | Ground |
| FG | Calandrinia eremaea | N | 0.5 | 500 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| | Carrichtera annua | HTE | 5 | 500 | Ground |
| TG | Casuarina pauper | N | 5 | 2 | Canopy |
| FG | Craspedia haplorrhiza | N | 0.1 | 50 | Ground |
| FG | Crassula colorata | N | 1 | 2000 | Ground |
| SG | Dissocarpus paradoxus | N | 0.3 | 20 | Ground |
| FG | Einadia nutans | N | 1 | 50 | Ground |
| SG | Enchylaena tomentosa | N | 2 | 30 | Ground |
| | Hordeum spp. | E | 2 | 2000 | Ground |
| | Lolium rigidum | E | 0.1 | 5 | Ground |
| SG | Maireana decalvans | N | 1 | 20 | Ground |
| SG | Malacocera tricornis | N | 0.1 | 2 | Ground |
| | Medicago laciniata | E | 5 | 1000 | Ground |
| | Medicago minima | E | 0.4 | 100 | Ground |
| | Medicago truncatula | E | 0.4 | 50 | Ground |
| FG | Myriocephalus rhizocephalus | N | 0.1 | 10 | Mid Storey |
| SG | Nitraria billardierei | N | 2 | 5 | Mid Storey |
| SG | Osteocarpum acropterum | N | 0.2 | 5 | Ground |
| FG | Oxalis perennans | N | 0.1 | 5 | Ground |
| SG | Pittosporum angustifolium | N | 0.2 | 1 | Mid Storey |
| FG | Plantago turrifera | N | 0.1 | 50 | Ground |
| | Psilocaulon tenue | E | 0.5 | 20 | Ground |
| SG | Rhagodia spinescens | N | 25 | 100 | Mid Storey |
| FG | Rhodanthe corymbiflora | N | 0.4 | 100 | Ground |
| FG | Roepera iodocarpa | N | 0.4 | 10 | Ground |
| SG | Salsola tragus | N | 0.1 | 1 | Ground |
| | Schismus barbatus | E | 30 | 5000 | Ground |
| SG | Sclerolaena brachyptera | N | 2 | 20 | Ground |
| SG | Sclerolaena diacantha | N | 2 | 100 | Ground |
| SG | Sclerolaena muricata var. | N | 0.5 | 10 | Ground |
| SG | Sclerolaena tricuspis | N | 0.4 | 5 | Ground |

| | | | | | |
|---|---|---|---|---|---|
| FG | Senecio glossanthus | N | 0.1 | 50 | Mid Storey |
| FG | Sida cunninghamii | N | 0.1 | 10 | Mid Storey |
| | Silene gallica | E | 0.1 | 50 | Ground |
| | Sisymbrium erysimoides | E | 5 | 400 | Ground |
| FG | Solanum esuriale | N | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 0.1 | 20 | Ground |
| FG | Spergularia spp. | N | 1 | 500 | Ground |
| GG | Sporobolus caroli | N | 0.1 | 5 | Ground |
| FG | Tetragonia moorei | N | 0.2 | 50 | Ground |
| FG | Vittadinia spp. | N | 0.1 | 50 | Ground |
| | Vulpia spp. | E | 0.2 | 1000 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B37 | Plot dimensions | 20x50 | Orientation of middle | 284 | |
| Easting 742680 | Northing 6138359 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 8 |
| | Grasses etc. | 3 |
| | Forbs | 11 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 23 |
| | Shrubs | 15.1 |
| | Grasses etc. | 5.3 |
| | Forbs | 2.6 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 25 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 28 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 5 | 10 | 30 | 60 | 2 |
| Average of the 5 subplots | 21.4 | | | | |

| Notes | Moderate. grazed understorey, high annual weed cover, spwrse mid and canopy |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sany clay loam |
|---|---|---|---|---|---|
| Soil Colour | Chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B37 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 3 | 1 | Canopy |
| SG | Atriplex leptocarpa | N | 2 | 40 | Ground |
| GG | Austrostipa nitida | N | 3 | 200 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 100 | Ground |
| FG | Calotis hispidula | N | 0.1 | 100 | Ground |
| | Carrichtera annua | HTE | 25 | 2000 | Ground |
| TG | Casuarina pauper | N | 20 | 1 | Canopy |
| FG | Crassula colorata | N | 0.5 | 2000 | Ground |
| FG | Daucus glochidiatus | N | 0.1 | 10 | Ground |
| FG | Einadia nutans | N | 0.5 | 20 | Ground |
| SG | Enchylaena tomentosa | N | 0.5 | 5 | Ground |
| GG | Enteropogon acicularis | N | 0.3 | 5 | Ground |
| | Hordeum spp. | E | 2 | 300 | Ground |
| SG | Maireana decalvans | N | 0.5 | 5 | Ground |
| | Malva parviflora | E | 0.1 | 2 | Ground |
| | Medicago minima | E | 45 | 3000 | Ground |
| | Mesembryanthemum | E | 10 | 300 | Ground |
| SG | Nitraria billardierei | N | 2 | 4 | Mid Storey |
| FG | Omphalolappula concava | N | 0.1 | 5 | Ground |
| FG | Plantago turrifera | N | 0.2 | 100 | Ground |
| SG | Rhagodia spinescens | N | 7 | 10 | Mid Storey |
| FG | Rhodanthe corymbiflora | N | 0.5 | 50 | Ground |
| GG | Rytidosperma setaceum | N | 2 | 200 | Ground |
| | Schismus barbatus | E | 0.1 | 10 | Ground |
| SG | Sclerolaena brachyptera | N | 1 | 50 | Ground |
| SG | Sclerolaena diacantha | N | 2 | 70 | Ground |
| FG | Senecio glossanthus | N | 0.2 | 20 | Ground |
| SG | Sida intricata | N | 0.1 | 2 | Ground |
| | Sisymbrium erysimoides | E | 10 | 300 | Ground |
| FG | Tetragonia moorei | N | 0.2 | 30 | Ground |
| FG | Wahlenbergia spp. | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 25/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B38 | Plot dimensions | 20x50 | Orientation of middle | 136 | |
| Easting 738053 | Northing 6142417 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 5 |
| | Grasses etc. | 0 |
| | Forbs | 6 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 30 |
| | Shrubs | 3.3 |
| | Grasses etc. | 0 |
| | Forbs | 2.5 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 55 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 25 | 20 | 5 | 10 | 5 |
| Average of the 5 subplots | 13 | | | | |

| Notes | Low. heavily weed invested, grazed. very little native understorey |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle rise | Soil Surface Texture | Sandy loam |
|---|---|---|---|---|---|
| Soil Colour | Orangey | Site Drainage | Mod poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B38 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| | Carrichtera annua | HTE | 5 | 1000 | Ground |
| | Conyza bonariensis | E | 0.1 | 5 | Ground |
| FG | Crassula colorata | N | 0.1 | 500 | Ground |
| SG | Enchylaena tomentosa | N | 0.2 | 5 | Ground |
| SG | Eremophila longifolia | N | 0.1 | 1 | Mid Storey |
| TG | Eucalyptus dumosa | N | 25 | 6 | Canopy |
| TG | Eucalyptus gracilis | N | 5 | 1 | Canopy |
| | Hordeum spp. | E | 5 | 1000 | Ground |
| | Lolium rigidum | E | 0.1 | 20 | Ground |
| SG | Maireana decalvans | N | 2 | 5 | Mid Storey |
| | Medicago minima | E | 0.5 | 300 | Ground |
| FG | Parietaria debilis | N | 0.1 | 5 | Ground |
| | Psilocaulon tenue | E | 60 | 1000 | Ground |
| SG | Rhagodia spinescens | N | 0.5 | 1 | Mid Storey |
| | Schismus barbatus | E | 0.5 | 200 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.5 | 50 | Ground |
| | Sisymbrium erysimoides | E | 15 | 500 | Ground |
| | Sonchus oleraceus | E | 0.5 | 50 | Ground |
| FG | Stuartina muelleri | N | 0.1 | 10 | Ground |
| FG | Tetragonia moorei | N | 2 | 200 | Ground |
| FG | Wahlenbergia spp. | N | 0.1 | 1 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B39 | Plot dimensions | 20x50 | Orientation of middle | 252 | |
| Easting 745807 | Northing 6133121 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_163 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 5 |
| | Grasses etc. | 2 |
| | Forbs | 11 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 16.2 |
| | Grasses etc. | 6 |
| | Forbs | 2.7 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 30 | 2 | 30 | 20 |
| Average of the 5 subplots | 28.4 | | | | |

| Notes | Moderate. heavy annual grass and medic cover, quite sparse native sh47bs, ok native grass cover |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle rise | Soil Surface Texture | Sand clay loam |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B39 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Asperula conferta | N | 0.1 | 5 | Ground |
| SG | Atriplex eardleyae | N | 0.1 | 5 | Ground |
| SG | Atriplex leptocarpa | N | 0.1 | 2 | Ground |
| GG | Austrostipa scabra | N | 5 | 500 | Ground |
| FG | Brachyscome lineariloba | N | 0.5 | 500 | Ground |
| FG | Craspedia haplorrhiza | N | 1 | 100 | Ground |
| FG | Crassula colorata | N | 0.2 | 500 | Ground |
| FG | Erodium crinitum | N | 0.1 | 5 | Ground |
| FG | Goodenia pusilliflora | N | 0.2 | 200 | Ground |
| | Hordeum spp. | E | 5 | 400 | Ground |
| | Limonium lobatum | E | 5 | 200 | Ground |
| | Medicago minima | E | 70 | 3000 | Ground |
| | Medicago truncatula | E | 5 | 300 | Ground |
| SG | Nitraria billardierei | N | 15 | 8 | Ground |
| FG | Plantago turrifera | N | 0.1 | 100 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 10 | Ground |
| FG | Rhodanthe floribunda | N | 0.1 | 10 | Ground |
| FG | Rhodanthe pygmaea | N | 0.2 | 500 | Ground |
| GG | Rytidosperma setaceum | N | 1 | 100 | Ground |
| SG | Sclerolaena diacantha | N | 0.5 | 30 | Ground |
| SG | Sclerolaena muricata | N | 0.5 | 5 | Ground |
| | Silene gallica | E | 0.1 | 30 | Ground |
| | Sisymbrium erysimoides | E | 1 | 50 | Ground |
| | Sonchus oleraceus | E | 0.2 | 30 | Ground |
| FG | Spergularia spp. | N | 0.1 | 10 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | DNG | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B40 | Plot dimensions | 20x50 | Orientation of middle | 44 | |
| Easting 743138 | Northing 6137998 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 7 |
| | Grasses etc. | 3 |
| | Forbs | 11 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 4.5 |
| | Grasses etc. | 4.5 |
| | Forbs | 1.3 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 15 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 17 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 40 | 20 | 60 | 15 | 40 |
| Average of the 5 subplots | 35 | | | | |

| Notes | DNG. evidence of trees, ground flora very similar to adjacent treed community |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sand clay loa |
|---|---|---|---|---|---|
| Soil Colour | Chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B40 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa nitida | N | 3 | 200 | Ground |
| GG | Austrostipa scabra | N | 1 | 50 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 50 | Ground |
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| | Carrichtera annua | HTE | 15 | 2000 | Ground |
| FG | Craspedia haplorrhiza | N | 0.2 | 20 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| FG | Daucus glochidiatus | N | 0.1 | 4 | Ground |
| SG | Dissocarpus paradoxus | N | 0.1 | 2 | Ground |
| SG | Enchylaena tomentosa | N | 2 | 20 | Ground |
| GG | Enteropogon acicularis | N | 0.5 | 30 | Ground |
| FG | Goodenia pusilliflora | N | 0.1 | 50 | Ground |
| | Hordeum spp. | E | 15 | 1000 | Ground |
| FG | Hyalosperma semisterile | N | 0.2 | 200 | Ground |
| SG | Maireana decalvans | N | 1 | 5 | Ground |
| | Malva parviflora | E | 0.1 | 3 | Ground |
| | Medicago minima | E | 65 | 4000 | Ground |
| FG | Minuria leptophylla | N | 0.1 | 1 | Ground |
| SG | Nitraria billardierei | N | 0.2 | 1 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 5 | Ground |
| FG | Roepera crenata | N | 0.1 | 2 | Ground |
| SG | Sclerolaena brachyptera | N | 0.1 | 1 | Ground |
| SG | Sclerolaena diacantha | N | 1 | 40 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.1 | 1 | Ground |
| | Silene gallica | E | 0.2 | 20 | Ground |
| | Sisymbrium erysimoides | E | 0.2 | 5 | Ground |
| | Sonchus oleraceus | E | 0.1 | 2 | Ground |
| FG | Vittadinia spp. | N | 0.1 | 2 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | DNG | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B41 | Plot dimensions | 20x50 | Orientation of middle | 1 | |
| Easting 743331 | Northing 6137424 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 5 |
| | Grasses etc. | 7 |
| | Forbs | 14 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 9.3 |
| | Grasses etc. | 19.4 |
| | Forbs | 29.2 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 10 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 60 | 5 | 1 | 10 |
| Average of the 5 subplots | 17.2 | | | | |

| Notes | DNG |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Depression | Soil Surface Texture | Clay sand loam |
|---|---|---|---|---|---|
| Soil Colour | chocolate | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B41 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa elegantissima | N | 0.5 | 10 | Ground |
| GG | Austrostipa nitida | N | 15 | 300 | Ground |
| FG | Brachyscome lineariloba | N | 0.2 | 100 | Ground |
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| | Carrichtera annua | HTE | 10 | 1000 | Ground |
| GG | Chloris truncata | N | 0.2 | 5 | Ground |
| FG | Crassula colorata | N | 0.1 | 100 | Ground |
| SG | Enchylaena tomentosa | N | 2 | 30 | Ground |
| GG | Enteropogon acicularis | N | 2 | 50 | Ground |
| FG | Goodenia pusilliflora | N | 0.5 | 300 | Ground |
| | Hordeum spp. | E | 0.2 | 40 | Ground |
| FG | Hyalosperma demissum | N | 2 | 500 | Ground |
| FG | Hyalosperma semisterile | N | 15 | 2000 | Ground |
| | Leontodon rhagadioloides | E | 0.2 | 5 | Ground |
| SG | Maireana erioclada | N | 0.2 | 5 | Ground |
| | Medicago minima | E | 40 | 3000 | Ground |
| | Medicago truncatula | E | 0.1 | 20 | Ground |
| SG | Nitraria billardierei | N | 5 | 1 | Ground |
| | Parapholis incurva | E | 0.1 | 10 | Ground |
| FG | Plantago cunninghamii | N | 0.1 | 3 | Ground |
| FG | Plantago turrifera | N | 0.1 | 20 | Ground |
| FG | Rhodanthe corymbiflora | N | 10 | 500 | Ground |
| FG | Rhodanthe pygmaea | N | 0.5 | 500 | Ground |
| FG | Roepera glauca | N | 0.1 | 1 | Ground |
| GG | Rytidosperma caespitosum | N | 1 | 50 | Ground |
| GG | Rytidosperma setaceum | N | 0.5 | 50 | Ground |
| SG | Salsola tragus | N | 0.1 | 2 | Ground |
| SG | Sclerolaena brachyptera | N | 2 | 100 | Ground |
| | Sisymbrium erysimoides | E | 0.2 | 5 | Ground |
| | Sonchus oleraceus | E | 0.1 | 2 | Ground |
| FG | Spergularia spp. | N | 0.2 | 50 | Ground |
| GG | Sporobolus caroli | N | 0.2 | 10 | Ground |
| FG | Vittadinia spp. | N | 0.2 | 30 | Ground |
| | Vulpia spp. | E | 1 | 500 | Ground |
| FG | Wahlenbergia spp. | N | 0.1 | 20 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B42 | Plot dimensions | 20x50 | Orientation of middle | 295 | |
| Easting 746274 | Northing 6133070 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_163 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 2 |
| | Grasses etc. | 4 |
| | Forbs | 11 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 15.1 |
| | Grasses etc. | 4.7 |
| | Forbs | 3.6 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 20 | 5 | 40 | 10 |
| Average of the 5 subplots | 17 | | | | |

| Notes | Moderate. hign annual weed cover |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B42 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa eremophila | N | 0.5 | 10 | Ground |
| GG | Austrostipa nitida | N | 0.2 | 10 | Ground |
| | Bromus rubens | E | 1 | 300 | Ground |
| | Carrichtera annua | HTE | 5 | 500 | Ground |
| | Centaurea melitensis | E | 0.2 | 20 | Ground |
| FG | Craspedia haplorrhiza | N | 0.5 | 50 | Ground |
| FG | Daucus glochidiatus | N | 0.1 | 20 | Ground |
| SG | Dissocarpus paradoxus | N | 0.1 | 5 | Ground |
| GG | Enteropogon acicularis | N | 2 | 50 | Ground |
| FG | Erodium crinitum | N | 0.1 | 2 | Ground |
| FG | Goodenia pusilliflora | N | 0.2 | 200 | Ground |
| FG | Hyalosperma demissum | N | 0.1 | 20 | Ground |
| FG | Leiocarpa leptolepis | N | 0.1 | 1 | Ground |
| FG | Leiocarpa tomentosa | N | 0.1 | 5 | Ground |
| | Leontodon rhagadioloides | E | 0.2 | 20 | Ground |
| | Lolium rigidum | E | 5 | 1000 | Ground |
| | Medicago minima | E | 60 | 5000 | Ground |
| FG | Minuria leptophylla | N | 2 | 100 | Ground |
| SG | Nitraria billardierei | N | 15 | 20 | Ground |
| FG | Plantago turrifera | N | 0.2 | 100 | Ground |
| | Reichardia tingitana | E | 0.1 | 5 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 20 | Ground |
| GG | Rytidosperma caespitosum | N | 2 | 100 | Ground |
| | Silene gallica | E | 0.2 | 100 | Ground |
| | Sisymbrium orientale | E | 0.1 | 5 | Ground |
| | Sonchus asper | E | 0.5 | 50 | Ground |
| FG | Vittadinia spp. | N | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B43 | Plot dimensions | 20x50 | Orientation of middle | 258 | |
| Easting 747652 | Northing 6132867 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 5 |
| | Grasses etc. | 1 |
| | Forbs | 5 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 10 |
| | Shrubs | 9.2 |
| | Grasses etc. | 25 |
| | Forbs | 1.8 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 15 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 2 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 120 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 70 | 15 | 10 | 5 | 15 |
| Average of the 5 subplots | 23 | | | | |

| Notes | Moderate. lower native cover in canopy and midstorey, weed load in ground |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Swndy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B43 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Asphodelus fistulosus | E | 0.1 | 5 | Ground |
| GG | Austrostipa nitida | N | 25 | 300 | Ground |
| FG | Calotis hispidula | N | 0.1 | 50 | Ground |
| | Carrichtera annua | HTE | 15 | 2000 | Ground |
| | Centaurea melitensis | E | 0.1 | 5 | Ground |
| SG | Chenopodium curvispicatum | N | 0.2 | 10 | Ground |
| FG | Craspedia haplorrhiza | N | 0.1 | 50 | Ground |
| SG | Dissocarpus paradoxus | N | 0.5 | 20 | Ground |
| | Echium plantagineum | E | 0.1 | 10 | Ground |
| SG | Enchylaena tomentosa | N | 3 | 30 | Ground |
| TG | Eucalyptus gracilis | N | 10 | 4 | Canopy |
| | Hordeum spp. | E | 2 | 200 | Ground |
| | Marrubium vulgare | E | 0.5 | 20 | Ground |
| | Medicago laciniata | E | 15 | 500 | Ground |
| | Medicago minima | E | 5 | 200 | Ground |
| | Reichardia tingitana | E | 0.1 | 1 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 5 | Ground |
| FG | Roepera crenata | N | 1 | 50 | Ground |
| SG | Sclerolaena diacantha | N | 5 | 200 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.5 | 10 | Ground |
| | Silene gallica | E | 0.1 | 20 | Ground |
| | Sisymbrium erysimoides | E | 0.5 | 100 | Ground |
| | Sisymbrium orientale | E | 0.1 | 20 | Ground |
| | Sonchus oleraceus | E | 0.2 | 10 | Ground |
| FG | Vittadinia spp. | N | 0.5 | 20 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 25/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B44 | Plot dimensions | 20x50 | Orientation of middle | 94 | |
| Easting 736941 | Northing 6140613 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 3 |
| | Shrubs | 8 |
| | Grasses etc. | 0 |
| | Forbs | 3 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 40 |
| | Shrubs | 2.3 |
| | Grasses etc. | 0 |
| | Forbs | 1.3 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 5 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 55 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 20 | 15 | 15 | 5 | 80 |
| Average of the 5 subplots | 27 | | | | |

| Notes | Moderate. potentially lower end of moderate, ground layer heavily grazed as shown by ground layer composition, but some nat8ve and mid/canopy ok |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle rise | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Poor to moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | 2 | R | Rabbit warrens, rabbit scats, grazing tolerant spp dominance |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 25/09/2022 | Burrawong WF | 37502_B44 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Arctotheca calendula | E | 0.1 | 5 | Ground |
| SG | Atriplex eardleyae | N | 0.1 | 5 | Ground |
| FG | Crassula colorata | N | 0.1 | 200 | Ground |
| SG | Dissocarpus paradoxus | N | 0.2 | 20 | Ground |
| SG | Enchylaena tomentosa | N | 0.1 | 5 | Ground |
| TG | Eucalyptus dumosa | N | 5 | 2 | Canopy |
| TG | Eucalyptus gracilis | N | 5 | 3 | Canopy |
| TG | Eucalyptus socialis | N | 30 | 4 | Canopy |
| SG | Exocarpos aphyllus | N | 1 | 1 | Mid Storey |
| | Hordeum spp. | E | 0.2 | 100 | Ground |
| | Lolium rigidum | E | 0.1 | 20 | Ground |
| SG | Maireana decalvans | N | 0.1 | 5 | Ground |
| | Medicago laciniata | E | 0.1 | 5 | Ground |
| | Psilocaulon tenue | E | 55 | 500 | Ground |
| SG | Rhagodia spinescens | N | 0.1 | 2 | Ground |
| FG | Roepera spp. | N | 0.2 | 20 | Ground |
| | Schismus barbatus | E | 15 | 2000 | Ground |
| SG | Sclerolaena diacantha | N | 0.2 | 40 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.5 | 20 | Ground |
| | Sisymbrium erysimoides | E | 25 | 500 | Ground |
| | Sonchus oleraceus | E | 0.1 | 10 | Ground |
| FG | Tetragonia moorei | N | 1 | 100 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B46 | Plot dimensions | 20x50 | Orientation of middle | 350 | |
| Easting 729390 | Northing 6139370 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 2 |
| | Grasses etc. | 0 |
| | Forbs | 2 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 25 |
| | Shrubs | 8 |
| | Grasses etc. | 0 |
| | Forbs | 0.4 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 46 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 15 | 5 | 30 | 5 | 70 |
| Average of the 5 subplots | 25 | | | | |

| Notes | Moderate. lower end of moderate, native spp poor, pretty weedy understorey |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Sandy rise | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B46 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Enchylaena tomentosa | N | 5 | 70 | Ground |
| TG | Eucalyptus gracilis | N | 25 | 9 | Canopy |
| | Psilocaulon tenue | E | 40 | 300 | Ground |
| FG | Roepera spp. | N | 0.2 | 100 | Ground |
| | Schismus barbatus | E | 10 | 1000 | Ground |
| SG | Sclerolaena diacantha | N | 3 | 100 | Ground |
| | Sisymbrium erysimoides | E | 5 | 300 | Ground |
| | Sonchus oleraceus | E | 0.1 | 10 | Ground |
| FG | Tetragonia moorei | N | 0.2 | 20 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B47 | Plot dimensions | 20x50 | Orientation of middle | 79 | |
| Easting 728907 | Northing 6139207 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 6 |
| | Grasses etc. | 1 |
| | Forbs | 11 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 20 |
| | Shrubs | 15.4 |
| | Grasses etc. | 0.1 |
| | Forbs | 2.4 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 68 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 15 | 60 | 15 | 30 | 80 |
| Average of the 5 subplots | 40 | | | | |

| Notes | Moderate. some weedy annuals in ground layer, pretty good though. higher end of moderate |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight rise | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B47 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.1 | 10 | Ground |
| GG | Austrostipa nitida | N | 0.1 | 10 | Ground |
| FG | Brachyscome lineariloba | N | 0.1 | 50 | Ground |
| FG | Calandrinia eremaea | N | 0.1 | 50 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| SG | Chenopodium desertorum | N | 0.1 | 5 | Ground |
| FG | Crassula colorata | N | 0.5 | 1000 | Ground |
| FG | Daucus glochidiatus | N | 0.1 | 5 | Ground |
| | Echium plantagineum | E | 0.1 | 5 | Ground |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 5 | 50 | Ground |
| FG | Erodium crinitum | N | 0.1 | 5 | Ground |
| TG | Eucalyptus gracilis | N | 10 | 5 | Canopy |
| TG | Eucalyptus socialis | N | 10 | 3 | Canopy |
| | Hordeum spp. | E | 15 | 1000 | Ground |
| | Limonium lobatum | E | 0.2 | 20 | Ground |
| SG | Maireana decalvans | N | 0.2 | 10 | Ground |
| | Medicago laciniata | E | 0.5 | 100 | Ground |
| FG | Minuria leptophylla | N | 0.1 | 10 | Ground |
| FG | Oxalis perennans | N | 0.1 | 5 | Ground |
| | Psilocaulon tenue | E | 0.1 | 5 | Ground |
| SG | Rhagodia spinescens | N | 5 | 10 | Mid Storey |
| FG | Rhodanthe moschata | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 20 | 2000 | Ground |
| SG | Sclerolaena diacantha | N | 5 | 100 | Ground |
| | Silene gallica | E | 0.1 | 5 | Ground |
| | Sisymbrium erysimoides | E | 0.5 | 100 | Ground |
| | Sisymbrium orientale | E | 0.1 | 10 | Ground |
| | Sonchus oleraceus | E | 0.1 | 5 | Ground |
| FG | Tetragonia moorei | N | 1 | 50 | Ground |
| | Vicia spp. | E | 0.1 | 5 | Ground |
| | Vulpia spp. | E | 0.2 | 100 | Ground |

| BAM Plot Data Sheet | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Site Sheet no:1 of 2 Recorders | | |
| Date | 05/12/2022 | 37502 plot B50 pct 16 | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B50 | Plot dimensions | 50x20 | Orientation of middle | 8 |
| Easting 746396 | Northing 6131811 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_16 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 5 |
| | Grasses etc. | 3 |
| | Forbs | 7 |
| | Ferns | 0 |
| | Other | 2 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 10.8 |
| | Grasses etc. | 45 |
| | Forbs | 0.8 |
| | Ferns | 0 |
| | Other | 0.2 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 15 | 15 | 15 | 25 | 10 |
| Average of the 5 subplots | 16 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Grey | Site Drainage | Black box ephemeral wetland | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 05/12/2022 | 37502 plot B50 pct 16 DNG | 37502_B50 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Asperula conferta | N | 0.1 | 10 | |
| GG | Austrostipa nitida | N | 40 | 200 | |
| OG | Convolvulus clementii | N | 0.1 | 10 | |
| OG | Convolvulus erubescens | N | 0.1 | 10 | |
| | Conyza bonariensis | E | 0.1 | 5 | |
| SG | Duma florulenta | N | 10 | 20 | |
| FG | Einadia nutans | N | 0.2 | 5 | |
| SG | Enchylaena tomentosa | N | 0.5 | 20 | |
| GG | Enteropogon acicularis | N | 1 | 20 | |
| FG | Euchiton sphaericus | N | 0.1 | 20 | |
| | Lactuca serriola | E | 0.1 | 10 | |
| | Medicago minima | E | 70 | 1000 | |
| FG | Oxalis perennans | N | 0.1 | 20 | |
| FG | Rhodanthe corymbiflora | N | 0.1 | 20 | |
| GG | Rytidosperma setaceum | N | 4 | 40 | |
| SG | Salsola australis | N | 0.1 | 5 | |
| SG | Sclerolaena diacantha | N | 0.1 | 10 | |
| SG | Sclerolaena obliquicuspis | N | 0.1 | 50 | |
| FG | Sida corrugata | N | 0.1 | 20 | |
| | Sisymbrium erysimoides | E | 0.5 | 50 | |
| FG | Solanum esuriale | N | 0.1 | 30 | |
| | Sonchus oleraceus | E | 0.5 | 50 | |

| BAM Plot Data Sheet | | | | | Site Sheet no:1 of 2 | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 05/12/2022 | 37502 plot B51 pct 16 | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B51 | Plot dimensions | 50x20 | Orientation of middle | 31 |
| Easting 746335 | Northing 6131531 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_16 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 10 |
| | Grasses etc. | 4 |
| | Forbs | 8 |
| | Ferns | 0 |
| | Other | 2 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 3 |
| | Grasses etc. | 77.2 |
| | Forbs | 1.3 |
| | Ferns | 0 |
| | Other | 0.2 |
| High Threat Weed cover | | 5 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 7 | 3 | 5 | 6 | 2 |
| Average of the 5 subplots | 4.6 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Light grey | Site Drainage | Ephemeral black box wetland to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |

| | | | |
|---|---|---|---|
| **Fire damage** | | | |
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 05/12/2022 | 37502 plot B51 pct 16 DNG | 37502_B51 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.1 | 10 | |
| SG | Atriplex leptocarpa | N | 0.1 | 5 | |
| GG | Austrostipa nitida | N | 70 | 500 | |
| FG | Bulbine semibarbata | N | 0.1 | 5 | |
| | Carrichtera annua | HTE | 5 | 100 | |
| OG | Convolvulus clementii | N | 0.1 | 5 | |
| OG | Convolvulus erubescens | N | 0.1 | 40 | |
| SG | Duma florulenta | N | 2 | 10 | |
| FG | Einadia nutans | N | 0.5 | 5 | |
| SG | Enchylaena tomentosa | N | 0.1 | 5 | |
| GG | Enteropogon acicularis | N | 2 | 50 | |
| | Hordeum spp. | E | 0.2 | 20 | |
| | Lactuca serriola | E | 0.1 | 5 | |
| SG | Maireana decalvans | N | 0.1 | 10 | |
| FG | Maireana pentagona | N | 0.1 | 5 | |
| SG | Malacocera tricornis | N | 0.1 | 2 | |
| | Medicago minima | E | 10 | 500 | |
| FG | Oxalis perennans | N | 0.1 | 20 | |
| SG | Rhagodia spinescens | N | 0.2 | 1 | |
| GG | Rytidosperma caespitosum | N | 0.2 | 10 | |
| GG | Rytidosperma setaceum | N | 5 | 50 | |
| SG | Sclerolaena muricata | N | 0.1 | 10 | |
| SG | Sclerolaena obliquicuspis | N | 0.1 | 5 | |
| SG | Sclerolaena tricuspis | N | 0.1 | 5 | |
| FG | Solanum esuriale | N | 0.2 | 40 | |
| | Sonchus oleraceus | E | 0.2 | 40 | |
| FG | Stuartina muelleri | N | 0.1 | 20 | |
| FG | Teucrium racemosum | N | 0.1 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 10 | |

| BAM Plot Data Sheet | | | | | Site Sheet no:1 of 2 | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 05/12/2022 | 37502 plot B52 pct 170 | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B52 | Plot dimensions | 50x20 | Orientation of middle | 80 |
| Easting 746287 | Northing 6131178 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_170 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 5 |
| | Grasses etc. | 6 |
| | Forbs | 13 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 2.5 |
| | Grasses etc. | 19.2 |
| | Forbs | 3.9 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 1 | 2 | 3 | 6 |
| Average of the 5 subplots | 4.4 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Grey/light brown | Site Drainage | Black box depression to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 05/12/2022 | 37502 plot B52 pct 170 | 37502_B52 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.2 | 50 | |
| SG | Atriplex leptocarpa | N | 0.1 | 1 | |
| FG | Atriplex lindleyi | N | 0.5 | 10 | |
| GG | Austrostipa nitida | N | 5 | 50 | |
| FG | Brachyscome lineariloba | N | 0.2 | 40 | |
| FG | Bulbine semibarbata | N | 0.1 | 1 | |
| GG | Chloris truncata | N | 0.1 | 2 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| FG | Cressa australis | N | 0.1 | 20 | |
| GG | Enteropogon acicularis | N | 10 | 100 | |
| FG | Euchiton sphaericus | N | 0.1 | 10 | |
| FG | Euphorbia drummondii | N | 0.1 | 20 | |
| FG | Goodenia fascicularis | N | 0.1 | 1 | |
| | Hordeum spp. | E | 5 | 20 | |
| | Limonium lobatum | E | 10 | 50 | |
| | Lolium rigidum | E | 2 | 3 | |
| SG | Maireana decalvans | N | 0.1 | 10 | |
| FG | Maireana pentagona | N | 2 | 100 | |
| | Medicago minima | E | 2 | 50 | |
| | Medicago polymorpha | E | 2 | 40 | |
| | Mesembryanthemum | E | 0.1 | 1 | |
| SG | Nitraria billardierei | N | 2 | 10 | |
| FG | Oxalis perennans | N | 0.1 | 20 | |
| FG | Rhodanthe corymbiflora | N | 0.2 | 50 | |
| FG | Rhodanthe floribunda | N | 0.2 | 50 | |
| GG | Rytidosperma caespitosum | N | 0.1 | 20 | |
| GG | Rytidosperma setaceum | N | 2 | 40 | |
| | Schismus barbatus | E | 5 | 100 | |
| SG | Sclerolaena tricuspis | N | 0.1 | 10 | |
| | Sisymbrium erysimoides | E | 0.1 | 20 | |
| | Sonchus oleraceus | E | 1 | 50 | |
| GG | Sporobolus caroli | N | 2 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 20 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 2 | |

| BAM Plot Data Sheet | | | | | Site Sheet no:1 of 2 | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 05/12/2022 | 37502 plot B53 pct 46 | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B53 | Plot dimensions | 50x20 | Orientation of middle | 191 |
| Easting 744905 | Northing 6136744 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 5 |
| | Grasses etc. | 7 |
| | Forbs | 10 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 1.7 |
| | Grasses etc. | 106.1 |
| | Forbs | 35.9 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 30 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 3 | 3 | 3 | 3 |
| Average of the 5 subplots | 4.4 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay sand |
|---|---|---|---|---|---|
| Soil Colour | Grey | Site Drainage | Within slight hollow | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 05/12/2022 | 37502 plot B53 pct 46 high | 37502_B53 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa elegantissima | N | 0.1 | 5 | |
| GG | Austrostipa eremophila | N | 1 | 40 | |
| GG | Austrostipa nitida | N | 20 | 100 | |
| | Carrichtera annua | HTE | 30 | 1000 | |
| OG | Convolvulus erubescens | N | 0.1 | 20 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 20 | |
| SG | Enchylaena tomentosa | N | 0.3 | 20 | |
| GG | Enteropogon acicularis | N | 15 | 100 | |
| FG | Euchiton sphaericus | N | 0.1 | 20 | |
| FG | Euphorbia drummondii | N | 0.1 | 20 | |
| | Lactuca serriola | E | 0.1 | 40 | |
| FG | Leiocarpa leptolepis | N | 0.1 | 20 | |
| FG | Maireana pentagona | N | 0.2 | 40 | |
| | Medicago minima | E | 0.5 | 40 | |
| FG | Minuria leptophylla | N | 20 | 500 | |
| SG | Nitraria billardierei | N | 1 | 5 | |
| FG | Oxalis perennans | N | 0.1 | 50 | |
| SG | Rhagodia spinescens | N | 0.2 | 2 | |
| GG | Rytidosperma caespitosum | N | 5 | 100 | |
| GG | Rytidosperma setaceum | N | 60 | 500 | |
| SG | Sclerolaena diacantha | N | 0.1 | 20 | |
| FG | Sida cunninghamii | N | 0.1 | 20 | |
| FG | Solanum esuriale | N | 0.1 | 20 | |
| | Sonchus oleraceus | E | 0.1 | 20 | |
| GG | Sporobolus caroli | N | 5 | 60 | |
| FG | Teucrium racemosum | N | 0.1 | 10 | |
| FG | Vittadinia cuneata | N | 15 | 500 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 06/12/2022 | 37502 plot B54 pct 21 | | Moderate | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B54 | Plot dimensions | 50x20 | Orientation of middle | 113 | |
| Easting 743479 | Northing 6132202 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_21 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 3 |
| | Grasses etc. | 2 |
| | Forbs | 2 |
| | Ferns | 0 |
| | Other | 2 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15 |
| | Shrubs | 6 |
| | Grasses etc. | 3 |
| | Forbs | 0.2 |
| | Ferns | 0 |
| | Other | 1.1 |
| High Threat Weed cover | | 0.1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 14 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 80 | 10 | 17 | 33 | 50 |
| Average of the 5 subplots | 38 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 8 degrees west | Soil Surface Texture | Sand |
|---|---|---|---|---|---|
| Soil Colour | Red | Site Drainage | Black box ephemeral wetland to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 06/12/2022 | 37502 plot B54 pct 21 | 37502_B54 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa nitida | N | 2 | 20 | |
| | Avena barbata | E | 0.2 | 20 | |
| TG | Callitris gracilis | N | 15 | 1 | |
| OG | Convolvulus clementii | N | 1 | 100 | |
| OG | Convolvulus erubescens | N | 0.1 | 20 | |
| | Conyza bonariensis | E | 0.5 | 20 | |
| FG | Dysphania cristata | N | 0.1 | 20 | |
| FG | Einadia nutans | N | 0.1 | 10 | |
| | Emex australis | E | 0.1 | 10 | |
| GG | Enteropogon acicularis | N | 1 | 20 | |
| | Hordeum spp. | E | 10 | 500 | |
| | Lactuca serriola | E | 0.1 | 5 | |
| | Lycium ferocissimum | HTE | 0.1 | 2 | |
| SG | Maireana decalvans | N | 2 | 10 | |
| | Malva nicaeensis | E | 2 | 20 | |
| | Marrubium vulgare | E | 0.1 | 5 | |
| | Medicago minima | E | 10 | 100 | |
| | Medicago polymorpha | E | 20 | 500 | |
| | Psilocaulon tenue | E | 10 | 100 | |
| SG | Salsola australis | N | 2 | 10 | |
| | Schismus barbatus | E | 50 | 1000 | |
| SG | Sclerolaena muricata | N | 2 | 10 | |
| | Sisymbrium officinale | E | 30 | 100 | |
| | Solanum nigrum | E | 0.1 | 20 | |
| | Sonchus oleraceus | E | 10 | 100 | |
| | Taraxacum officinale | E | 0.1 | 5 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 08/12/2022 | Burrawong WF | | Moderate | NL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B55 | Plot dimensions | 20x50 | Orientation of middle | 274 | |
| Easting 733666 | Northing 6140312 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_23 | | | | EEC: Acacia mellvelli shrubland | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 8 |
| | Grasses etc. | 2 |
| | Forbs | 12 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 14 |
| | Shrubs | 26.6 |
| | Grasses etc. | 0.2 |
| | Forbs | 1.3 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 10 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 80 | 70 | 80 | 5 | 65 |
| Average of the 5 subplots | 60 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentle decline | Soil Surface Texture | Fine sandy |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 08/12/2022 | Burrawong WF | 37502_B55 | NL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Acacia melvillei | N | 10 | 1 | |
| TG | Acacia oswaldii | N | 4 | 1 | |
| SG | Atriplex eardleyae | N | 0.1 | 10 | |
| GG | Austrostipa elegantissima | N | 0.1 | 1 | |
| FG | Bulbine semibarbata | N | 0.1 | 1 | |
| FG | Chrysocephalum apiculatum | N | 0.1 | 10 | |
| SG | Dodonaea viscosa subsp. | N | 20 | 5 | |
| FG | Dysphania melanocarpa | N | 0.1 | 5 | |
| | Echium plantagineum | E | 0.1 | 1 | |
| FG | Einadia nutans | N | 0.2 | 2 | |
| SG | Enchylaena tomentosa | N | 2 | 20 | |
| GG | Enteropogon acicularis | N | 0.1 | 6 | |
| SG | Eremophila longifolia | N | 0.1 | 1 | |
| FG | Goodenia pusilliflora | N | 0.1 | 2 | |
| | Hordeum spp. | E | 0.1 | 10 | |
| | Lactuca serriola | E | 0.1 | 3 | |
| | Limonium lobatum | E | 20 | 1000 | |
| | Medicago minima | E | 0.1 | 5 | |
| SG | Nitraria billardierei | N | 2 | 1 | |
| FG | Pseudognaphalium luteoalbum | N | 0.1 | 6 | |
| SG | Rhagodia spinescens | N | 2 | 10 | |
| SG | Salsola australis | N | 0.2 | 10 | |
| | Schismus barbatus | E | 40 | 5000 | |
| SG | Sclerolaena diacantha | N | 0.2 | 70 | |
| FG | Sida ammophila | N | 0.1 | 10 | |
| FG | Sida corrugata | N | 0.1 | 20 | |
| | Sisymbrium spp. | E | 0.1 | 3 | |
| FG | Solanum esuriale | N | 0.1 | 4 | |
| | Sonchus oleraceus | E | 0.1 | 20 | |
| FG | Tetragonia tetragonioides | N | 0.1 | 10 | |
| FG | Vittadinia cuneata | N | 0.1 | 2 | |
| | Vulpia bromoides | E | 0.2 | 200 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 20 | |

| BAM Plot Data Sheet | | | | | Site Sheet no:1 of 2 | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 07/12/2022 | 37502 plot B56 pct 170 | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B56 | Plot dimensions | 50x20 | Orientation of middle | 70 |
| Easting 739243 | Northing 6137337 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_170 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 11 |
| | Grasses etc. | 4 |
| | Forbs | 9 |
| | Ferns | 1 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 10.4 |
| | Grasses etc. | 18.1 |
| | Forbs | 1.4 |
| | Ferns | 0.2 |
| | Other | 0.1 |
| High Threat Weed cover | | 10 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 7 | 10 | 5 | 4 | 3 |
| Average of the 5 subplots | 5.8 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Black box drainage line to the east | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B56 pct 170 | 37502_B56 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Arctotheca calendula | E | 0.1 | 10 | |
| SG | Atriplex eardleyae | N | 5 | 50 | |
| SG | Atriplex leptocarpa | N | 2 | 5 | |
| FG | Bulbine semibarbata | N | 0.1 | 10 | |
| | Carrichtera annua | HTE | 10 | 100 | |
| FG | Chrysocephalum apiculatum | N | 0.1 | 20 | |
| OG | Convolvulus erubescens | N | 0.1 | 20 | |
| | Echium plantagineum | E | 0.2 | 10 | |
| SG | Enchylaena tomentosa | N | 0.2 | 10 | |
| GG | Enteropogon acicularis | N | 2 | 30 | |
| GG | Eragrostis dielsii | N | 0.1 | 10 | |
| FG | Euchiton sphaericus | N | 0.1 | 10 | |
| | Lolium rigidum | E | 20 | 200 | |
| SG | Maireana decalvans | N | 0.1 | 2 | |
| EG | Marsilea drummondii | N | 0.2 | 30 | |
| | Medicago minima | E | 10 | 50 | |
| | Medicago polymorpha | E | 20 | 200 | |
| FG | Oxalis perennans | N | 0.5 | 50 | |
| SG | Rhagodia spinescens | N | 0.2 | 1 | |
| GG | Rytidosperma setaceum | N | 15 | 200 | |
| SG | Salsola australis | N | 0.1 | 5 | |
| | Schismus barbatus | E | 5 | 10 | |
| SG | Sclerolaena brachyptera | N | 2 | 50 | |
| SG | Sclerolaena diacantha | N | 0.1 | 10 | |
| SG | Sclerolaena divaricata | N | 0.1 | 5 | |
| SG | Sclerolaena muricata | N | 0.5 | 5 | |
| SG | Sclerolaena stelligera | N | 0.1 | 10 | |
| FG | Sida ammophila | N | 0.1 | 5 | |
| FG | Sida cunninghamii | N | 0.1 | 10 | |
| FG | Solanum esuriale | N | 0.2 | 20 | |
| | Sonchus oleraceus | E | 0.2 | 20 | |
| GG | Sporobolus caroli | N | 1 | 30 | |
| FG | Teucrium racemosum | N | 0.1 | 10 | |
| FG | Vittadinia cuneata | N | 0.1 | 1 | |
| | Vulpia myuros | E | 0.2 | 10 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no: 1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 08/12/2022 | Burrawong WF | | Moderate | NL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B57 | Plot dimensions | 20x50 | Orientation of middle | 180 | |
| Easting 737149 | Northing 6138079 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_57 | | | | EEC: No | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 12 |
| | Grasses etc. | 5 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 60 |
| | Shrubs | 14 |
| | Grasses etc. | 0.6 |
| | Forbs | 1.8 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 0.1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 1 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 30 | 55 | 70 | 60 | 60 |
| Average of the 5 subplots | 55 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight rise | Soil Surface Texture | Sandy fine |
|---|---|---|---|---|---|
| Soil Colour | Red brown | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 08/12/2022 | Burrawong WF | 37502_B57 | NL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 60 | 40 | |
| | Arctotheca calendula | E | 0.1 | 1 | |
| GG | Austrostipa nodosa | N | 0.1 | 3 | |
| SG | Atriplex angulata | N | 0.2 | 5 | |
| SG | Atriplex eardleyae | N | 0.4 | 20 | |
| GG | Austrostipa scabra | N | 0.1 | 4 | |
| SG | Chenopodium curvispicatum | N | 0.1 | 3 | |
| OG | Convolvulus erubescens | N | 0.1 | 6 | |
| GG | Digitaria ammophila | N | 0.1 | 1 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 1 | |
| | Echium plantagineum | E | 0.1 | 10 | |
| FG | Einadia nutans | N | 1 | 30 | |
| SG | Enchylaena tomentosa | N | 2 | 20 | |
| GG | Enneapogon avenaceus | N | 0.1 | 20 | |
| GG | Enteropogon acicularis | N | 0.2 | 30 | |
| | Hordeum spp. | E | 0.1 | 10 | |
| | Lolium rigidum | E | 2 | 200 | |
| SG | Maireana decalvans | N | 10 | 40 | |
| SG | Maireana excavata | N | 0.1 | 6 | |
| | Malva parviflora | E | 0.1 | 6 | |
| | Marrubium spp. | E | 0.1 | 5 | |
| | Medicago minima | E | 0.1 | 6 | |
| | Psilocaulon tenue | E | 10 | 500 | |
| SG | Rhagodia spinescens | N | 0.3 | 5 | |
| SG | Salsola australis | N | 0.1 | 3 | |
| | Schismus barbatus | E | 30 | 3000 | |
| SG | Sclerolaena diacantha | N | 0.2 | 20 | |
| SG | Sclerolaena muricata | N | 0.2 | 20 | |
| SG | Senna artemisioides subsp. | N | 0.3 | 1 | |
| FG | Sida corrugata | N | 0.5 | 50 | |
| | Sisymbrium officinale | E | 0.1 | 3 | |
| | Sonchus oleraceus | E | 0.5 | 90 | |
| FG | Tetragonia tetragonioides | N | 0.1 | 5 | |
| FG | Wahlenbergia fluminalis | N | 0.2 | 60 | |
| | Xanthium spinosum | HTE | 0.1 | 1 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 05/12/2022 | 37502 plot B_58 pct 58 | | Moderate | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B58 | Plot dimensions | 50x20 | Orientation of middle | 330 | |
| Easting 747305 | Northing 6133869 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 6 |
| | Grasses etc. | 2 |
| | Forbs | 6 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 15.2 |
| | Shrubs | 13.3 |
| | Grasses etc. | 5.2 |
| | Forbs | 26 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 3 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 0 |
| Length of logs (m) | 18 |
| No. trees with hollows | 5 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 95 | 60 | 90 | 90 | 90 |
| Average of the 5 subplots | 85 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | On top of small duney hill | Soil Surface Texture | Sand |
|---|---|---|---|---|---|
| Soil Colour | Red | Site Drainage | Black box patch to the south-west | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 05/12/2022 | 37502 plot B_58 pct 58 | 37502_B58 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 0.2 | 1 | |
| GG | Aristida nitidula | N | 0.2 | 10 | |
| FG | Bulbine semibarbata | N | 0.1 | 5 | |
| TG | Casuarina pauper | N | 15 | 20 | |
| SG | Chenopodium curvispicatum | N | 0.1 | 5 | |
| | Conyza bonariensis | E | 10 | 100 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 1 | |
| | Echium plantagineum | E | 1 | 50 | |
| FG | Einadia nutans | N | 0.1 | 1 | |
| SG | Enchylaena tomentosa | N | 1 | 20 | |
| GG | Enteropogon acicularis | N | 5 | 20 | |
| | Hordeum spp. | E | 2 | 100 | |
| | Lactuca serriola | E | 0.1 | 5 | |
| | Medicago polymorpha | E | 5 | 50 | |
| | Medicago truncatula | E | 5 | 100 | |
| | Psilocaulon tenue | E | 40 | 100 | |
| SG | Salsola tragus | N | 0.1 | 5 | |
| | Schismus barbatus | E | 40 | 500 | |
| SG | Sclerolaena diacantha | N | 2 | 20 | |
| SG | Sclerolaena muricata | N | 10 | 50 | |
| FG | Sida ammophila | N | 0.1 | 1 | |
| | Sisymbrium officinale | E | 0.2 | 20 | |
| | Solanum nigrum | E | 0.1 | 10 | |
| | Sonchus oleraceus | E | 5 | 50 | |
| FG | Tetragonia tetragonioides | N | 25 | 100 | |
| FG | Wahlenbergia fluminalis | N | 0.5 | 20 | |
| FG | Wahlenbergia stricta | N | 0.2 | 10 | |

| BAM Plot Data Sheet | | | | | Site Sheet no:1 of 2 | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 07/12/2022 | 37502 plot B60 pct 58 | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B60 | Plot dimensions | 50x20 | Orientation of middle | 317 |
| Easting 739901 | Northing 6138931 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_58 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 8 |
| | Grasses etc. | 7 |
| | Forbs | 15 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 17.2 |
| | Grasses etc. | 43.3 |
| | Forbs | 4.7 |
| | Ferns | 0 |
| | Other | 0.5 |
| High Threat Weed cover | | 6 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 4 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 28 | 10 | 10 | 35 | 15 |
| Average of the 5 subplots | 19.6 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 4 degrees west | Soil Surface Texture | Clay loam |
|---|---|---|---|---|---|
| Soil Colour | Liggt brown | Site Drainage | Depression to the west | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B60 pct 58 | 37502_B60 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Aristida behriana | N | 0.1 | 5 | |
| FG | Arthropodium minus | N | 0.1 | 5 | |
| GG | Austrostipa nitida | N | 20 | 100 | |
| GG | Austrostipa scabra | N | 1 | 20 | |
| | Bromus diandrus | HTE | 5 | | |
| | Carrichtera annua | HTE | 1 | 50 | |
| OG | Convolvulus erubescens | N | 0.5 | 100 | |
| | Conyza bonariensis | E | 0.1 | 5 | |
| FG | Crassula colorata | N | 0.1 | 1 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 2 | |
| FG | Dysphania melanocarpa | N | 0.1 | 5 | |
| | Emex australis | E | 0.1 | 5 | |
| SG | Enchylaena tomentosa | N | 1 | 20 | |
| GG | Enneapogon avenaceus | N | 2 | 100 | |
| GG | Enteropogon acicularis | N | 20 | 50 | |
| FG | Erodium crinitum | N | 0.1 | 5 | |
| FG | Euchiton sphaericus | N | 0.1 | 20 | |
| FG | Euphorbia drummondii | N | 0.1 | 20 | |
| FG | Goodenia fascicularis | N | 0.5 | 50 | |
| | Hordeum spp. | E | 2 | 100 | |
| | Leontodon rhagadioloides | E | 0.2 | 10 | |
| | Limonium lobatum | E | 0.5 | 20 | |
| | Lolium rigidum | E | 0.1 | 10 | |
| GG | Lomandra effusa | N | 0.1 | 1 | |
| SG | Maireana decalvans | N | 0.2 | 10 | |
| | Medicago polymorpha | E | 40 | 200 | |
| | Medicago truncatula | E | 10 | 200 | |
| FG | Oxalis perennans | N | 0.1 | 2 | |
| GG | Paspalidium jubiflorum | N | 0.1 | 1 | |
| FG | Plantago turrifera | N | 0.1 | 20 | |
| FG | Rhodanthe pygmaea | N | 0.5 | 200 | |
| SG | Salsola australis | N | 0.1 | 10 | |
| | Schismus barbatus | E | 0.5 | 50 | |
| SG | Sclerolaena bicornis | N | 0.5 | 50 | |
| SG | Sclerolaena brachyptera | N | 0.1 | 2 | |
| SG | Sclerolaena diacantha | N | 15 | 500 | |
| SG | Sclerolaena muricata | N | 0.2 | 10 | |
| FG | Sida ammophila | N | 0.1 | 1 | |
| FG | Sida corrugata | N | 0.5 | 100 | |
| | Sisymbrium orientale | E | 0.2 | 10 | |
| FG | Solanum esuriale | N | 2 | 500 | |
| | Sonchus oleraceus | E | 0.2 | 20 | |
| FG | Vittadinia cuneata | N | 0.2 | 20 | |
| | Vulpia myuros | E | 20 | | |

| | | | | | |
|---|---|---|---|---|---|
| FG | Wahlenbergia fluminalis | N | 0.1 | 50 | |

| BAM Plot Data Sheet | | | | | Site Sheet no:1 of 2 | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 07/12/2022 | 37502 plot 63 pct 163 | | Moderate | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B63 | Plot dimensions | 50x20 | Orientation of middle | 65 |
| Easting 741379 | Northing 6138331 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_163 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 11 |
| | Grasses etc. | 7 |
| | Forbs | 8 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 19.2 |
| | Grasses etc. | 83.3 |
| | Forbs | 5.9 |
| | Ferns | 0 |
| | Other | 0.2 |
| High Threat Weed cover | | 20 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 20 | 22 | 10 | 5 | 5 |
| Average of the 5 subplots | 12.4 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay loam |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | Flat | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot 63 pct 163 | 37502_B63 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| | Arctotheca calendula | E | 0.1 | 5 | |
| SG | Atriplex eardleyae | N | 0.1 | 5 | |
| GG | Austrostipa elegantissima | N | 0.2 | 10 | |
| GG | Austrostipa nitida | N | 10 | 100 | |
| FG | Bulbine semibarbata | N | 0.1 | 5 | |
| | Carrichtera annua | HTE | 20 | 500 | |
| GG | Chloris truncata | N | 2 | 50 | |
| OG | Convolvulus erubescens | N | 0.2 | 20 | |
| | Conyza bonariensis | E | 0.1 | 10 | |
| SG | Dissocarpus paradoxus | N | 0.2 | 20 | |
| FG | Einadia nutans | N | 0.1 | 5 | |
| SG | Enchylaena tomentosa | N | 2 | 50 | |
| GG | Enteropogon acicularis | N | 50 | 100 | |
| FG | Euphorbia drummondii | N | 0.1 | 5 | |
| GG | Juncus flavidus | N | 0.1 | 5 | |
| | Lactuca serriola | E | 0.1 | 10 | |
| | Leontodon rhagadioloides | E | 0.5 | 50 | |
| | Lolium rigidum | E | 0.1 | 10 | |
| SG | Maireana decalvans | N | 0.2 | 20 | |
| | Medicago polymorpha | E | 10 | 200 | |
| SG | Nitraria billardierei | N | 8 | 10 | |
| FG | Oxalis perennans | N | 0.2 | 50 | |
| FG | Rhodanthe corymbiflora | N | 0.1 | 20 | |
| GG | Rytidosperma setaceum | N | 20 | 200 | |
| SG | Salsola australis | N | 1 | 100 | |
| SG | Sclerolaena brachyptera | N | 2 | 100 | |
| SG | Sclerolaena diacantha | N | 5 | 100 | |
| SG | Sclerolaena divaricata | N | 0.1 | 10 | |
| SG | Sclerolaena stelligera | N | 0.1 | 10 | |
| SG | Sclerolaena tricuspis | N | 0.5 | 20 | |
| FG | Solanum esuriale | N | 0.2 | 100 | |
| | Sonchus oleraceus | E | 0.1 | 5 | |
| GG | Sporobolus caroli | N | 1 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 10 | |
| | Vulpia myuros | E | 5 | | |
| FG | Wahlenbergia gracilis | N | 5 | 500 | |

| BAM Plot Data Sheet | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Site Sheet no:1 of 2<br>Recorders | | |
| Date | 06/12/2022 | 37502 plot B64 pct 163 | | Moderate | NL CW | | |
| Zone<br>54 | Datum<br>GDA94 | Plot ID | 37502_B64 | Plot dimensions | 50x20 | Orientation of middle | 348 |
| Easting<br>745679 | Northing<br>6132980 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_163 | | | | EEC: None | Confidence<br>H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 9 |
| | Grasses etc. | 6 |
| | Forbs | 12 |
| | Ferns | 0 |
| | Other | 2 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 21.6 |
| | Grasses etc. | 81.4 |
| | Forbs | 3.1 |
| | Ferns | 0 |
| | Other | 0.6 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 15 | 8 | 1 | 10 | 12 |
| Average of the 5 subplots | 9.2 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Black box lignum ephemeral wetland | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |

| | | | |
|---|---|---|---|
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 06/12/2022 | 37502 plot B64 pct 163 moderate | 37502_B64 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex eardleyae | N | 0.1 | 10 | |
| SG | Atriplex leptocarpa | N | 1 | 10 | |
| FG | Atriplex lindleyi | N | 0.1 | 10 | |
| GG | Austrostipa elegantissima | N | 0.1 | 5 | |
| GG | Austrostipa eremophila | N | 0.1 | 10 | |
| GG | Austrostipa nitida | N | 40 | 500 | |
| FG | Bulbine semibarbata | N | 0.1 | 10 | |
| OG | Convolvulus clementii | N | 0.5 | 20 | |
| OG | Convolvulus erubescens | N | 0.1 | 50 | |
| | Conyza bonariensis | E | 0.1 | 5 | |
| FG | Cressa australis | N | 1 | 100 | |
| FG | Dysphania melanocarpa | N | 0.1 | 1 | |
| FG | Einadia nutans | N | 1 | 10 | |
| SG | Enchylaena tomentosa | N | 0.1 | 5 | |
| GG | Enteropogon acicularis | N | 1 | 20 | |
| FG | Euchiton sphaericus | N | 0.1 | 20 | |
| | Limonium lobatum | E | 0.2 | 20 | |
| | Lolium rigidum | E | 1 | 10 | |
| SG | Maireana decalvans | N | 0.1 | 1 | |
| FG | Maireana pentagona | N | 0.1 | 20 | |
| | Medicago minima | E | 0.5 | 50 | |
| | Medicago truncatula | E | 5 | 100 | |
| SG | Nitraria billardierei | N | 15 | 10 | |
| FG | Plantago cunninghamii | N | 0.1 | 5 | |
| FG | Rhodanthe corymbiflora | N | 0.1 | 50 | |
| FG | Roepera ammophila | N | 0.1 | 5 | |
| GG | Rytidosperma setaceum | N | 40 | 500 | |
| SG | Salsola australis | N | 0.1 | 5 | |
| | Schismus barbatus | E | 5 | 500 | |
| SG | Sclerolaena brachyptera | N | 0.1 | 50 | |
| SG | Sclerolaena diacantha | N | 0.1 | 10 | |
| SG | Sclerolaena muricata | N | 5 | 20 | |
| FG | Solanum esuriale | N | 0.2 | 100 | |
| | Sonchus oleraceus | E | 0.1 | 20 | |
| | Spergula spp. | E | 0.1 | 50 | |
| GG | Sporobolus caroli | N | 0.2 | 20 | |
| FG | Tetragonia tetragonioides | N | 0.1 | 5 | |
| | Trifolium tomentosum | E | 1 | 10 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 06/12/2022 | 37502 plot B_65 pct 163 | | Moderate | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B65 | Plot dimensions | 50x20 | Orientation of middle | 302 | |
| Easting 746033 | Northing 6133318 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_163 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 6 |
| | Grasses etc. | 7 |
| | Forbs | 14 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 17.2 |
| | Grasses etc. | 51.4 |
| | Forbs | 9 |
| | Ferns | 0 |
| | Other | 0.2 |
| High Threat Weed cover | | 30 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 3 | 10 | 50 | 85 | 75 |
| Average of the 5 subplots | 44.6 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 2 degrees east/south-east | Soil Surface Texture | Clay sand |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | East/south-east | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 06/12/2022 | 37502 plot B_65 pct 163 | 37502_B65 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Arthropodium minus | N | 0.1 | 20 | |
| FG | Atriplex lindleyi | N | 2 | | |
| GG | Austrostipa elegantissima | N | 0.2 | 10 | |
| GG | Austrostipa eremophila | N | 1 | 20 | |
| GG | Austrostipa nitida | N | 10 | 100 | |
| GG | Austrostipa scabra | N | 0.2 | 20 | |
| FG | Bulbine semibarbata | N | 0.1 | 20 | |
| | Carrichtera annua | HTE | 30 | 500 | |
| | Centaurea melitensis | E | 5 | 50 | |
| FG | Chrysocephalum apiculatum | N | 0.2 | 20 | |
| OG | Convolvulus clementii | N | 0.2 | 20 | |
| | Conyza bonariensis | E | 2 | 50 | |
| SG | Dissocarpus paradoxus | N | 2 | 50 | |
| SG | Enchylaena tomentosa | N | 2 | 50 | |
| GG | Enteropogon acicularis | N | 30 | 100 | |
| FG | Euchiton sphaericus | N | 0.1 | 20 | |
| FG | Goodenia fascicularis | N | 0.2 | 20 | |
| | Lactuca serriola | E | 0.2 | 20 | |
| FG | Leiocarpa leptolepis | N | 0.2 | 20 | |
| | Leontodon rhagadioloides | E | 5 | 100 | |
| | Limonium lobatum | E | 0.5 | 20 | |
| SG | Maireana decalvans | N | 0.2 | 20 | |
| | Medicago minima | E | 5 | 200 | |
| | Medicago polymorpha | E | 10 | 200 | |
| FG | Minuria leptophylla | N | 5 | 50 | |
| SG | Nitraria billardierei | N | 10 | 5 | |
| FG | Plantago cunninghamii | N | 0.1 | 20 | |
| SG | Rhagodia spinescens | N | 2 | 10 | |
| FG | Rhodanthe corymbiflora | N | 0.1 | 20 | |
| FG | Rhodanthe pygmaea | N | 0.2 | 100 | |
| GG | Rytidosperma setaceum | N | 5 | 50 | |
| SG | Sclerolaena eriacantha | N | 1 | 100 | |
| | Sisymbrium orientale | E | 0.2 | 20 | |
| | Sonchus oleraceus | E | 2 | 50 | |
| GG | Sporobolus caroli | N | 5 | 100 | |
| FG | Vittadinia cuneata | N | 0.5 | 100 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 5 | |
| FG | Wahlenbergia stricta | N | 0.1 | 20 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 26/09/2022 | Burrawong WF | | Moderate | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B902 | Plot dimensions | 20x50 | Orientation of middle | 155 | |
| Easting 746310 | Northing 6133008 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_23 | | | | EEC: Acacia mellevilleii shrubland | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 6 |
| | Grasses etc. | 4 |
| | Forbs | 8 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 35 |
| | Shrubs | 9.3 |
| | Grasses etc. | 0.8 |
| | Forbs | 0.9 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 15 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 85 | 75 | 5 | 5 |
| Average of the 5 subplots | 36 | | | | |

| Notes | Moderate. h8gher condition example of pct, little weed cover, better nat8ve cover and richness |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sand clay loam |
|---|---|---|---|---|---|
| Soil Colour | Orange brown | Site Drainage | Moderate | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 26/09/2022 | Burrawong WF | 37502_B902 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Acacia melvillei | N | 35 | 9 | Canopy |
| | Alyssum linifolium | E | 0.1 | 5 | Ground |
| | Asphodelus fistulosus | E | 0.1 | 1 | Ground |
| SG | Atriplex semibaccata | N | 0.1 | 5 | Ground |
| GG | Austrostipa eremophila | N | 0.1 | 2 | Ground |
| GG | Austrostipa scabra | N | 0.5 | 20 | Ground |
| | Carrichtera annua | HTE | 15 | 1000 | Ground |
| FG | Einadia nutans | N | 0.1 | 5 | Ground |
| SG | Enchylaena tomentosa | N | 2 | 20 | Ground |
| GG | Enteropogon acicularis | N | 0.1 | 5 | Ground |
| FG | Goodenia fascicularis | N | 0.1 | 1 | Ground |
| FG | Leiocarpa tomentosa | N | 0.1 | 1 | Ground |
| | Lolium rigidum | E | 0.1 | 10 | Ground |
| | Medicago minima | E | 0.1 | 100 | Ground |
| FG | Minuria leptophylla | N | 0.2 | 10 | Ground |
| FG | Plantago turrifera | N | 0.1 | 20 | Ground |
| SG | Rhagodia spinescens | N | 5 | 20 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 5 | Ground |
| FG | Roepera glauca | N | 0.1 | 10 | Ground |
| GG | Rytidosperma caespitosum | N | 0.1 | 10 | Ground |
| SG | Salsola tragus | N | 0.1 | 5 | Ground |
| | Schismus barbatus | E | 1 | 300 | Ground |
| SG | Sclerolaena brachyptera | N | 0.1 | 10 | Ground |
| SG | Sclerolaena obliquicuspis | N | 2 | 100 | Ground |
| FG | Senecio glossanthus | N | 0.1 | 10 | Ground |
| | Silene gallica | E | 0.1 | 10 | Ground |
| | Sisymbrium orientale | E | 0.1 | 5 | Ground |
| | Sonchus oleraceus | E | 0.1 | 5 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 27/09/2022 | Burrawong WF | | DNG | MJAL, CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B903 | Plot dimensions | 20x50 | Orientation of middle | 189 | |
| Easting 743379 | Northing 6137594 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_58 | | | | EEC: No | Confidence M | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 5 |
| | Grasses etc. | 3 |
| | Forbs | 10 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 5 |
| | Shrubs | 0.9 |
| | Grasses etc. | 30.5 |
| | Forbs | 1.1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 35 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 30 | 20 | 40 | 30 |
| Average of the 5 subplots | 26 | | | | |

| Notes | DNG. grassy but with very occasional black oak |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Slight rise | Soil Surface Texture | Sandy clay loam |
|---|---|---|---|---|---|
| Soil Colour | Orange brown | Site Drainage | Poor | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 27/09/2022 | Burrawong WF | 37502_B903 | MJAL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa eremophila | N | 10 | 300 | Ground |
| GG | Austrostipa nitida | N | 20 | 400 | Ground |
| FG | Calotis hispidula | N | 0.1 | 20 | Ground |
| | Carrichtera annua | HTE | 35 | 3000 | Ground |
| TG | Casuarina pauper | N | 5 | 1 | Canopy |
| SG | Dissocarpus paradoxus | N | 0.1 | 2 | Ground |
| SG | Enchylaena tomentosa | N | 0.1 | 1 | Ground |
| FG | Goodenia fascicularis | N | 0.1 | 5 | Ground |
| FG | Goodenia pusilliflora | N | 0.1 | 20 | Ground |
| FG | Hypoxis glabella var. glabella | N | 0.1 | 10 | Ground |
| | Medicago minima | E | 30 | 1000 | Ground |
| FG | Minuria leptophylla | N | 0.1 | 3 | Ground |
| FG | Myriocephalus rhizocephalus | N | 0.1 | 20 | Ground |
| FG | Rhodanthe corymbiflora | N | 0.1 | 5 | Ground |
| FG | Rhodanthe pygmaea | N | 0.1 | 20 | Ground |
| FG | Roepera crenata | N | 0.2 | 20 | Ground |
| FG | Roepera glauca | N | 0.1 | 1 | Ground |
| GG | Rytidosperma setaceum | N | 0.5 | 30 | Ground |
| SG | Sclerolaena brachyptera | N | 0.1 | 2 | Ground |
| SG | Sclerolaena diacantha | N | 0.5 | 20 | Ground |
| SG | Sclerolaena obliquicuspis | N | 0.1 | 2 | Ground |
| | Sonchus oleraceus | E | 0.1 | 3 | Ground |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 06/12/2022 | 37502 plot | | DNG | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B904 | Plot dimensions | 50x20 | Orientation of middle | 46 | |
| Easting 745864 | Northing 6132909 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_16 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 3 |
| | Grasses etc. | 4 |
| | Forbs | 7 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 5.6 |
| | Grasses etc. | 22.2 |
| | Forbs | 8.1 |
| | Ferns | 0 |
| | Other | 0.5 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 3 | 6 | 75 | 70 | 28 |
| Average of the 5 subplots | 36.4 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Grey | Site Drainage | Black box/lignum ephemeral wetland | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 06/12/2022 | 37502 plot B221206_0900 pct 16 | 37502_B904 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa nitida | N | 15 | 50 | |
| FG | Bulbine semibarbata | N | 0.1 | 5 | |
| FG | Chrysocephalum apiculatum | N | 2 | 500 | |
| OG | Convolvulus erubescens | N | 0.5 | 100 | |
| SG | Duma florulenta | N | 5 | 5 | |
| FG | Einadia nutans | N | 0.2 | 5 | |
| GG | Enteropogon acicularis | N | 0.2 | 5 | |
| | Lactuca serriola | E | 0.1 | 10 | |
| | Medicago polymorpha | E | 1 | 50 | |
| FG | Oxalis perennans | N | 0.2 | 5 | |
| FG | Plantago cunninghamii | N | 0.1 | 10 | |
| GG | Rytidosperma caespitosum | N | 2 | 50 | |
| GG | Rytidosperma setaceum | N | 5 | 50 | |
| SG | Sclerolaena diacantha | N | 0.1 | 5 | |
| SG | Sclerolaena muricata | N | 0.5 | 20 | |
| | Sisymbrium orientale | E | 0.1 | 10 | |
| FG | Solanum esuriale | N | 0.5 | 100 | |
| | Sonchus oleraceus | E | 0.1 | 10 | |
| FG | Teucrium racemosum | N | 5 | | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 06/12/2022 | 37502 plot | | DNG | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B905 | Plot dimensions | 50x20 | Orientation of middle | 1 | |
| Easting 743654 | Northing 6132954 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 3 |
| | Grasses etc. | 8 |
| | Forbs | 9 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 0.3 |
| | Grasses etc. | 80.7 |
| | Forbs | 1.1 |
| | Ferns | 0 |
| | Other | 0.1 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 25 | 20 | 3 | 10 | 25 |
| Average of the 5 subplots | 16.6 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 3 degeees north | Soil Surface Texture | Sand loam |
|---|---|---|---|---|---|
| Soil Colour | Brown | Site Drainage | Black box ephemeral wetland to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |

| | | | |
|---|---|---|---|
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 06/12/2022 | 37502 plot B221206_1422 pct 170 dng | 37502_B905 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Aristida behriana | N | 0.1 | 1 | |
| GG | Austrostipa elegantissima | N | 2 | 20 | |
| GG | Austrostipa nitida | N | 70 | 500 | |
| GG | Austrostipa scabra | N | 5 | 50 | |
| FG | Bulbine semibarbata | N | 0.1 | 10 | |
| OG | Convolvulus erubescens | N | 0.1 | 20 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| FG | Dysphania melanocarpa | N | 0.2 | 50 | |
| SG | Enchylaena tomentosa | N | 0.1 | 2 | |
| GG | Enneapogon avenaceus | N | 0.5 | 10 | |
| GG | Enteropogon acicularis | N | 0.1 | 1 | |
| FG | Maireana pentagona | N | 0.1 | 5 | |
| | Medicago laciniata | E | 5 | 50 | |
| | Medicago polymorpha | E | 60 | 500 | |
| FG | Plantago turrifera | N | 0.1 | 10 | |
| FG | Rhodanthe floribunda | N | 0.1 | 10 | |
| GG | Rytidosperma setaceum | N | 1 | 40 | |
| SG | Salsola australis | N | 0.1 | 5 | |
| SG | Sclerolaena diacantha | N | 0.1 | 20 | |
| FG | Sida ammophila | N | 0.1 | 5 | |
| FG | Solanum esuriale | N | 0.2 | 50 | |
| | Sonchus oleraceus | E | 0.2 | 20 | |
| GG | Sporobolus caroli | N | 2 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 5 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 10 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 06/12/2022 | 37502 plot | | Low | NL CW | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B906 | Plot dimensions | 50x20 | Orientation of middle | 73 | |
| Easting 743756 | Northing 6132975 | IBRA region | Murray Darling Depression | Photo # | | | | |
| Plant Community Type | | 8_170 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 3 |
| | Grasses etc. | 1 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 20 |
| | Shrubs | 7.1 |
| | Grasses etc. | 0.5 |
| | Forbs | 0.5 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0.1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 1 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 30 | 3 | 8 | 60 | 10 |
| Average of the 5 subplots | 22.2 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | 8 degrees north | Soil Surface Texture | Very sandy loam |
|---|---|---|---|---|---|
| Soil Colour | Red | Site Drainage | Black box ephemeral wetland to the north | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |

| | | | |
|---|---|---|---|
| **Fire damage** | | | |
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 06/12/2022 | 37502 plot B221206_1457 pct 170 | 37502_B906 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa nitida | N | 0.5 | 20 | |
| SG | Chenopodium curvispicatum | N | 5 | 10 | |
| | Chenopodium murale | E | 0.1 | 2 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| | Echium plantagineum | E | 0.1 | 10 | |
| SG | Enchylaena tomentosa | N | 2 | 20 | |
| TG | Eucalyptus oleosa subsp. oleosa | N | 20 | 1 | |
| | Hordeum spp. | E | 0.5 | 50 | |
| | Lactuca serriola | E | 0.1 | 10 | |
| | Lycium ferocissimum | HTE | 0.1 | 1 | |
| | Medicago minima | E | 0.5 | 20 | |
| | Psilocaulon tenue | E | 50 | 500 | |
| FG | Roepera crenata | N | 0.2 | 10 | |
| | Schismus barbatus | E | 1 | 50 | |
| SG | Sclerolaena diacantha | N | 0.1 | 10 | |
| | Sisymbrium orientale | E | 0.2 | 20 | |
| FG | Solanum esuriale | N | 0.1 | 5 | |
| | Solanum nigrum | E | 0.1 | 1 | |
| | Sonchus oleraceus | E | 0.2 | 50 | |
| FG | Tetragonia tetragonioides | N | 0.1 | 5 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 10 | |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 07/12/2022 | 37502 plot | | DNG | NL CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B907 | Plot dimensions | 50x20 | Orientation of middle | 298 |
| Easting 738209 | Northing 6137419 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_16 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 8 |
| | Forbs | 7 |
| | Ferns | 1 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0.1 |
| | Shrubs | 10.8 |
| | Grasses etc. | 77.1 |
| | Forbs | 1 |
| | Ferns | 3 |
| | Other | 0.1 |
| High Threat Weed cover | | 0.1 |

| BAM Attribute (1000m2 plot) | |
|---|---|
| DBH | # Tree Stems Count |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 2 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 30 | 20 | 30 | 5 | 18 |
| Average of the 5 subplots | 20.6 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Clay |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Along black box drainage line to the south-east | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |

| | | | |
|---|---|---|---|
| **Fire damage** | | | |
| **Storm damage** | | | |
| **Weediness** | | | |
| **Other** | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 07/12/2022 | 37502 plot B221207_15 20 pct 15 | 37502_B907 | NL CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 0.1 | 1 | |
| FG | Alternanthera denticulata | N | 0.2 | 20 | |
| SG | Atriplex leptocarpa | N | 0.1 | 10 | |
| GG | Austrostipa nitida | N | 10 | 50 | |
| | Carthamus lanatus | HTE | 0.1 | 5 | |
| GG | Chloris truncata | N | 0.2 | 10 | |
| OG | Convolvulus erubescens | N | 0.1 | 20 | |
| SG | Duma florulenta | N | 10 | 10 | |
| | Echium plantagineum | E | 0.1 | 10 | |
| GG | Eleocharis acuta | N | 0.2 | 20 | |
| GG | Eleocharis pallens | N | 1 | 100 | |
| SG | Enchylaena tomentosa | N | 0.1 | 10 | |
| GG | Enteropogon acicularis | N | 50 | 100 | |
| GG | Eragrostis dielsii | N | 0.2 | 10 | |
| FG | Euphorbia drummondii | N | 0.1 | 10 | |
| FG | Goodenia fascicularis | N | 0.2 | 20 | |
| | Limonium lobatum | E | 2 | 50 | |
| | Lolium rigidum | E | 10 | 100 | |
| EG | Marsilea drummondii | N | 3 | 100 | |
| | Medicago polymorpha | E | 20 | 100 | |
| SG | Nitraria billardierei | N | 0.2 | 1 | |
| FG | Oxalis perennans | N | 0.1 | 20 | |
| GG | Rytidosperma setaceum | N | 15 | 100 | |
| | Schismus barbatus | E | 10 | 100 | |
| SG | Sclerolaena muricata | N | 0.2 | 20 | |
| SG | Sclerolaena stelligera | N | 0.1 | 10 | |
| SG | Sclerolaena tricuspis | N | 0.1 | 1 | |
| FG | Solanum esuriale | N | 0.1 | 10 | |
| | Sonchus oleraceus | E | 0.1 | 10 | |
| GG | Sporobolus caroli | N | 0.5 | 20 | |
| FG | Teucrium racemosum | N | 0.1 | 10 | |
| FG | Wahlenbergia gracilis | N | 0.2 | 50 | |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 08/12/2022 | Burrawong WF | | DNG | NL, CW | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B908 | Plot dimensions | 20x50 | Orientation of middle | 336 |
| Easting 737017 | Northing 6143170 | IBRA region | Murray Darling Depression | Photo # | | | |
| Plant Community Type | | 8_170 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 0 |
| | Shrubs | 2 |
| | Grasses etc. | 4 |
| | Forbs | 7 |
| | Ferns | 0 |
| | Other | 1 |
| Sum of Cover of native vascular plans by growth form group | Trees | 0 |
| | Shrubs | 2.1 |
| | Grasses etc. | 90.5 |
| | Forbs | 0.7 |
| | Ferns | 0 |
| | Other | 0.2 |
| High Threat Weed cover | | 5.2 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 40 | 30 | 70 | 30 |
| Average of the 5 subplots | 36 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Gentlehard | Soil Surface Texture | Hard, sandy loam |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Good | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 08/12/2022 | Burrawong WF | 37502_B908 | NL, CW |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| GG | Austrostipa eremophila | N | 50 | 5000 | |
| GG | Austrostipa nitida | N | 40 | 4000 | |
| | Carrichtera annua | HTE | 5 | 2000 | |
| | Carthamus lanatus | HTE | 0.1 | 10 | |
| OG | Convolvulus erubescens | N | 0.2 | 3 | |
| | Conyza bonariensis | E | 0.1 | 20 | |
| | Echium plantagineum | E | 0.1 | 1 | |
| SG | Enchylaena tomentosa | N | 2 | 20 | |
| GG | Enteropogon acicularis | N | 0.1 | 20 | |
| FG | Euchiton sphaericus | N | 0.1 | 5 | |
| | Hypochaeris glabra | E | 0.1 | 1 | |
| | Lactuca serriola | E | 0.1 | 3 | |
| FG | Leiocarpa leptolepis | N | 0.1 | 1 | |
| | Leontodon rhagadioloides | E | 0.1 | 3 | |
| | Medicago minima | E | 0.1 | 10 | |
| GG | Rytidosperma setaceum | N | 0.4 | 400 | |
| SG | Sclerolaena diacantha | N | 0.1 | 10 | |
| FG | Sida corrugata | N | 0.1 | 20 | |
| FG | Solanum esuriale | N | 0.1 | 2 | |
| | Sonchus oleraceus | E | 0.5 | 50 | |
| FG | Thysanotus baueri | N | 0.1 | 2 | |
| FG | Vittadinia cuneata | N | 0.1 | 6 | |
| | Vulpia bromoides | E | 0.1 | 5 | |
| FG | Wahlenbergia fluminalis | N | 0.1 | 10 | |
| | Xanthium spinosum | HTE | 0.1 | 1 | |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 29/03/2023 | Burrawong Windfarm | | Low | TOH, NL | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B909 | Plot dimensions | 50x20 | Orientation of middle | 352 |
| Easting 746338 | Northing 6130833 | IBRA region | Riverina | Photo # | | | |
| Plant Community Type | | 170 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 2 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 10 |
| | Shrubs | 9.8 |
| | Grasses etc. | 3.5 |
| | Forbs | 1.1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 2 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 95 | 85 | 65 | 20 |
| Average of the 5 subplots | 65 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy clay |
|---|---|---|---|---|---|
| Soil Colour | Yellow to brown | Site Drainage | Free | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 29/03/2023 | Burrawong Windfarm | 37502_B909 | TOH, NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Atriplex lindleyi | N | 0.4 | 10 | |
| SG | Atriplex semibaccata | N | 0.1 | 2 | |
| GG | Austrostipa scabra | N | 0.5 | 30 | |
| | Bromus rubens | E | 20 | 2000 | |
| | Conyza bonariensis | E | 0.3 | 20 | |
| FG | Einadia nutans | N | 0.5 | 5 | |
| SG | Enchylaena tomentosa | N | 0.3 | 2 | |
| GG | Enteropogon acicularis | N | 3 | 80 | |
| TG | Eucalyptus dumosa | N | 10 | 1 | |
| | Hordeum spp. | E | 0.3 | 50 | |
| | Limonium lobatum | E | 25 | 500 | |
| | Lolium rigidum | E | 10 | 500 | |
| SG | Maireana aphylla | N | 0.3 | 1 | |
| SG | Maireana decalvans | N | 4 | 30 | |
| | Medicago polymorpha | E | 40 | 1000 | |
| SG | Nitraria billardierei | N | 2 | 10 | |
| | Psilocaulon tenue | E | 20 | 300 | |
| FG | Ptilotus nobilis | N | 0.1 | 20 | |
| | Schismus barbatus | E | 1 | 100 | |
| SG | Sclerolaena muricata | N | 3 | 20 | |
| SG | Sclerolaena tricuspis | N | 0.1 | 2 | |
| | Sisymbrium orientale | E | 1 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 1 | |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 29/03/2023 | Burrawong Windfarm | | Paddock trees | TOH, NL | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B910 | Plot dimensions | 50x20 | Orientation of middle | 272 |
| Easting 745021 | Northing 6131905 | IBRA region | Riverina | Photo # | | | |
| Plant Community Type | | 58 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 3 |
| | Forbs | 3 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 25 |
| | Shrubs | 7.2 |
| | Grasses etc. | 0.7 |
| | Forbs | 0.4 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 1 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 1 |
| Length of logs (m) | 4 |
| No. trees with hollows | 0 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 95 | 90 | 70 | 30 | 35 |
| Average of the 5 subplots | 64 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy clay |
|---|---|---|---|---|---|
| Soil Colour | Orange/red to brown | Site Drainage | Good | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 29/03/2023 | Burrawong Windfarm | 37502_B910 | TOH, NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 25 | 10 | |
| SG | Atriplex semibaccata | N | 0.2 | 3 | |
| GG | Austrostipa nitida | N | 0.1 | 10 | |
| | Bromus rubens | E | 5 | 100 | |
| SG | Chenopodium spp. | N | 0.3 | 10 | |
| | Conyza bonariensis | E | 2 | 30 | |
| | Cucumis myriocarpus subsp. | E | 0.3 | 10 | |
| SG | Enchylaena tomentosa | N | 1 | 5 | |
| GG | Enteropogon acicularis | N | 0.5 | 30 | |
| | Hordeum spp. | E | 15 | 1000 | |
| | Lactuca serriola | E | 0.1 | 1 | |
| | Lamarckia aurea | E | 0.5 | 50 | |
| SG | Maireana decalvans | N | 0.5 | 4 | |
| | Marrubium spp. | E | 0.1 | 10 | |
| | Medicago polymorpha | E | 5 | 200 | |
| SG | Nitraria billardierei | N | 2 | 5 | |
| FG | Oxalis perennans | N | 0.1 | 1 | |
| | Psilocaulon tenue | E | 2 | 100 | |
| SG | Rhagodia spinescens | N | 3 | 8 | |
| SG | Salsola tragus | N | 0.2 | 5 | |
| | Salvia verbenaca | E | 1 | 20 | |
| | Sisymbrium officinale | E | 0.5 | 20 | |
| GG | Sporobolus caroli | N | 0.1 | 5 | |
| FG | Vittadinia cuneata | N | 0.1 | 1 | |
| FG | Wahlenbergia fluminalis | N | 0.2 | 20 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 29/03/2023 | Burrawong Windfarm | | Moderate | TOH, NL | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B911 | Plot dimensions | 50x20 | Orientation of middle | 182 | |
| Easting 743964 | Northing 6136003 | IBRA region | Riverina | Photo # | | | | |
| Plant Community Type | | 21 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 2 |
| | Shrubs | 6 |
| | Grasses etc. | 3 |
| | Forbs | 3 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 19 |
| | Shrubs | 9.5 |
| | Grasses etc. | 0.6 |
| | Forbs | 0.3 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 2 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 14 |
| No. trees with hollows | 2 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 50 | 75 | 80 | 80 | 40 |
| Average of the 5 subplots | 65 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Small | Soil Surface Texture | Sandy |
|---|---|---|---|---|---|
| Soil Colour | Orange brown | Site Drainage | Free | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 29/03/2023 | Burrawong Windfarm | 37502_B911 | TOH, NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| TG | Alectryon oleifolius | N | 4 | 2 | |
| GG | Austrostipa nitida | N | 0.3 | 20 | |
| GG | Austrostipa scabra | N | 0.2 | 10 | |
| TG | Callitris gracilis | N | 15 | 2 | |
| SG | Chenopodium desertorum | N | 0.1 | 1 | |
| | Conyza bonariensis | E | 2 | 50 | |
| FG | Einadia nutans | N | 0.1 | 1 | |
| SG | Enchylaena tomentosa | N | 2 | 10 | |
| GG | Enteropogon acicularis | N | 0.1 | 5 | |
| | Hordeum spp. | E | 1 | 100 | |
| | Lamarckia aurea | E | 0.2 | 20 | |
| SG | Maireana aphylla | N | 0.2 | 2 | |
| SG | Maireana decalvans | N | 4 | 30 | |
| FG | Maireana pentagona | N | 0.1 | 3 | |
| | Medicago polymorpha | E | 20 | 300 | |
| | Psilocaulon tenue | E | 1 | 50 | |
| SG | Rhagodia spinescens | N | 0.2 | 2 | |
| SG | Salsola tragus | N | 3 | 20 | |
| | Salvia verbenaca | E | 0.2 | 5 | |
| | Schismus barbatus | E | 20 | 1000 | |
| | Sisymbrium orientale | E | 2 | 50 | |
| FG | Vittadinia cuneata | N | 0.1 | 1 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 29/03/2023 | Burrawong Windfarm | | Moderate | TOH, NL | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B912 | Plot dimensions | 50x20 | Orientation of middle | 123 | |
| Easting 746382 | Northing 6135821 | IBRA region | Riverina | Photo # | | | | |
| Plant Community Type | | 58 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 7 |
| | Grasses etc. | 3 |
| | Forbs | 5 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 30 |
| | Shrubs | 18.2 |
| | Grasses etc. | 0.8 |
| | Forbs | 1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 1 |
| 50 - 79 cm | 0 |
| 30 - 49 cm | 0 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 1 |
| 5 - 9 cm | 1 |
| < 5 cm | 1 |
| Length of logs (m) | 10 |
| No. trees with hollows | 1 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 60 | 30 | 70 | 50 | 50 |
| Average of the 5 subplots | 52 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy clay |
|---|---|---|---|---|---|
| Soil Colour | Light brown | Site Drainage | Good | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 29/03/2023 | Burrawong Windfarm | 37502_B912 | TOH, NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Atriplex lindleyi | N | 0.3 | 10 | |
| GG | Austrostipa nitida | N | 0.2 | 10 | |
| GG | Austrostipa scabra | N | 0.5 | 20 | |
| TG | Casuarina pauper | N | 30 | 10 | |
| | Conyza bonariensis | E | 0.2 | 20 | |
| | Cucumis myriocarpus subsp. | E | 0.1 | 4 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 1 | |
| FG | Einadia nutans | N | 0.2 | 5 | |
| SG | Enchylaena tomentosa | N | 6 | 40 | |
| GG | Enteropogon acicularis | N | 0.1 | 8 | |
| | Hordeum spp. | E | 1 | 50 | |
| | Lamarckia aurea | E | 0.1 | 20 | |
| SG | Maireana decalvans | N | 10 | 60 | |
| SG | Pittosporum angustifolium | N | 1 | 4 | |
| | Psilocaulon tenue | E | 35 | 800 | |
| SG | Rhagodia spinescens | N | 0.4 | 10 | |
| SG | Salsola tragus | N | 0.5 | 10 | |
| | Schismus barbatus | E | 10 | 1000 | |
| SG | Sclerolaena diacantha | N | 0.2 | 10 | |
| FG | Sida corrugata | N | 0.1 | 10 | |
| | Sisymbrium orientale | E | 0.3 | 20 | |
| FG | Vittadinia cuneata | N | 0.1 | 5 | |
| FG | Wahlenbergia fluminalis | N | 0.3 | 20 | |

| BAM Plot Data Sheet | | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | | |
| Date | 29/03/2023 | Burrawong Windfarm | | Paddock trees | TOH, NL | | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B914 | Plot dimensions | 50x20 | Orientation of middle | 21 | |
| Easting 736478 | Northing 6142281 | IBRA region | Riverina | Photo # | | | | |
| Plant Community Type | | 16 | | | | EEC: None | Confidence H | |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 10 |
| | Grasses etc. | 2 |
| | Forbs | 4 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 4 |
| | Shrubs | 10.4 |
| | Grasses etc. | 0.2 |
| | Forbs | 0.6 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 3 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 6 |
| No. trees with hollows | 3 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 10 | 5 | 20 | 5 | 2 |
| Average of the 5 subplots | 8.4 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy Clay |
|---|---|---|---|---|---|
| Soil Colour | Red to Brown | Site Drainage | Good | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 29/03/2023 | Burrawong Windfarm | 37502_B914 | TOH, NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| FG | Atriplex lindleyi | N | 0.1 | 10 | |
| SG | Atriplex semibaccata | N | 0.3 | 20 | |
| GG | Austrostipa nitida | N | 0.1 | 2 | |
| | Bromus rubens | E | 0.2 | 50 | |
| | Conyza bonariensis | E | 0.1 | 10 | |
| FG | Cressa australis | N | 0.1 | 10 | |
| SG | Dissocarpus paradoxus | N | 0.1 | 3 | |
| FG | Einadia nutans | N | 0.1 | 1 | |
| SG | Enchylaena tomentosa | N | 0.4 | 10 | |
| GG | Enteropogon acicularis | N | 0.1 | 1 | |
| TG | Eucalyptus largiflorens | N | 4 | 2 | |
| | Hordeum spp. | E | 0.2 | 20 | |
| | Lolium rigidum | E | 0.1 | 20 | |
| SG | Maireana decalvans | N | 0.2 | 5 | |
| FG | Maireana pentagona | N | 0.3 | 20 | |
| SG | Nitraria billardierei | N | 3 | 3 | |
| | Psilocaulon tenue | E | 60 | 2000 | |
| SG | Rhagodia spinescens | N | 0.1 | 1 | |
| SG | Salsola australis | N | 0.1 | 3 | |
| | Schismus barbatus | E | 25 | 1000 | |
| SG | Sclerolaena diacantha | N | 0.1 | 3 | |
| SG | Sclerolaena muricata | N | 0.1 | 2 | |
| SG | Sclerolaena tricuspis | N | 6 | 200 | |
| | Sisymbrium spp. | E | 0.1 | 10 | |
| | Vulpia myuros | E | 0.1 | 5 | |

| BAM Plot Data Sheet | | | | | | | Site Sheet no:1 of 2 |
|---|---|---|---|---|---|---|---|
| | | Survey Name | | Veg Zone ID | Recorders | | |
| Date | 29/03/2023 | Burrawong Windfarm | | Paddock trees | TOH, NL | | |
| Zone 54 | Datum GDA94 | Plot ID | 37502_B915 | Plot dimensions | 50x20 | Orientation of middle | 142 |
| Easting 735952 | Northing 6142846 | IBRA region | Riverina | Photo # | | | |
| Plant Community Type | | 58 | | | | EEC: None | Confidence H |

| BAM Attribute (400m2 plot) | | Sum values |
|---|---|---|
| Count of Native Richness | Trees | 1 |
| | Shrubs | 5 |
| | Grasses etc. | 0 |
| | Forbs | 1 |
| | Ferns | 0 |
| | Other | 0 |
| Sum of Cover of native vascular plans by growth form group | Trees | 4 |
| | Shrubs | 42.2 |
| | Grasses etc. | 0 |
| | Forbs | 0.1 |
| | Ferns | 0 |
| | Other | 0 |
| High Threat Weed cover | | 0 |

| BAM Attribute (1000m2 plot) | # Tree Stems Count |
|---|---|
| DBH | |
| 80+ cm | 0 |
| 50 - 79 cm | 1 |
| 30 - 49 cm | 1 |
| 20 - 29cm | 0 |
| 10 - 19 cm | 0 |
| 5 - 9 cm | 0 |
| < 5 cm | 0 |
| Length of logs (m) | 0 |
| No. trees with hollows | 2 |

| BAM Attibute (1 x 1m plots) | Litter cover (%) | | | | |
|---|---|---|---|---|---|
| Subplot score (% in each) | 40 | 30 | 45 | 30 | 40 |
| Average of the 5 subplots | 37 | | | | |

| Notes | |
|---|---|

**Physiography + site features that may help in determining PCT and Management Zone**

| Landform Pattern | | Slope | Flat | Soil Surface Texture | Sandy clay |
|---|---|---|---|---|---|
| Soil Colour | Pink to Brown | Site Drainage | Good | Distance to nearest water | |

| Plot Disturbance | Severity code | Age code | Observational evidence |
|---|---|---|---|
| Clearing inc. logging) | | | |
| Cultivation (inc. pasture) | | | |
| Soil erosion | | | |
| Firewood/CWD removal | | | |
| Grazing (identify native/livestock | | | |
| Fire damage | | | |
| Storm damage | | | |
| Weediness | | | |
| Other | | | |

| **400 m2 plot:**Sheet 2 of 2 | | **Survey Name** | **Plot ID** | **Recorders** |
|---|---|---|---|---|
| **Date** | 29/03/2023 | Burrawong Windfarm | 37502_B915 | TOH, NL |

| GF Code | Genus species | N,E or HTE | Cover | Abund | Stratum |
|---|---|---|---|---|---|
| SG | Atriplex semibaccata | N | 1 | 30 | |
| | Bromus rubens | E | 1 | 80 | |
| TG | Casuarina pauper | N | 4 | 1 | |
| | Conyza bonariensis | E | 0.2 | 20 | |
| FG | Cressa australis | N | 0.1 | 40 | |
| SG | Enchylaena tomentosa | N | 0.1 | 2 | |
| | Hordeum spp. | E | 5 | 500 | |
| | Lolium rigidum | E | 3 | 100 | |
| | Medicago minima | E | 2 | 90 | |
| | Medicago polymorpha | E | 20 | 800 | |
| | Psilocaulon tenue | E | 10 | 500 | |
| SG | Rhagodia spinescens | N | 1 | 3 | |
| SG | Salsola tragus | N | 0.1 | 3 | |
| | Schismus barbatus | E | 15 | 1000 | |
| SG | Sclerolaena tricuspis | N | 40 | 400 | |
| | Sisymbrium spp. | E | 0.1 | 8 | |

# Appendix 3.3. SVTM mapped PCTs Types outside development corridor but within subject land

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**Table A 5 PCT 13 Black Box - Lignum woodland wetland**

| PCT 13 Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) | |
|---|---|
| **Common name** | Black Box - Lignum woodland wetland |
| **Vegetation formation** | Semi-arid Woodlands (Grassy sub-formation) |
| **Vegetation class** | Inland Floodplain Woodlands |
| **Description** | Woodland, open forest or open woodland averaging about 15 m high dominated by a sparse to dense stands of Lignum *Muehlenbeckia florulenta*, Nitre Goosefoot *Chenopodium nitrariaceum* and River Cooba *Acacia stenophylla*. The ground cover includes low shrubs such as *Sclerolaena muricata* var. *muricata*, *Enchylaena tomentosa*, *Einadia nutans* subsp. *nutans* and various saltbush species *Atriplex* spp. Forb species include *Solanum esuriale*, *Cotula australis*, *Oxalis perennans*, *Alternanthera denticulata* and *Pratia concolor*. Grass species include Warrego Summer Grass *Paspalidium jubiflorum*, Curly Windmill Grass *Enteropogon acicularis* and *Walwhalleya proluta* and wallaby grasses *Austrodanthonia* spp. Occurs on clay or clay-loam, often gilgaied, soils on inner floodplains and on alluvial plains mostly in depressions that are frequently flooded along the Murray, Wakool, lower Darling, Lachlan, Murrumbidgee Rivers and Willandra Creek. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 6 PCT 15 Black Box open woodland wetland with chenopod understorey**

| PCT 15 Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW | |
|---|---|
| **Common name** | Black Box open woodland wetland with chenopod understorey |
| **Vegetation formation** | Semi-arid Woodlands (Grassy sub-formation) |
| **Vegetation class** | Inland Floodplain woodlands |
| **Condition** | This community was recorded in moderate condition state. |
| **Description** | Woodland or open woodland dominated by Black Box *Eucalyptus largiflorens* with an understorey of chenopod shrubs such as Black Bluebush *Maireana pyramidata*, *Maireana decalvans*, Nitre Goosefoot *Chenopodium nitrariaceum* and Old Man Saltbush *Atriplex nummularia* but the latter has mostly disappeared due to grazing. Small shrubs include Bladder Saltbush Atriplex vesicaria and Cotton Bush *Maireana aphylla* with a ground cover of annual or perennial saltbushes, copperburrs, grasses and forbs. Common copperburrs include *Sclerolaena obliquicuspis*, *Sclerolaena stelligera*, *Sclerolaena divaricata*, *Sclerolaena brachyptera*. Lignum *Muehlenbeckia florulenta* may be absent or very sparse. Weed species include Black Nightshade Solanum nigrum and Paddy Melon *Cucumis myriocarpus* subsp. *leptodermis*. Occurs on alkaline brown or grey clay soil on alluvial plains or sandy-loam soils on the flood plain of river systems. Also observed on sandy lunettes of some dry lakes in the semi-arid (warm) and arid climate zones of far south western NSW. |
| **Survey effort** | One BAM plot was collected over the course of the field assessment. |

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**Table A 7 PCT 17 Lignum shrubland wetland**

| PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) | |
|---|---|
| **Common name** | Lignum shrubland wetland |
| **Vegetation formation** | Freshwater Wetlands |
| **Vegetation class** | Inland Floodplain Shrublands |
| **Description** | Open shrubland usually up to 2 m high dominated by Lignum *Muehlenbeckia florulenta* often with Nitre Goosefoot *Chenopodium nitrariaceum* and low cover of Canegrass *Eragrostis australasica*. Scattered trees of Black Box *Eucalyptus largiflorens* may be present. Cooba *Acacia salicina* and River Cooba *Acacia stenophylla* may be present as tall shrubs. Ground cover species include the small shrubs such as Giant Redburr *Sclerolaena tricuspis*, Roly Poly *Sclerolaena muricata* var. *muricata*, *Atriplex lindleyi*, *Atriplex suberecta* and *Salsola tragus* subsp. *tragus*, the fern *Marsilea drummondii*, the rush *Juncus flavidus*, the forbs *Rumex tenax*, *Einadia nutans* subsp. *nutans*, *Bulbine bulbosa, Senecio glossanthus* and *Senecio cunninghamii*. Grass species include *Walwhalleya proluta* and *Enteropogon ramosus*. Occurs on black, brown and grey-cracking clay soils and clay loam soils in river channels and depressions on floodplains subject to regular flooding in south-western NSW extending into Victoria and South Australia mainly in the semi-arid (warm) climate zone. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 8 PCT 19 Cypress Pine woodland**

| PCT 19 Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains | |
|---|---|
| **Common name** | Cypress Pine woodland |
| **Vegetation formation** | Semi-arid Woodlands (Shrubby sub-formation) |
| **Vegetation class** | Riverine Sandhill Woodlands |
| **Description** | Mid-high woodland with trees up to 13 m high dominated by White Cypress Pine *Callitris glaucophylla* sometimes with Slender Cypress Pine *Callitris gracilis* subsp. *murrayensis*. The shrub layer is often absent or if present the most common shrub is *Calytrix tetragona* and *Banksia marginata* is now rare but would have been more common. The ground cover is sparse and includes native grasses such as *Austrodanthonia caespitosa* and native forbs such as *Oxalis perennans* and *Actinobole uliginosum*. Occurs on sandy soils on source-bordering sand dunes along the mid-western sections of the Murray and lower Murrumbidgee Rivers with mean annual rainfall of about 300 - 450 mm. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 9 PCT 28 White Cypress Pine open woodland**

| PCT 28 White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone | |
|---|---|
| **Common name** | White Cypress Pine open woodland |
| **Vegetation formation** | Semi-arid Woodlands (Shrubby sub-formation) |
| **Vegetation class** | Riverine Sandhill Woodlands |
| **Description** | Open woodland or a derived grassland with scattered trees up to 15 m high dominated by White Cypress Pine *Callitris glaucophylla*. Associated small trees or tall shrubs include |

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| PCT 28 White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone | |
|---|---|
| | Buloke *Allocasuarina luehmannii*, Needlewood *Hakea leucoptera*, Hooked Needlewood *Hakea tephrosperma*, Sugarwood *Myoporum platycarpum*, *Pittosporum angustifolium*, Western Rosewood *Alectryon oleifolius* subsp. *canescens*, Emu Bush *Eremophila longifolia* and Wilga *Geijera parviflora*. Common chenopod shrub species include Black Bluebush *Maireana pyramidata*, *Maireana enchylaenoides* and Thorny Saltbush *Rhagodia spinescens*. Copperburr low shrubs include *Sclerolaena diacantha* and *Sclerolaena obliquicuspis*. Forb species include *Tetragonia tetragonioides*, *Calandrinia eremaea*, *Calotis hispidula*, *Tribulus terrestris* and *Zygophyllum ammophilum*. Many stands contain a very sparse shrub understorey that has been grazed out with the ground being dominated by native and exotic grasses and forbs. Native grass species include *Austrostipa scabra* subsp. *scabra*, *Austrodanthonia caespitosa*, *Aristida behriana, Enneapogon nigricans* and *Paspalidium constrictum*. Occurs on sandy loam soils on prior streams, source bordering sand dunes and sand plains in south-western NSW. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 10 PCT 159 Old Man Saltbush shrubland**

| PCT 159 Old Man Saltbush shrubland mainly of the semi-arid (warm) climate zone (south western NSW) | |
|---|---|
| **Common name** | Old Man Saltbush shrubland |
| **Vegetation formation** | Arid Shrublands (Chenopod sub-formation) |
| **Vegetation class** | Riverine Chenopod Shrublands |
| **Description** | Tall shrubland up to 2.5 metres high, dominated by Old Man Saltbush *Atriplex nummularia* with a lower chenopod shrub layer dominated by bluebushes such as *Maireana microcarpa, Maireana appressa, Maireana pyramidata* and *Maireana brevifolia*, Thorny Rhagodia *Rhagodia spinescens*, Bladder Saltbush *Atriplex vesicaria* and Nitre Goosefoot *Chenopodium nitrariaceum*. Low ground shrubs include *Dissocarpus biflorus*, *Atriplex lindleyi* and a number of copperburr species *Sclerolaena* spp. Forb species include *Senecio runcinifolius, Brachyscome lineariloba, Geococcus pusillus, Calandrinia eremaea, Bulbine bulbosa, Tetragonia tetragonioides, Crassula colorata* var. *colorata*, *Crassula sieberiana* subsp. *sieberiana* and *Osteocarpum acropterum* var. *deminuta*; grass species include *Chloris truncata, Austrodanthonia caespitosa, Austrostipa nodosa* and *Walwhalleya prolut*. Eastern occurrences in the Riverina Bioregion often contain scattered Myall trees *Acacia pendula*. Occurs on cracking grey and brown clay or brown loam soils that are sometimes gilgaied on floodplains in drainage depressions in the Riverina and Murray Darling Depression Bioregions. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 11 PCT 164 Cotton Bush open shrubland**

| PCT 164 Cotton Bush open shrubland of the semi-arid (warm) zone | |
|---|---|
| **Common name** | Black Box - Lignum woodland wetland |
| **Vegetation formation** | Saline Wetlands |
| **Vegetation class** | Inland Saline Lakes |
| **Description** | A disturbed and probably derived open chenopod, herbland or grassland dominated by annual saltbushes such as Baldoo *Atriplex lindleyi*, *Atriplex eardleyae* and *Atriplex angulata* along with and Babbagia *Osteocarpum acropterum* var. *deminuta*. *Atriplex holocarpa* is often present. Many species of copperburr may be present including *Sclerolaena* |

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| PCT 164 Cotton Bush open shrubland of the semi-arid (warm) zone | |
|---|---|
| | *divaricata, Sclerolaena intricata, Sclerolaena brachyptera, Sclerolaena decurrens, Sclerolaena diacantha, Sclerolaena stelligera, Sclerolaena ventricosa* and *Sclerolaena bicornis*. Cottonbush *Maireana aphylla* common in places. Other *Maireana* species include *Maireana ciliata, Maireana coronata* and *Maireana turbinata*. Forbs include daisies such as *Rhodanthe floribunda* and *Brachyscome ciliaris*. Swainsona peas - *Swainsona affinis* and *Swainsona campylantha* may be present after rain. Neverfail grass *Eragrostis setifolia* is common in northern areas. This community occurs on clay and loam clay soils on dry lake-beds and alluvial floodplains in the semi-arid and arid zones - mainly in south-western NSW but also to the north. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 12 PCT 165 Derived corkscrew grass grassland/forbland**

| PCT 165 Derived corkscrew grass grassland/forbland on sandplains and plains in the semi-arid (warm) climate zone | |
|---|---|
| **Common name** | Derived corkscrew grass grassland/forbland |
| **Vegetation formation** | Arid Shrublands (Chenopod sub-formation) |
| **Vegetation class** | Riverine Chenopod Shrublands |
| **Description** | Mid-high open chenopod shrubland and/or very open woodland dominated by species of copperburr including several varieties of Black Roly Poly *Sclerolaena muricata, Sclerolaena bicornis* and Galvanised Burr *Sclerolaena birchii*. Other species include Buckbush *Salsola* kali, Maireana microphylla, Atriplex leptocarpa, Black Bluebush *Maireana pyramidata*. Scattered woodland trees may be present including Western Rosewood *Alectryon oleifolius*, Poplar Box *Eucalyptus populnea* subsp. *bimbil*, Black Box *Eucalyptus largiflorens* and Coolabah *Eucalyptus coolabah*. The ground cover is dominated by grasses and forbs including *Sporobolus mitchellii, Enteropogon acicularis, Boerhavia dominii, Chloris truncata, Panicum decompostum, Sporobolus caroli, Marsilea drummondii, Goodenia fascicularis* and *Solanum esuriale*. Occurs on slight rises with yellow-brown clay-loam soils or red-brown or grey cracking clays on periodically flooded sections of floodplains of rivers mainly in the Darling Riverine Plain Bioregion in the semi-arid (hot) and temperate (hot summer) climatic zones. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 13 PCT 173 Sandplain mallee**

| PCT 173 Sandplain mallee of central NSW | |
|---|---|
| **Common name** | Sandplain mallee |
| **Vegetation formation** | Semi-arid Woodlands (Grassy sub-formation) |
| **Vegetation class** | Sand Plain Mallee Woodlands |
| **Description** | Very tall, open mallee shrubland generally up to 6 m tall dominated by White Mallee *Eucalyptus dumosa*, Red Mallee *Eucalyptus socialis*, Snap and Rattle *Eucalyptus gracilis*. Either White Cypress Pine *Callitris glaucophylla* or Mallee Pine *Callitris verrucosa* may occur in some locations. The mallee structure can either be bull mallee or whipstick mallee depending on time since disturbance (including fire) and soil type. A shrubby understorey is often present but sometimes absent, the density of which depends on grazing pressure, time since fire and soil type. Common shrub species include *Olearia pimeleoides, Eremophila glabra*, Broombush *Melaleuca uncinata, Acacia rigens, Acacia brachybotrya, Acacia tindaleae, Acacia havilandiorum, Dodonaea viscosa* subsp. *cuneata* and *Senna artemisioides*. Ground cover is sparse with Porcupine Grass *Triodia scariosa* subsp. |

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| PCT 173 Sandplain mallee of central NSW | |
|---|---|
| | *scariosa*, *Dianella revoluta* var. *revoluta, Lomandra effusa, Chrysocephalum apiculatum* and *Austrostipa* spp. Triodia is not as common in this community as in dune-mallee community (ID171). Occurs on red, sandy loam or sandy clay soils on undulating or flat plains in central NSW including the Paddington-Yathong-Nombinnie regions of the Western Division and areas to the south and east in the Central Division (southern NSW wheatbelt). |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 14 PCT 216 Black Roly Poly low open shrubland**

| PCT 216 Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion | |
|---|---|
| **Common name** | Black Roly Poly low open shrubland |
| **Vegetation formation** | Arid Shrublands (Chenopod sub-formation) |
| **Vegetation class** | Riverine Chenopod Shrublands |
| **Description** | Low or mid-high open chenopod shrubland dominated by Black Roly Poly *Sclerolaena muricata* var. *semiglabra*, with other low shrubs such as *Sclerolaena diacantha, Maireana microphylla, Leiocarpa panaetioides* and *Teucrium racemosum*. Scattered Black Box trees *Eucalyptus largiflorens* may be present. The ground cover is sparse and includes forbs such as *Atriplex semibaccata, Vittadinia cuneata, Vittadinia pterochaeta, Rhodanthe corymbiflora, Sida trichopoda, Geranium solanderi* var. *solanderi* and grass species such as *Austrostipa scabra* subsp. *scabra*, *Austrodanthonia caespitosa, Walwhalleya proluta* and *Chloris truncata*. Occurs on grey and brown clays on alluvial plains primarily in the Riverina and Murray-Darling Depression Bioregions of south-western NSW. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

**Table A 15 PCT 238 Permanent and semi-permanent freshwater lakes wetland PCT 238 Permanent and semi-permanent freshwater lakes wetland**

| PCT 238 Permanent and semi-permanent freshwater lakes wetland of the inland slopes and plains | |
|---|---|
| **Common name** | Permanent and semi-permanent freshwater lakes wetland |
| **Vegetation formation** | Freshwater Wetlands |
| **Vegetation class** | Inland Floodplain Swamps |
| **Description** | Low open forbland or sedgeland in open water bodies dominated on the water surface by free floating, submerged unattached or submerged attached aquatic plant species. Free floating species include *Azolla, Wolffia, Lemna, Vallisneria gigantea* and *Spirodela* spp. Submerged species include *Myriophyllum* spp. and *Potamogeton* spp. growing in water about 150 cm deep. Submerged species with floating leaves include *Ludwigia peploides*. Tall sedges such as *Eleocharis sphacelate* may be present. This community grades into tall rushland dominated by *Typha* spp. or tall reedland dominated by *Phragmites australis*. Many wetland species disperse readily and therefore occur over large geographical ranges - others are more restrictive. Water Hyacinth *Eichhornia crassipes* is a problem weed in the lower Murray River and in some sections of the Darling River system. Occurs in freshwater ox-bow lakes and permanent lakes on the floodplains of the inland river systems usually on clay or humic grey soils with substantial organic content. |
| **Survey effort** | No BAM plots were collected over the course of the field assessment. |

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# Appendix 4. Fauna

**Table A 16: Fauna species recorded at the subject land**

| Common name | Scientific name |
|---|---|
| **Mammals** | |
| **Brown Hare** | *Lepus capensis* |
| **Eastern Grey Kangaroo** | *Macropus giganteus* |
| **Red Kangaroo** | *Macropus rufus* |
| **Birds** | |
| **Apostlebird** | *Struthidea cinerea* |
| **Australian Magpie** | *Cracticus tibicen* |
| **Australian Owlet-nightjar** | *Aegotheles cristatus* |
| **Australian Raven** | *Corvus coronoides* |
| **Australian Ringneck** | *Barnardius zonarius* |
| **Barn Owl** | *Tyto alba* |
| **Black-shouldered Kite** | *Elanus axillaris* |
| **Blue Bonnet** | *Northiella haematogaster* |
| **Crested Pigeon** | *Ocyphaps lophotes* |
| **Galah** | *Eolophus roseicapillus* |
| **Grey-crowned Babbler** | *Pomatostomus temporalis* |
| **Major Mitchell's Cockatoo** | *Lophochroa leadbeateri* |
| **Nankeen Kestrel** | *Falco cenchroides* |
| **Noisy Miner** | *Manorina melanocephala* |
| **Pied Butcherbird** | *Cracticus nigrogularis* |
| **Rainbow Bee-eater** | *Merops ornatus* |
| **Wedge-tailed Eagle** | *Aquila audax* |
| **White-winged Chough** | *Corcorax melanorhamphos* |
| **White-winged Fairy-wren** | *Malurus leucopterus* |
| **Willie Wagtail** | *Rhipidura leucophrys* |
| **Yellow-throated Honeyeater** | *Nesoptilotis flavicollis* |
| **Reptiles** | |
| **Bearded Dragon** | *Pogona barbata* |
| **Ragged Snake-eyed Skink** | *Cryptoblepharus pannosus* |
| **South-eastern Morethia Skink** | *Morethia boulengeri* |

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# Appendix 5. EPBC Act Significant Impact Criteria assessments

## Appendix 5.1. Corben's Long-eared Bat – Vulnerable

### Distribution

This species occurs across NSW, with a primary band of records leading north-east through inland areas from Wentworth across to Moree (NSW DCCEEW 2024b). Potential occurrence is noted throughout most of inland, semi arid and arid NSW (DCCEEW 2024), however the subject land occurs approximately 30 kilometres south of the species current distribution as detailed on the Australian Bat Society's BatMap viewer (AusBats 2024).

### Habitat Requirements

This species occurs in a wide range of habitats including inland woodland with box, ironbark, cypress pine, Buloke, brigalow, Belah, Smooth-barked Apple, River Red Gum, Black Box and various types of mallee (Threatened Species Scientific Committee 2015). The species is noted as being more abundant in extensive stands of vegetation in comparison to small or fragmented woodland patches, suggesting a large home range. Old growth vegetation is likely a critical component to this species habitat requirements (Threatened Species Scientific Committee 2015).

Corben's Long-eared Bat is not considered to be at risk of turbine strike due it its flight characteristics being generally below RSA, with details provided in Table A 17 below.

**Table A 17 Corben's Long-eared Bat flight characteristics**

| Species | Foraging space | Flight characteristics | Canopy | Overview |
|---|---|---|---|---|
| **Long-eared Bat** *Nyctophilus sp* | Closed | Slower, more manoeuvrable. | Below canopy, in and around vegetation. | Highly manoeuvrable and able to change direction often and quickly (Churchill 2008). Fly very close to vegetation, usually at canopy height, where they weave between gaps in the canopy (Churchill 2008). |

### Survey observation

No threatened species were positively identified during the bat utilisation survey effort completed by Nature Advisory, however, three species complexes were identified. One of the three species complexes has the potential of being Corben's Long-eared Bat *Nyctophilus corbeni*. This species has been assessed within the BDAR as having the potential to occur and as such, is subject to Significant Impact Assessment below.

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**Table A 18 SIC assessment for Corben's Long-eared Bat**

| SIC assessment for vulnerable species |
|---|
| **Lead to the long-term decrease in the size of an important population of a species.** |
| **No.** The subject land is south of the recognised distribution of this species, however the species is wide ranging and its presence could conservatively be assumed, for this trap-shy species that cannot be identified from call analysis. A call complex was identified during the Nature Advisory bat utilisation survey effort which has the potential of being Corben's Long-eared Bat *Nyctophilus corbeni.* Species complexes occur, as not all microbat species are able to be consistently or reliably identified using echolocation detection alone. Where this occurs, groupings are compiled of possible species and labelled as a species complex (Nature Advisory 2022a). The conclusion of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) concluded no threatened bat species were positively identified, or considered likely to occur, this included Corben's Long-eared Bat. No records of this species are present under the NSW BioNet atlas within 40 kilometres of the subject land, with the nearest cluster of records located from around 10 kilometres north-west of Balranald, leading west and north-west to the Mallee Cliffs National Park and Mungo National Park.<br>The woodland and mallee habitat within the subject land supported by PCTs 23, 21, 170, 57 and 58 constitute potential breeding and foraging habitat for this species.<br>An evaluation completed by Nature Advisory **(Nature Advisory 2022a)** determined *Nyctophilus corbeni* was unlikely to occur, with the call complex detected likely to be attributed to one of two common bat species, Lesser Long-eared Bat *Nyctophilus geoffroyi* or Gould's Long-eared Bat *Nyctophilus gouldi*. Both of these species are common and widespread within NSW, with historical records from 1994 around 4 kilometres south-west of the subject land **(NSW DCCEEW 2024b)**.<br>If a population of Corben's Long-eared Bat is present it is likely to be fragmented due to the nature of the habitat within the subject land, with occurrence likely to be concentrated in areas of larger woodland patches located along the roadsides leading to areas of more likely occurrence such as the Yanga National Park. An important population is not considered likely to be present.<br>This species was not determined as part of this assessment to be 'At Risk' of wind turbine collision by Nature Advisory and was not assessed further.<br>Mitigation measures including two-staged clearing procedures will be undertaken for removal of any HBTs that could support this species, in the event this species is identified. Works would cease and further assessment would be undertaken. |
| **Reduce the area of occupancy of an important population.** |
| **No.** The species widespread, but patchily distributed in larger consolidated blocks of remnant native vegetation, with the closest records located around 40-45 km north-west of the subject land leading across woodland and mallee habitat to the Mallee Cliffs and Mungo National Parks. The study area is potentially within the range for this species, however, a population is not known to occur within the locality, although presence/absence of this species can only be confirmed through live trapping, it is not expected to be present within the subject land. An important population is not considered likely to be present.<br>The project will remove up to 30.37 hectares of this habitat would be considered suitable habitat for this species. This reduction is not expected to incur an impact on the microbat populations within the locality, where, in a 1500 m buffer from the subject land, over 7,900 hectares of native vegetation is mapped. The project would impact <1% of the potential suitable habitat for this species within a 1500 m buffer area from the subject land. |
| **Fragment an existing important population into two or more populations.** |
| **No.** An important population is not considered likely to be present.<br>Connectivity within the development site will be impacted, however, this impact is considered relatively minor at a broader scale due to the presence of key connectivity corridors in the form of native vegetation and TSRs along Yanga Way and Balranald-Moulamein Road. At the scale of the subject land, key consequences of the development include an increase of fragmentation and edge effect.<br>The proposal is expected to reduce the width of habitat connectivity areas, but will not remove any key areas of connectivity. Key connectivity through the subject land, to important wildlife corridors will be maintained. The proposed |

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| SIC assessment for vulnerable species |
| --- |
| development will not result in the loss of, or substantial impacts to key functional corridors within the landscape. It is expected that fauna species will continue to utilise the existing corridors within the subject land and broader landscape, with minor impacts to movement patterns and/or population viability. |
| **Adversely affect habitat critical to the survival of a species.** |
| **No.** Habitat critical to the survival of Corben's Long-eared Bat has not been defined in an approved national recovery plan for the species or in the approved conservation advice for the species. Similarly, there is no critical habitat for this species on the Register of Critical Habitat maintained by the Minister under the EPBC Act.<br>When viewed in isolation, potential Corben's Long-eared Bat habitat affected by the proposal is not considered necessary for the long-term maintenance of the species or to maintain genetic diversity and long-term evolutionary development, nor is that habitat necessary for reintroduction of populations or for the species recovery. While habitat within the study area includes of potential foraging, breeding, roosting and dispersal (as defined in COA 2013), it is not considered to be habitat that is critical for the species' survival, and it is not considered likely to support a population of this species. |
| **Disrupt the breeding cycle of an important population.** |
| **No.** The study area is potentially within the range for this species, however, a population is not known to occur within the locality, although presence/absence of this species can only be confirmed through live trapping, it is not expected to be present within the subject land. Mitigation measures including two-staged clearing procedure will be undertaken for removal of any HBTs that could support this species, in the event this species is identified, works would cease and further mitigation would be triggered as part of the BMP. |
| **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** |
| **No.** The study area is potentially within the range for this species, however, a population is not known to occur within the locality, although presence/absence of this species can only be confirmed through live trapping, it is not expected to be present within the subject land. The project would impact <1% of the potential suitable habitat for this species within a 1500 m buffer area from the subject land. This reduction is not considered an action that would modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that any microbat species is considered likely to decline. |
| **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.** |
| **No.** The project area is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Introduce disease that may cause the species to decline.** |
| **No.** The project is not likely to introduce any diseases this species is susceptible to. In addition to this the project will implement several controls and management plans including a Bird and Bat Adaptive Management Plan, Biodiversity Management Plan and a Weed and Pest Management Plan. Considering the nature of the project and the management plans which will be implemented it is considered unlikely the project would introduce disease that may cause microbat species to decline. |
| **Interfere substantially with the recovery of the species.** |
| **No.** An approved national recovery plan has not been prepared for Corben's Long-eared Bat, however the Threatened Species Scientific Committee (TSSC) has prepared Conservation Advice for the species which outlines recovery actions. Habitat loss and fragmentation are listed as known key threats to the species in the Conservation Advice.<br>The project will result in a relatively small amount, approximately 30 hectares of potential habitat for this species, amounting to <1% of the potential habitat within a 1500 m buffer from the subject land, in an area that is not considered likely to support a population of this species. The proposal will incur a minor increase in fragmentation, however this increase would not lead to fragmentation of microbat populations.<br>The project would not interfere with Conservation Actions identified in the Conservation Advice. |

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| SIC assessment for vulnerable species |
| --- |
| **Conclusion.** |
| **The project is not considered likely to significantly impact this species.** A population of this species is not considered likely to be present within the subject land, or immediate surrounding areas. This species was not determined through the Nature Advisory assessment, or this BDAR as a species 'At Risk' of wind farm collision. Less than 1% of the potential habitat that may be used by this species would be impacted by the project.<br>This assessment has found the project is unlikely to:<br>• Lead to the long-term decrease in the population of this species.<br>• Reduce the area of occupancy of this species.<br>• Fragment an existing important population into two or more populations.<br>• Adversely affect habitat critical to the survival of a species.<br>• Disrupt the breeding cycle of an important population.<br>• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere with the recovery of the species. |

## Appendix 5.2. Regent Parrot – Vulnerable

### Distribution

The eastern subspecies species occurs in south-western NSW, with records concentrated from Balranald in the east, Mungo National Park in the North and across to Cal Cal in the south-west on the South Australian/Victorian border (NSW DCCEEW 2024b). This area lines up with the lower Murray-Darling basin (DSE 2011).

### Habitat requirements

The National Recovery Plan (DSE 2011) for this species states '*Relatively little is known about the habitat utilised by eastern Regent Parrots during the non-breeding season, though they are known to remain within the Murray-Darling Basin all year round. Some birds appear to move away from their riverine breeding areas, and will use mallee woodlands for foraging up to 100 kilometres from the river.*'

*'The eastern Regent Parrot breeds almost entirely in River Red Gum forest and woodland. Nest trees are typically large (mean 160 cm DBH), tall (mean 28 m), mature, healthy River Red Gums with many hollows, usually close to water. Growth rates indicate nest trees are a minimum of 160 years of age and most are probably significantly older. Most nests are in hollow branches, with a few in holes in the tree trunk, and are usually high (av. 18 metres, range 6–36 metres) above the ground. '*

### Survey observations

Nature Advisory was commissioned on behalf of Windlab to complete a targeted assessment of the Regent Parrot for the proposed Junction Rivers Wind Project. This assessment was commissioned to provide detailed information on the utilisation of the subject land by the species, which was originally identified during the BBUS survey (Nature Advisory 2023d).

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The field assessment included identification of potential roosting and foraging habitat. A targeted field assessment was completed.

Regent Parrot was recorded on multiple occasions within the subject land by Nature Advisory during BUS, incidental surveys and targeted site utilisation surveys for the species (described in further detail in Section 6 above).

It should be noted that whilst Regent Parrot has been recorded on site, it is not considered to occur in a "species credit – breeding" capacity, due to an absence of breeding habitat and the nomadic movements between the subject land and riparian habitats along the Wakool and Murrumbidgee Rivers.

**Table A 19 SIC assessment for Regent Parrot**

| SIC assessment for critically endangered or endangered species |
|---|
| **Lead to a long-term decrease in the size of an important population.** |
| **No.** A population of this of this species was identified within the subject land, where, connectivity pathways along the road reserves are considered to be used by this species between major watercourses within the landscape. This population would meet the definition of important as the individuals are likely to form part of the breeding population along the Murrumbidgee and Wakool Rivers (DSE 2011).<br>To prevent a long-term decrease in the size of the population of this species, the following avoid and minimise steps will be undertaken:<br>• A 100 metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable Regent Parrot foraging and roosting habitat and along the known movement corridor along the western boundary of the subject land.<br>• Area of expected high use for Regent Parrot are to be mapped once final development footprint has been determined at least one month prior to scheduled vegetation removal.<br>• Pre-clearance surveys are to be undertaken to determine if these areas of habitat are being used by the species 24-48 hours before vegetation removal.<br>• Two-staged tree removal under ecologist supervision is required for the removal of all potential Regent Parrot high use areas.<br>• A BMP would be implemented demonstrating adaptive management strategies to ensure key milestones and mitigation measures are achieved.<br>Barrier effect and collision risk have been minimised as a result of the proposed layout of WTGs, with substantial areas of airspace remaining available for birds to move through once the wind farm becomes optional. The south-eastern potion of the wind farm encompasses the area where turbines remain closest together and RSA separation is lowest (WTGs 46 – 55), however this area is away from the main movement corridors for Regent Parrot.<br>This species was not recorded flying at RSA height, and collisions are not expected to occur.<br>The project will not result in barriers to the species movement, or impact to breeding habitat, therefore with the implementation of the avoid and minimise steps outlined above, a long-term decrease in the size of an important population is not expected to occur. |
| **Reduce the area of occupancy of the species.** |
| **No.** The area of occupancy of the Regent Parrot (eastern) is estimated at 500 km² (Cth DCCEEW 2024c). This species uses habitat within the subject land for foraging and roosting, in association with connectivity corridors between key breeding areas. To avoid a reduction in habitat for this species, which would lead to a reduction in the area of occupancy, avoid and minimise steps will be undertaken, these steps are outlined above within this table. |

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**SIC assessment for critically endangered or endangered species**

**Fragment an existing population into two or more populations.**

**No.** This species uses habitat within the subject land for foraging and roosting (short term, not breeding), in association with connectivity corridors between key breeding areas. Connectivity within the development site will be impacted, however, this impact is considered minor at a broader scale due to the presence of key connectivity corridors in the form of native vegetation and TSRs along Yanga Way and Balranald-Moulamein Road. At the scale of the subject land, key consequences of the development include a potential increase in fragmentation and edge effect. It should be noted that the patchy nature of the habitats within the subject land are already considered fragmented and edge effected.
The proposal will not remove any key areas of connectivity, including connectivity through the subject land, to important wildlife corridors. The proposed development will not result in the loss of, or substantial impacts to key functional corridors within the landscape. It is expected that Regent Parrots will continue to utilise the existing corridors within the subject land and broader landscape, with minor or negligible impact to movement patterns and/or population viability. This will be ensured through implementation of the 100 metre setbacks from the important movement corridor along Yanga Way.

**Adversely affect habitat critical to the survival of a species.**

**No.** Under the National Recovery Plan, habitat critical to the survival of the eastern Regent Parrot contains all known sites for nesting, food resources, water, shelter, essential travel routes, dispersal, and buffer areas, and is defined as all potential eastern Regent Parrot habitat within its 'current normal range' (DSE 2011). Habitat can be divided into those areas used during the breeding and non-breeding seasons. Non-breeding habitat known to be utilised by this species occurs within the subject land, and as such can be considered habitat critical to the survival of the species.
Habitat critical to the survival of the species, present within the subject land, includes:

- Primary important movement corridors along Yanga Way, and secondary corridors along other TSRs (although no birds were recorded away from the primary movement corridor during the current assessment (Nature Advisory 2023d).
- Primary forage habitat supported by mallee woodland (PCT 170) within 100 m of the Yanga Way corridor, and secondary forage habitat supported by mallee woodland elsewhere within the subject land.
- Other forage habitat, expected to be utilised only on occasion by the species, including woodlands and native grasslands (where grazing levels are low), supported by PCTs 16, 21, 57 and 58.

The project will not impact upon primary movement corridors or primary forage habitat due to the 100 m setbacks implemented during project design and commitments made regarding future micro-siting of turbines.
The project will impact upon 8.74 ha of PCT 170 providing secondary forage habitat for the species, and a further 63.37 ha of habitat providing 'other foraging habitat' for the species. Whilst impacts to over 72 ha of secondary, and other foraging habitats, that can be considered habitat critical to the survival of the species, is somewhat substantial, the vast majority of this impact occurs away from the key habitat and movement corridors known to provide critical habitat to the species.
The removal of approximately 72 ha of habitat also equates to just 4 % of commensurate habitat present within the subject land, and approximately 1 % of habitats within the 1500 m buffer assessment area.
The project is not considered likely to adversely affect habitat critical to the survival of Regent Parrot based on:

- Impacts to primary movement corridors and primary forage habitats being avoided.
- Impacts to secondary and other forage habitats only representing a small fraction of the commensurate habitats available to the species, as well as impact being located away from keys habitats, in areas where the species has not been recorded in over two years of survey.

**Disrupt the breeding cycle of a population.**

**No.** Breeding habitat is not present within the subject land for this species. As outlined above, strategic avoid and minimise steps have been undertaken that will ensure connectivity between key breeding areas located north and south of the subject land is maintained.

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**SIC assessment for critically endangered or endangered species**

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

**No.** As outlined above in relation to critical habitat, strategic avoid and minimise steps have been undertaken that will ensure connectivity between key breeding areas located north and south of the subject land is maintained, and impacts will only occur to secondary or other forage areas, which are not limited in the landscape.

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

**No**. The project area is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species.

**Introduce disease that may cause the species to decline.**

**No.** The project is not likely to introduce Psittacine Beak and Feather Disease, or any other diseases this species is susceptible to. In addition to this the project will implement several controls and management plans including a Bird and Bat Adaptive Management Plan, Biodiversity Management Plan and a Weed and Pest Management Plan. Considering the nature of the project and the management plans which will be implemented it is considered unlikely the project would introduce disease that may cause the species to decline.

**Interfere with the recovery of the species.**

**No.** The National Recovery Plan for this species states the recovery objectives are:

- Determine population trends.
- Reduce environmental impacts and restore habitat.
- Identify strategic flyways and their features and protect and enhance these.
- Reduce human-induced mortality.
- Investigate key aspects of the biology and ecology.
- Increase community involvement in the recovery program.

The project will not interfere with these recovery objectives due to the implementation of strategic avoid and minimise steps that will ensure connectivity between key breeding areas located north and south of the subject land is maintained.

**Conclusion.**

The project is not considered likely to result in a significant impact on this species, provided the steps outlined to avoid and minimise potential impacts are undertaken adequately. These steps are:

- A 100 metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable Regent Parrot foraging and roosting habitat and along the known movement corridor along the western boundary of the subject land.
- Area of expected high use for Regent Parrot are to be mapped once final development footprint has been determined at least one month prior to scheduled vegetation removal.
- Pre-clearance surveys are to be undertaken to determine if these areas of habitat are being used by the species 24-48 hours before vegetation removal.
- Two-staged tree removal under ecologist supervision is required for the removal of all potential Regent Parrot high use areas.
- A BMP would be implemented demonstrating adaptive management strategies to ensure key milestones and mitigation measures are achieved.

With the implementation of these avoid and minimise steps, the project will not:

- Lead to the long-term decrease in the population of this species.
- Reduce the area of occupancy of an important population.

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| SIC assessment for critically endangered or endangered species |
|---|
| • Fragment an existing important population into two or more populations.<br>• Adversely affect habitat critical to the survival of a species.<br>• Disrupt the breeding cycle of an important population.<br>• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere with the recovery of the species. |

## Appendix 5.3. Grey Falcon – Vulnerable

### Distribution

This species is recorded evenly at low densities throughout most of semi-arid and arid NSW, with isolated records located in Albury, Glen Innes and several coastal areas (NSW DCCEEW 2024b). The nearest record of this species to the subject land is around 35 kilometres north of the subject land at Pika Lake.

### Habitat requirements

Preferred habitat for this species includes timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined watercourses. This species has been recorded hunting in treeless areas and frequents tussock grassland and open woodland. Nesting occurs in the tallest trees along watercourses in the nests of other bird species. Nests are often observed in man made structures such as telecommunication towers (Threatened Species Scientific Committee 2020b).

### Survey observations

This species was not recorded within the subject land during the BUS survey effort completed by Nature Advisory. This species was not detected during survey by Biosis.

**Table A 20 SIC assessment for Grey Falcon**

| SIC assessment for vulnerable species |
|---|
| **Lead to the long-term decrease in the size of an important population of a species.** |
| **No.** The subject land occurs within the known distribution of this species, however it was not identified as present during the bird utilisation surveys completed by Nature Advisory, or recorded during targeted and opportunistic survey efforts. The nearest record for this species is located over 30 kilometres from the subject land. An important population of this species is not considered likely to occur.<br>Preferred breeding habitat for this species is not considered to be present within the subject land, with 75.68 hectares of potential foraging habitat proposed to be impacted. Although this is a somewhat substantial amount of vegetation, it equates to around 3.4% of the potential native vegetation foraging habitat for this species within the subject land, and <1% of the potential native vegetation foraging habitat for this species within the assessment area (1500m buffer of the subject land).<br>A potential was identified for rare occurrence within the subject land where an individual may pass through during movements between areas of suitable foraging and/or breeding habitat. Detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species. Barrier |

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| SIC assessment for vulnerable species |
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| effect and collision risk have been minimised as a result of the proposed layout of WTGs, with substantial areas of airspace remaining available for birds and bats to move through once the wind farm becomes operational. The south-eastern portion of the wind farm encompasses the area where turbines remain closest together and RSA separation is lowest (WTGs 46 – 55), however bird movements through this area are unlikely to be as common as elsewhere within the subject land due to a lack of habitat features providing or eliciting flyways compared to elsewhere within and surround the subject land. |
| **Reduce the area of occupancy of the species.** |
| **No.** The extent of occurrence for this species is estimated at 6.1 million km$^2$, with the area of occupancy estimated at 6000 km$^2$ (Threatened Species Scientific Committee 2020b). The proposal would result in a small reduction of potential foraging habitat for this species, in an area where a population is not considered present in any regular capacity. The project would not reduce the area of occupancy of this species. |
| **Fragment an existing important population into two or more populations.** |
| **No**. An important population is not considered likely to be present. Connectivity within the development site will be impacted, however, this impact is considered minor at a broader scale due to the presence of key connectivity corridors in the form of native vegetation and TSRs along Yanga Way and Balranald-Moulamein Road. At the scale of the subject land, key consequences of the development include a potential increase in fragmentation and edge effects. However it should be noted that native vegetation within the subject land already occurs in a fragmented and edged effected sate. The project will not remove any key areas of connectivity. Key connectivity through the subject land, to important wildlife corridors will be maintained. The proposed development will not result in the loss of, or substantial impacts to key functional corridors within the landscape. It is expected that fauna species will continue to utilise the existing corridors within the subject land and broader landscape, with minor or negligible impact to movement patterns and/or population viability. |
| **Adversely affect habitat critical to the survival of a species.** |
| **No.** Critical habitat has not been defined for the species. Therefore 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• For activities such as foraging, breeding, roosting, or dispersal<br>• For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• To maintain genetic diversity and long-term evolutionary development, or<br>• For the reintroduction of populations or recovery of the species or ecological community.<br>Habitat within the subject land is not considered to be utilised by a population of this species on more than a transient basis, therefore, no critical habitat is considered to be present. |
| **Disrupt the breeding cycle of an important population.** |
| **No.** Preferred breeding habitat is not considered to present within the subject land for this species. Strategic avoid and minimise steps have been undertaken that will ensure connectivity between potential key breeding areas along major watercourses located north and south of the subject land is maintained. |
| **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** |
| **No.** The entire subject land is within the known range for this species, however, a population is not known to occur within the locality. The project would impact <1% of the potential suitable habitat for this species within a 1500 m buffer area from the subject land. This reduction is not considered an action that would modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the wide ranging Grey Falcon is considered likely to decline. |

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| SIC assessment for vulnerable species |
|---|
| **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.** |
| **No**. The project area is already located within a highly modified environment, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Introduce disease that may cause the species to decline.** |
| **No.** The project is not likely to introduce any diseases this species is susceptible to. In addition to this the project will implement several controls and management plans including a Bird and Bat Adaptive Management Plan, Biodiversity Management Plan and a Weed and Pest Management Plan. Considering the nature of the project and the management plans which will be implemented it is considered unlikely the project would introduce disease that may cause microbat species to decline. |
| **Interfere with the recovery of the species.** |
| **No.** No national recovery plan for this species has been adapted. The Conservation Advice outlines the following threats:<br>• Invasive species: Predation by cats.<br>• Climate change: Increased temperatures in arid and semi-arid Australia.<br>• Demographic and genetic stochastic events: Small population size.<br>• Habitat loss and fragmentation: Grazing by exotic herbivores, Nest shortage.<br>• Disturbance: Birdwatchers and photographers.<br>• Direct mortality: Collision with traffic, Collision with fences and powerlines.<br>• Harvesting: Egg collecting, Falconry.<br>Through the construction of project, activities including clearing of woodland vegetation will add to a global cumulative impact leading to increases in climate change, however, the operational use of the wind farm, as a renewable energy source will aid in reducing this global cumulative impact. Direct mortality will be managed via mitigation measures associated with turbine and powerline collision in the BBAMP. The project will not increase any other threats identified for this species. |
| **Conclusion.** |
| The project is unlikely to significantly impact this species. A population of this species is not considered likely to be present within the subject land, or immediate surrounding areas, on any more than a transient basis. A very rare potential for collision risk is present, however, detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species. Additional to this, <1% of the potential habitat that may be used by this species for foraging would be impacted by the project within the assessment area, and around 3.5% within the subject land.<br>This assessment has found the project is unlikely to:<br>• Reduce the area of occupancy of an important population.<br>• Fragment an existing important population into two or more populations.<br>• Adversely affect habitat critical to the survival of a species.<br>• Disrupt the breeding cycle of an important population.<br>• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere substantially with the recovery of the species. |

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# Appendix 5.4. Southern Whiteface – Vulnerable

## Distribution

This species is recorded throughout central and inland NSW, some records are present in coastal areas near Sydney (NSW DCCEEW 2024b). More broadly the species occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range (Cth DCCEEW 2023e).

## Habitat requirements

The approved conservation advice for this species (Cth DCCEEW 2023e) details this species occupies '*a wide range of open woodlands and shrublands where there is an understory of grasses or shrubs, or both. These are usually habitats dominated by acacias or eucalyptus on ranges, foothills and lowlands and plains.*'

## Survey observation

This species was recorded within south-eastern portion of subject land, and would utilise habitats likely to be impacted by the project.

**Table A 21 SIC assessment for Southern Whiteface**

| SIC assessment for vulnerable species |
|---|
| **Lead to the long-term decrease in the size of an important population of a species.** |
| **No.** Important populations have not been defined in the Commonwealth Conservation Advice and a national recovery plan has not been prepared. The population is estimated to be 477,000 mature individuals in the wild, consisting of two subspecies: the south-east southern whiteface (410,000) and the south-west southern whiteface (67,000). The population of the species within the subject land cannot be said to be:<br>• Key source populations either for breeding or dispersal.<br>• Populations that are necessary for maintaining genetic diversity, and/or<br>• Populations that are near the limit of the species range.<br>As such the population is not considered an important population of the species.<br>Habitat loss and fragmentation is the likely cause of species decline, as a result of intensive agriculture and increasing drought. The subject land contains habitat suitable for this species in the form of moderate and high condition PCTs 16, 23, 57, 58 and 170. Around 32.44 hectares of this habitat is proposed to be impacted. This removal amounts to around 4% of the available habitat suitable for this species within the subject land. Although ecological condition has not been mapped within the entire 1500 m buffer area, around 6750 hectares of native vegetation is mapped as present, based on an assessment of aerial imagery, it is likely that the removal of habitat within the subject land amounts to <1% of the available habitat for this species. There is a low likelihood that the project would lead to the long-term decrease in the size of the population of the Southern Whiteface. |
| **Reduce the area of occupancy of an important population.** |
| **No.** No important populations have been identified for the Southern Whiteface. The extent of occurrence for the species is estimated to be 4,910,000 km$^2$, however the area of occupancy is contracting and is estimated to be 70,000 km$^2$ (Cth DCCEEW 2023e). Reduced area of occupancy for the species is associated with the complete removal of habitat for intensive agriculture. Around 4% of the suitable habitat for this species within the subject land would be impacted, connectivity would be retained along key movement corridors, the project is not considered an action that would reduce the area of occupancy of this species of this species. |

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| SIC assessment for vulnerable species |
|---|
| **Fragment an existing important population into two or more populations.** |
| **No.** Southern Whiteface is considered sedentary, but may move into wetter areas outside of their normal range during wetter years. It is unlikely that the project would result in fragmentation for the species. The operational phase of the project is considered compatible with continued occupation by Southern Whiteface, which would be able to utilise retained habitats within the development corridor and subject land. The project would not result in a barrier to movement for the species, connectivity would be retained, including in key areas such as TSRs and roadside vegetation connecting areas of suitable habitat within the landscape. This species is not considered to be at risk of collision with wind turbines and typically lies below RSA height. |
| **Adversely affect habitat critical to the survival of a species.** |
| **Partial.** The Conservation Advice for the Southern Whiteface defines habitat critical to its survival as:<br>• Relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both;<br>• Habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat;<br>• Living and dead trees with hollows and crevices which are essential for roosting and nesting.<br>The habitat within the subject land to be impacted is considered to meet this meet the definition of critical habitat for this species. This impact, as noted above is around 4% of the habitat that would meet this definition within the subject land, and <1% within the 1500 metre buffer area. The removal of this habitat as a result of the project is not considered to be adverse to the species given the commensurate habitat available within the local area, as well as the very wide ranging nature of the species, given the localised impact to habitat. |
| **Disrupt the breeding cycle of an important population.** |
| **No.** The population of the species with the subject land is not considered to be an Important Population. The vegetation to be removed is likely to support suitable breeding habitat and may contain breeding individuals. Pre-clearance surveys will be implemented prior to the removal of vegetation suitable for breeding of this species to ensure mitigation measures are implemented to minimise impacts breeding individuals.<br>Breeding of this species takes place between July – October, however timing in more arid regions can be affected by rainfall. A nest is constructed in the hollows, crevices and sometimes low bushes (Cth DCCEEW 2023e). |
| **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** |
| **No.** Around 4 % of the habitat that is considered suitable for this species would be removed within the subject land, < 1% of the available habitat for this species would be impacted within the 1500m buffer area of the subject land. Connectivity would be maintained. The area of habitat to be impacted for this species, and as such its removal is not considered an action that would lead to the decline of this species. |
| **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.** |
| **No**. The subject land is already located within a highly modified environment, dominated in land used for agricultural activities. As a part of the construction and operation management of the Project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. The CMP and BMP to be implemented would action measures, including weed control to ensure any occurrence of this species outside the disturbance footprint are not out competed by exotic species and control the introduction of new weed species. With the implementation of the CEMP and BMP it is considered unlikely the Project would introduce disease that may cause the species to decline. |
| **Introduce disease that may cause the species to decline.** |
| **No.** The Project is not likely to introduce any diseases this species is susceptible to. In addition to this the Project will implement several controls and management plans including a CEMP and BMP. |

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| SIC assessment for vulnerable species |
|---|
| **Interfere substantially with the recovery of the species.** |
| There is currently no National Recovery Plan for the Southern Whiteface, however conservation and management priorities within the approved conservation advice for the species primarily relate to reducing clearing of critical habitat (particularly for agriculture), revegetation to expand and connect areas of existing habitat and minimising habitat degradation caused by livestock.<br>The project would result in direct impacts to 4% of suitable habitat for this species within the subject land.<br>The operational phase of the project is considered compatible with persistence of Southern Whiteface in the landscape, and would not present a barrier to movement. The project is not likely to interfere with the recovery of this species. |
| **Conclusion.** |
| A significant impact on this species has been determined unlikely to occur. An important population of this species is not considered to occur within the subject land. Impacts will occur to <1% of the potential habitat that may be used by this species by the project within the assessment area, and around 4% within the subject land. This habitat meets the definition of habitat critical to the survival of the species, however the removal of this habitat as a result of the project is not considered to be adverse to the species given the commensurate habitat available within the local area, as well as the very wide ranging nature of the species, given the localised impact to habitat<br>This assessment has found the project is unlikely to:<br>• Reduce the area of occupancy of an important population.<br>• Fragment an existing important population into two or more populations.<br>• Disrupt the breeding cycle of an important population.<br>• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere substantially with the recovery of the species. |

# Appendix 5.5. Major Mitchell's Cockatoo – Endangered

## Distribution

Major Mitchell's Cockatoo is found in arid and semi-arid inland landscapes, the species distribution occurs from south-western Queensland to north-west Victoria, through to most of South Australia, north into the south-west Northern Territory and across to the west coast between shark bay and about Jurien (OEH, 2023). The Eastern subspecies *Lophochora leadbeateri leadbeateri* is listed as Endangered under the EPBC Act, and has been recorded within the subject land.

## Habitat requirements

Major Mitchell's Cockatoo is typically distributed across arid and semi-arid woodlands, dominated by Mulga *Acacia aneura*, mallee and box eucalyptus, Slender Cypress Pine *Callitris gracilis* or Belah *Casuarina cristata* (DCCEEW, 2023). The species requires freshwater sources, with trees and suitable nesting hollows. Suitable nesting hollows are 10 centimetres or greater in diameter.

Major Mitchell's Cockatoo has specific preference of nesting hollows close to wooded areas, using these areas for travel between feeding area and nesting or roosting sites. Fragmented landscapes, the vegetated corridors tend to be the preference for travel and well as roadside remnant vegetation patches (DCCEEW, 2023).

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Major Mitchell's Cockatoo typically prefer hollows with the following characteristics (Cth DCCEEW 2023b):

- Average hollow entrance diameter of 13.3 x 27.7 cm (range 8-30 x 9-80 cm, horizontal x vertical diameter).
- Average hollow depth of 53.9 cm (range 19 – 180 cm).
- Average nest chamber floor diameter of 18 cm (range 9-34 cm).
- Average nest tree diameter at breast height of 72.5 cm (range 34-149 cm).

### Survey observations

Major Mitchell's Cockatoo has been sighted numerous times and identified as a resident within the subject land during the Bird Utilisation Surveys (BUS) and surveys undertaken for the development of this BDAR. Over the survey period, Major Mitchell's Cockatoo was recorded over 93 times during BUS work and 114 times incidentally.

The large majority of the development corridor has been located within degraded and highly disturbed agricultural land which has been cleared over generations of farming and is mainly used for cereal cropping activities. There is a relatively small proportion of native vegetation which remains in the subject land. This native vegetation is considered to support potential breeding habitat for Major Mitchell's Cockatoo, within areas of PCT 170, PCT 16 and PCT 58, which provide suitable habitat, including tree hollows, for the species. Furthermore, the species is known to potentially utilise small patches of vegetation as habitat, and NSW BioNet notes paddock trees with hollows greater than 10 centimetres in diameter can also be considered important habitat.

The direct impacts to the species from the project would be the loss of approximately 39.45 hectares of foraging and potential breeding habitat. Direct and indirect impacts would also include the loss of (or impacts within BAM prescribed 200 metre breeding habitat buffers) at least 14 trees considered suitable for the species' breeding in patches of suitable vegetation, and a further 3 scattered trees that support one or more hollow**.**

The BBUS and BDAR surveys identified the Major Mitchell's Cockatoo several times throughout the survey program, observations from Nature Advisory and earlier by NGH Consulting identified that Major Mitchell's Cockatoo were investigating some of the hollow bearing trees within the subject land. As such potential breeding could not be excluded.

Surveys have also identified that the individuals have been noted investigating suitable nesting hollows within the eastern portion of the subject land. Based on the species nesting behaviour (nests at least 1 kilometre apart with no more than one pair every 30 square kilometres) the subject land could be expected to support 5-6 breeding pairs.

During BUS the species was not observed to be flying at RSA height and is not expected to fly at RSA height when transitioning between foraging areas, as such it is considered that this species is at low risk of ongoing operational impacts as a result of collision with operational turbines.

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**Table A 22 SIC assessment for Major Mitchell's Cockatoo**

| SIC assessment for vulnerable species |
|---|
| **Lead to the long-term decrease in the size of a population.** |
| **No.** The project is unlikely to lead to a long-term decrease in the size of the local Major Mitchell's Cockatoo population. It is expected that the subject land could support 5-6 breeding pairs of the species - a maximum of 12 individuals. The national population size is estimated (with low reliability) at 15,000 mature individuals in 2011, with only a single population (sub-population) of the species listed as occurring in the Commonwealth Conservation Advice (DCCEEW, 2023). Therefore, the subject land represents a very small portion (0.08%) of the estimated population.<br>One month prior to vegetation clearing, pre-clearance surveys will be completed to map all potential breeding trees for this species. Removal of potential breeding trees would be subject to further mitigation, as outlined in Section 9 of the BDAR, to reduce direct impacts to the species and minimise impact to breeding individuals and juveniles. All potential breeding trees for this species to be impacted would be subject to a 2-stage clearing protocol, including survey to confirm absence of breeding individuals 24-hours prior to removal. Active nests will be avoided by clearing. Furthermore whilst the project will impact upon potential breeding habitat including suitable tress, these trees are not considered to be rare in the broader landscape and opportunities for the species to continue to breed outside the development footprint will remain. |
| **Reduce the area of occupancy of the species.** |
| **No**. The species area of occupancy is estimated to be 225,000 km$^2$ (DCCEEW 2023). The project will lead to the loss of up to 39.45 ha of potential breeding habitat. The species occurs across a large range across Australia and the project will only lead to loss of potential breeding habitat on a local scale. As such it is not considered likely that the project will reduce the area of occupancy for the species. |
| **Fragment an existing population into two or more populations.** |
| **No.** The project is not anticipated to increase fragmentation within the population's distribution. The subject land has undergone significant disturbance through agricultural practices in the past and contains patches of remanent vegetation which have been avoided through the project design development. In addition to the subject land being highly fragmented the surrounding landscape also occurs in a fragmented state and includes a variety of uses including utility scale solar farms, agricultural land including cereal cropping and orchids, and the Murray Valley National Park.<br>Parts of the surrounding landscape contain native vegetation which act as movement corridors, generally occurring alongside road corridors and are typically linear in shape. Vegetation corridors will not be subject to large scale direct impacts by the project, and the level of habitat fragmentation, in relation to Major Mitchell's Cockatoo will generally remain unchanged. The species is not expected to regularly fly at RSH, and therefore operation turbines are not expect to result in connectivity impacts to the species. |
| **Adversely affect habitat critical to the survival of a species.** |
| **Yes.** The Conservation Advice for Major Mitchell's Cockatoo describes habitat critical to the survival of Major Mitchell's Cockatoo as consisting of:<br>• Arid and semi-arid woodlands dominated by Mulga, mallee and box eucalypts, Slender Cypress Pine or Belah.<br>• Known habitat containing suitable attributes, including potential habitat for the subspecies, especially where there are large mature trees with suitable hollows; and<br>• Surrounding matrix of these areas for the role of providing movement corridors for dispersal across the landscape (DCCEEW, 2023).<br>The habitat present within the development footprint development corridor and broader subject land is considered to support areas that conform to the attributes listed in the Conservation Advice (DCCEEW, 2023) as habitat critical to the survival of a species. The habitat to be impacted by the project support semi-arid woodland dominated by Black Box, Cypress Pine and Black Oak (the latter two closely related to the species listed specifically in the critical habitat description), |

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**SIC assessment for vulnerable species**

as well as suitable hollows seen to be being investigated by the species for use as breeding resources, with the species being commonly recorded over the duration of the biodiversity surveys completed for the project.

Although extensive efforts have been made to avoid and minimise impacts to the species' suitable habitat, the project would likely have a residual impact to Major Mitchell's Cockatoo habitat comprising up to 39.45 ha of semi-arid woodland and grasslands, as well as at least 17 hollow-bearing trees suitable for breeding. In applying a conservative approach and the precautionary principle it is considered this is habitat critical to the survival which would be adversely affected.

**Disrupt the breeding cycle of a population.**

**Potential.** The subject land supports potential breeding habitat for the Major Mitchell's Cockatoo, surveys could not exclude breeding activity in the subject land, and the species was seen investigating hollows for breeding purposes on at least two occasions. It is expected that the subject land could support 5-6 breeding pairs of the species, based on published nest density statistics. The project is expected to lead to impacts to at least 17 hollow bearing trees suitable for breeding within 39.45 ha of potential breeding habitat, and additional scattered paddock trees that the species could also utilise for breeding. Whilst alternative hollow-bearing trees are likely to be available in the surrounding, un-impacted, locality, the project has the potential to disrupt the breeding cycle of this species given the low numbers of pairs likely to be present within the subject land. Following the removal of adequate nesting hollows, competition for breeding hollows will increase between resident pairs in subsequent seasons, with breeding pairs often returning to the same hollow or habitat area used previously (Cth DCCEEW 2023b).

In order to minimise the potential for impact to breeding pairs and juveniles, mitigation measures will be implemented, including:

- One month prior to vegetation clearing, an HBT survey would be completed to map all potential breeding trees for this species.
- Removal of potential breeding trees would be subject to pre-clearance surveys, as outlined in section 8 of the BDAR, this pre-clearance survey includes a stop works protocol for the identified presence of a threatened species.
- All potential breeding trees for this species to be impacted would be subject to a 2-stage HBT removal protocol, including survey to confirm absence of breeding individuals 24-hours prior to removal.
- Active nests will be avoided by clearing.
- Clearing of trees identified as active nest trees may occur post-breeding outside the breeding season for this species (September-December) once the tree is confirmed to no longer be used for breeding and would follow the 2-stage HBT removal protocol.

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

**Potential.** The project will impact upon 39.45 ha of foraging and potential breeding habitat, however nature of the impact is relatively localised compared to the large area of occupancy of this species. The subject land is a highly modified environment which has been fragmented previously by land clearing and has been used for continual agricultural practices. While there are patches of remnant vegetation throughout the subject land, where possible the project has implemented design measures to avoid native vegetation.

It is important to note, through the removal of potential breeding hollows, an increase is hollow competition would occur for resident breeding pairs, this could lead to a decrease in the availability and quality of habitat for the species, which could in-turn could lead to a reduction in successful breeding and therefore, has the potential to lead to species decline.

**Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat.**

**No**. The project area is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species.

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| SIC assessment for vulnerable species |
|---|
| **Introduce disease that may cause the species to decline.** |
| **No.** The project is not likely to introduce Psittacine Beak and Feather Disease, or any other diseases Major Mitchell's Cockatoos are susceptible to. In addition to this the project will implement several controls and management plans including a Bird and Bat Adaptive Management Plan, Biodiversity Management Plan and a Weed and Pest Management Plan. Considering the nature of the project and the management plans which will be implemented it is considered unlikely the project would introduce disease that may cause the species to decline. |
| **Interfere substantially with the recovery of the species.** |
| **Potential.** Currently there is no recovery plan for the species, however the Conservation Advice outlines conservation and recovery actions for the species, which include:<br>• Arrest the current decline and achieve a stable or increasing population trend.<br>• Increase nesting habitat availability within the subspecies' range, and improve connectivity of woodland habitat.<br>The project would lead to the loss of 39.45 ha of potential foraging and breeding habitat for the species, including 17 suitable breeding trees, this is considered to have the potential to interfere with the recovery of local population of the species, and potentially species as a whole. |
| **Conclusion.** |
| The project will impact upon 39.45 ha of Major Mitchell's Cockatoo foraging and potential breeding habitat considered to confirm to the DCCEEW (2003) requirements for habitat critical to the survival of the species. This also includes the loss of at least 17 suitable breeding trees. As a result of these impacts, the project is also considered to have the potential to disrupt the breeding cycle of the local population and reduce the availability and quality of suitable habitat. The removal of potential breeding resources is considered to have the potential to interfere with the recovery of the local population, and possibly the species more broadly. Ongoing operational impacts associated with collision with turbine blades are not considered likely as the species was not recorded at RSH, however habitat sterilisation and more broad-scale avoidance of operational wind farms may be possible.<br>Based on the current level of understanding of impacts to Major Mitchell's Cockatoo, and based on consideration of the above eight factors, the project is considered to be a significant impact to Major Mitchell's Cockatoo. |

## Appendix 5.6. Australasian Bittern – Endangered

### Distribution

This species occurs throughout the Murray-Darling Basin as well as coastal NSW (NSW DCCEEW 2024b). Within inland areas, notable records are located in key areas of wetland and major watercourses/floodplains including the Murray, Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers (DEE 2019).

### Habitat requirements

This species occurs in freshwater wetlands, and rarely, estuaries or tidal wetlands. Wetlands with tall, dense vegetation with aquatic habitat in up to 0.3 metres deep of water are utilised for foraging. Nesting occurs adjacent to relatively deep, densely vegetated freshwater swamps and pools, building a nest in vegetation generally up to 2.5 metres tall, with nests built up to around 0.3 metres above the water level (DEE 2019).

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### Survey observations

This species was not recorded within the subject land during the BUS effort completed by Nature Advisory over 24 months, comprising eight season replicate surveys. This species was not detected incidentally during survey by Biosis, Nature Advisory or NHG Consulting.

Nature Advisory were commissioned to complete an independent review of the occurrence and collision risk potential for Australasian Bittern (Nature Advisory 2023c). The full assessment is presented in Appendix 9 of this BDAR.

A variety of scientific literature on Australasian Bittern was consulted by Nature Advisory, with records of the species' occurrence in the Riverina region assessed from BioNet and the Atlas of Living Australia. The records closest to the study area were sorted into clusters that occurred relatively close together(Nature Advisory 2023c).

Flight routes were considered based on satellite imagery, by measuring distances between two plausible points between clusters, and between clusters and wetlands identified as potentially attracting the species over long distances. Such wetlands were identified by consulting the scientific literature and using the EPBC Act Protected Maters Search Tool to identify Ramsar wetlands downstream of the study area. Flight routes passing within roughly 10 kilometres of the study area were considered to have potential to pass through the study area (Nature Advisory 2023c)..

Key findings from this assessment relevant to collision risk are (Nature Advisory 2023c):

- Based on historical flooding and weather patterns it is estimated that that wetlands in the study area (outside the project's subject land) could flood and serve as potential breeding habitat for the species no more than once in a potential 20-year lifespan of the proposed wind farm. Based on the behaviour of other waterbirds, the flight behaviour of Australasian Bitterns using local habitat is not thought to expose them to unacceptably high-risks of collision with turbines, provided a 400 metre buffer between turbines and wetlands is observed. This is based on the better-known flight behaviour of other waterbirds and the fact that this species is normally very closely tied to their breeding wetlands when using them, and would normally only be found away from them on their approach in and exit out during the start and end of breeding.
- Three two-way flight routes (six routes in total) have been determined to be the likeliest long-distance flight routes that the species may take between seasonal breeding grounds and non-breeding season habitat that may cause them to cross through the airspace of the proposed wind farm. The species is known to fly at RSA height and is known to make long-distance flights at night and in low-light conditions, which are both factors potentially increasing the risk of collision. However, most waterbirds fly above RSA height when making long-distance flights, and only fly at RSA height when almost directly above their destination waterbody (i.e. within 400 metres of it), and assuming Australasian Bitterns fly in a similar way, the risk of them colliding with turbines during long-distance flights is minimal.
- A worst-case scenario (in which most bitterns fly within RSA height when making long-distance movements) would involve a handful of birds colliding with turbines twice a year over the life of the windfarm, which could have long-term detrimental impacts on the migrating population within the Murray-Darling Basin (minimum roughly 475 birds). However, this is a very unlikely scenario, as based on the behaviour of other waterbirds, the species likely flies above RSA height when making long-distance movements, and cumulatively over a decade of mortality monitoring at various wind farms has never discovered either it, or higher-risk and more detectable waterbirds as a mortality attributable to collision with wind turbines.

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**Table A 23 SIC assessment for Australasian Bittern**

| SIC assessment for critically endangered or endangered species |
|---|
| **Lead to a long-term decrease in the size of a population.** |
| **No.** As noted in the survey observations above, this species has not been recorded within the subject land. An assessment completed by Nature Advisory (Nature Advisory 2023c) noted this species is unlikely to forage or breed within the subject land. The habitat within the subject land was determined by this BDAR to be unlikely to support this species due to its niche habitat preferences. Condoulpe Lake may support this species on very rare occasions following a prolonged wetting period (i.e. when the lake is in flood), however, in its usual form as a dryland lake, it does not support habitat for the species. Dams and other waterbodies within the subject land are disturbed and would not support this species. The assessment completed by Nature Advisory determined, based on historical flooding and weather patterns it is estimated that that wetlands in the study area could flood and serve as potential breeding habitat for the species no more than once in a given 20-year lifespan of the proposed wind farm.<br>The assessment completed by Nature Advisory, noted as a worst-case scenario, a handful of birds colliding with turbines up to twice a year would lead to a long-term decrease in the population of this species. However, turbine strikes are not considered likely to occur at such a rate or regular occurrence, as this species typically flies well above RSA height. Furthermore this worst case scenario could only be realised in the highly unlikely event of regular migrations, by a large number of birds, occurring through the subject land leading to multiple collisions, and also not being recorded during two years of BUS designed to detect such events.<br>Detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species. As part of this BDAR, local and nomadic flight paths were assessed for waterbird species to assist in turbine placement planning. All WTGs have been placed more than 400 metres from identified and mapped wetlands and wetland like habitat, including Condoulpe Lake and Harveys Lake. An analysis of multispectral imagery data, available satellite imagery and historic imagery was undertaken, this assessment determined it is unlikely that wetland habitat that may support this species would occur within 400 metres of any proposed turbine during seasonal/annual rainfall events (refer Section 9.1.2). In the event of a major flood, leading to wetland habitat within 400 metres of a proposed turbine, mitigation focussed on the affected turbine(s) would occur to allow analysis of the conditions against collision risk for this species. It is important to note that, the scenario, where curtailment of a turbine occurs due to mass expansion of wetland conditions within the subject land is considered to have the potential to occur only in very rare and limited circumstance. This mitigation has been included to ensure due diligence against the worst-case scenario proposed by Nature Advisory.<br>Barrier effect and collision risk have been minimised as a result of the proposed layout of WTGs, with substantial areas of airspace remaining available for birds to move through once the wind farm becomes operational. The south-eastern potion of the wind farm encompasses the area where turbines remain closest together and RSA separation is lowest (WTGs 46 – 55), however movements through this area are unlikely to be as common as elsewhere within the subject land due to a lack of habitat features providing or eliciting flyways compared to elsewhere within and surround the subject land. |
| **Reduce the area of occupancy of the species.** |
| **No.** The National Recovery Plan (Cth DCCEEW 2022c) for this species states *'The area of occupancy of the Australasian Bittern in Australia is thought to have declined by seventy percent between 1977 and 2008. These declines are considered to have led to a comparable decline in the size of the adult population. The declines are primarily linked to the clearing or modification of wetlands for urban and agricultural development, as well as the extraction of water from wetlands for irrigation.'* The NSW Scientific Committee final determination (NSW DCCEEW 2010) states the following **'...***the national area of occupancy (AOO) is estimated to be 1200 km2, with low reliability. Based on these figures from 2000, and considering that a half to two-thirds of the species' distribution is thought to occur in NSW, the ... AOO is estimated to be between 600 and 800 km2. However, as a result of loss of wetland habitat since 2000, it is likely that these figures are now lower.'* The habitat within the subject land is not likely to be considered to form part of the area of occupancy of this species, as such, the project will not lead to a |

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| SIC assessment for critically endangered or endangered species |
|---|
| reduction in the area of occupancy of this species. |
| **Fragment an existing population into two or more populations.** |
| **No.** This species typically flies above RSA height, the project is not anticipated to increase fragmentation within the population's distribution. The project is unlikely to involve major disturbance to localised riparian areas within the subject land and will not incur a disturbance to the key riparian areas more likely to be used by this species within the broader landscape between areas of key habitat areas such as north of Balranald, and surrounding Kerang, Echuca and Deniliquin (Nature Advisory 2023c). |
| **Adversely affect habitat critical to the survival of a species.** |
| **No.** The species' National Recovery Plan (Cth DCCEEW 2022c) states 'the habitat, or biophysical environment, of the Australasian Bittern varies across its range, so it is not possible to generate one detailed description or definition of habitat critical to survival. The habitat critical to the survival of the Australasian Bittern may be more usefully defined at a bioregional scale that considers the combination of plants, animals, water depth, geology, landforms, and climate that is relevant to a geographical unit. In general, Australasian Bitterns occur mainly in freshwater wetlands in the temperate southeast and southwest of Australia and, exceptionally, in estuaries or tidal wetlands. Preferred habitat comprises wetlands with dense vegetation, especially where there is a mosaic of cover, from 0.5–3.5 m in height, where they forage in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water… freshwater habitats with permanent or seasonal water, particularly those dominated by sedges, rushes and/or reeds. In the Murray–Darling Basin, Australasian Bitterns occur in floodplain swamps that may include Lignum shrubs within sedge or reed beds as well as in commercial rice-fields (NSW Riverina). Despite occurring in a range of wetland types, breeding is only known to occur at a smaller number of locations.'<br>As noted above, the habitat present within the subject land is not considered likely to support this species, except for potential ephemeral habitat support by Condoulpe Lake in very rare, prolonged flooding events, likely to occur once is a 20-year event. Even in the event of such conditions, turbines and the development footprint are located more than 400m from this area and are unlikely to incur impacts. |
| **Disrupt the breeding cycle of a population.** |
| **No.** As noted above, the habitat present within the subject land is not considered likely to support this species, except for potential ephemeral habitat support by Condoulpe Lake in very rare, prolonged flooding events, likely to occur once is a 20-year event. Even in the event of such conditions, turbines and the development footprint are located more than 400 m from this area and are unlikely to incur impacts. |
| **Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.** |
| **No.** As noted above, the habitat present within the subject land is not considered likely to support this species, except for potential ephemeral habitat support by Condoulpe Lake in very rare, prolonged flooding events, likely to occur once is a 20-year event. Even in the event of such conditions, turbines and the development footprint are located more than 400 m from this area and are unlikely to incur impacts. |
| **Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.** |
| **No**. The subject land is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Introduce disease that may cause the species to decline.** |

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| SIC assessment for critically endangered or endangered species |
|---|
| **No.** The project is not likely to introduce any diseases this species is susceptible to. In addition to this the project will implement several controls and management plans including a Bird and Bat Adaptive Management Plan, Biodiversity Management Plan and a Weed and Pest Management Plan. Considering the nature of the project and the management plans which will be implemented it is considered unlikely the project would introduce disease that may cause the species to decline. |
| **Interfere with the recovery of the species.** |
| **No.** The National Recovery Plan(Cth DCCEEW 2022c) lists the following threats to this species:<br>• Reduced wetland availability due to changes water regimes.<br>• Habitat loss and/or alteration.<br>• Climate variability and change.<br>• Reduced water quality.<br>• Invasive species.<br>• Loss of genetic diversity.<br>The project will not reduce wetland availability for this species, or result in habitat loss, changes to the water quality or regimes within the subject land or surrounding landscape. The project will not introduce or increase invasive species to any areas this species may be breeding or foraging within the landscape. The project will not lead to a loss of genetic diversity for this species, due to the in-depth collision risk assessments and mitigation measures to be implemented. Through the construction of project, activities including clearing of vegetation will add to a global cumulative impact leading to increases in climate change, however, the operational use of the solar farm, as a renewable energy source will aid in reducing this global cumulative impact. |
| **Conclusion.** |
| The project is not considered likely to incur a significant impact on this species. This species is unlikely to utilise habitat within the subject land.<br>This assessment has found the project is unlikely to:<br>• Lead to the long-term decrease in the population of this species.<br>• Reduce the area of occupancy of this species.<br>• Fragment an existing population into two or more populations.<br>• Adversely affect habitat critical to the survival of the species.<br>• Disrupt the breeding cycle of this species.<br>• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.<br>• Result in invasive species that are harmful to a vulnerable species becoming established in the species' habitat.<br>• Introduce disease that may cause the species to decline.<br>• Interfere with the recovery of the species. |

## Appendix 5.7. Sharp-tailed Sandpiper – Migratory

### Distribution

This species is a non-breeding migrant to Australia. It occurs throughout Australia with records across most areas excluding arid deserts, however the majority of the records for this species are situated within coastal areas. Globally this species occurs in China, South Korea, New Zealand, Indonesia, Papua New Guinea, Russia and the United States of America (Cwth DCCEEW 2024a).

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## Habitat requirements

Within Australia this species occupies and utilises muddy edges of shallow freshwater or brackish wetlands, with inundated or emergent aquatic vegetation. This includes a wide variety of habitat includes dams, swamps, lakes, waterholes, bore drains, flooded paddocks and salt pans (Cwth DCCEEW 2024a).

During the non-breeding season, most of the world population of Sharp-tailed Sandpipers occurs in Australia. After arriving in Australia, most birds move slowly south across the continent to south-east Australia, southern Australia (including Tasmania) and south-west Western Australia. Temporary influxes occur in northern-Australia, north-west Queensland, and the inland wetlands of arid and east Australia. This species is dispersive, moving to temporary or flooded wetlands and leaving them when they dry (Cwth DCCEEW 2024a).

## Survey observations

Surveys for this species were completed over two years of Bird Utilisation Surveys over summer, autumn, winter and spring seasons completed for the subject land by Nature Advisory. These surveys did not detect this species, despite periods of above average rainfall and flooding events increasing the quantity and availability of water within the subject land and surrounding landscape. This species has been recorded at Yanga Lake (approximately 6 kilometres north of the subject land), floodplains north-east of Balranald, and at Lake Poomah around 23 kilometres south of the subject land (NSW DCCEEW 2024).

**Table A 24 SIC assessment for Sharp-tailed Sandpiper - Migratory**

| SIC assessment for listed migratory species |
|---|
| **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.** |
| **No.** This species typically flies above RSA height, and is unlikely to utilise habitat within the subject land. The project is unlikely to incur major disturbance to local riparian areas within the subject land and will not incur a disturbance to the key wetland or riparian areas likely to be used by this species within the broader landscape between areas of key habitat such as the Wakool River and Yanga Lake, as such, it will not modify, destroy or isolate the availability or quality of important foraging habitat for this species. Alongside this the project is not anticipated to increase fragmentation within the population's distribution, as the species is not considered to fly at rotor-swept height given the proximity of potential habitat and the operation wind farm. The species is therefore not expected to be required to implement macro (wind farm) scale or meso (individual turbine) scale avoidance behaviour, which could result in the fragmentation of connectivity between more distant areas of important habitat for the species. Further detail assessment is provided in Sections 6 and 8.3.5. |
| **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.** |
| **No**. The subject land is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.** |
| **No.** This species does not breed within Australia, as such, the breeding cycle of this species would not be impacted. The project would not interfere with the availability of quality of feeding habitat for this species within Australia.<br>As noted in the survey observation above, this species was not recorded within the subject land. An assessment completed by Nature Advisory (Nature Advisory 2023e) reviewing waterbirds of the Riverina in relation to the Junction Rivers Wind Project noted this species is not considered likely to use habitat present within the subject land, and as such |

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| SIC assessment for listed migratory species |
|---|
| is not likely to incur impacts from the construction or operation of the wind farm. An ecologically significant proportion of the population of the species is not considered to occur within the subject land. Turbine strikes are not considered likely to occur at a regular rate or be a regular occurrence as this species typically flies well above RSA height, with a steep flight trajectory. However, a potential was identified for rare occurrence within the subject land where flocks may pass through during movements between areas of suitable foraging habitat. Therefore, detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species.<br>Local and nomadic flight paths were assessed for waterbird species to assist in turbine placement planning. All WTGs have been placed more than 400 metres from identified and mapped wetlands and wetland like habitat, including Condoulpe Lake and Harveys Lake. An analysis of multispectral imagery data, available satellite imagery and historic imagery was undertaken, this assessment determined it is unlikely that wetland habitat that may support this species would occur within 400 metres of any proposed turbine during seasonal/annual rainfall events (refer Section 9.1.2). In the event of a major flood, leading to wetland habitat within 400 metres of a proposed turbine, mitigation focussed on the affected turbine(s) would occur to allow analysis of the conditions against collision risk for this species. It is important to note that, the scenario, where curtailment of a turbine occurs due to mass expansion of wetland conditions within the subject land is considered to have the potential to occur only in very rare and limited circumstance. This mitigation has been included to ensure due diligence of all potential worst-case scenarios have been considered for migratory species. Detailed mitigation measures, and avoid/minimise steps outlined within this BDAR will be incorporated within the BBAMP, with detailed monitoring and triggers outlined for collision risk for the life of the project. |
| **Conclusion.** |
| The project is unlikely to significantly impact this species, turbine strikes are not considered likely to occur at a rate or regular occurrence as this species typically flies well above RSA height, with a steep flight trajectory. Detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species and minimise potential disruption of the species' lifecycle.<br>This assessment has found the project is unlikely to:<br>• Substantially modify, destroy or isolate an area of important habitat for a migratory species.<br>• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.<br>• Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species. |

# Appendix 5.8. Common Greenshank – Migratory

## Distribution

This species is a non-breeding migrant to Australia. It occurs throughout Australia with records occurring across most areas excluding arid deserts, however the majority of the records for this species are situated within coastal areas of Australia. Globally this species occurs in Europe, Africa, Asia, Melanesia and Australasia (Cwth DCCEEW 2024b).

## Habitat requirements

This species is a non-breeding migrant to Australia. Within Australia, this species occurs in all types of wetlands and has the largest distribution of any shorebird in Australia. Typical habitat includes inland wetlands, sheltered coastal habitat, large mudflats, saltmarsh, mangroves, embayment's, harbours, rivers and estuaries, deltas and lagoons, lakes, swamps, dams, creeks, billabongs and inundated floodplains, claypans and salt flats. Both permanent and ephemeral habitats are utilised for foraging and roosting. (Cwth DCCEEW 2024b)

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## Survey observations

Surveys for this species were completed over two years of Bird Utilisation Surveys over summer, autumn, winter and spring completed for the subject land by Nature Advisory. These surveys did not detect this species, despite periods of above average rainfall and flooding events increasing the quantity and availability of water within the subject land and surrounding landscape. This species has been recorded at Yanga Lake (approximately 6 kilometres north of the subject land), floodplains north-east of Balranald, at Lake Wollar around 25 kilometres south of the subject land, Lake Coomaroop around 25 kilometres south-west of the subject land and near the Merran Creek around 30 kilometres south-east of the subject land (NSW DCCEEW 2024).

**Table A 25 SIC assessment for Common Greenshank**

| SIC assessment for listed migratory species |
|---|
| **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.** |
| **No.** This species typically flies above RSA height, and is unlikely to utilise habitat within the subject land. The project is unlikely to involve major disturbance to local riparian areas within the subject land and will not incur a disturbance to the key riparian/wetland areas likely to be used by this species within the broader landscape between areas of key habitat such as the Wakool River and Yanga Lake, as such, it will not modify, destroy or isolate the availability or quality of important foraging habitat for this species. Alongside this the project is not anticipated to increase fragmentation within the population's distribution as the species is not considered to fly at rotor-swept height given the proximity of potential habitat and the operation wind farm. The species is therefore not expected to be required to implement macro (wind farm) scale or meso (individual turbine) scale avoidance behaviour, which could result in the fragmentation of connectivity, which could result in the fragmentation of connectivity between more distant areas of important habitat for the species. Further detail assessment is provided in Sections 6 and 8.3.5 |
| **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.** |
| **No**. The subject land is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.** |
| **No.** This species does not breed within Australia, as such, the breeding cycle of this species would not be impacted. The project would not interfere with the availability of quality of feeding habitat for this species within Australia.<br>As noted in the survey observation above, this species was not recorded within the subject land. An assessment completed by Nature Advisory (Nature Advisory 2023e) reviewing waterbirds of the Riverina in relation to the Junction Rivers Wind Project noted this species is not considered likely to use habitat present within the subject land, and as such is not likely to incur impacts from the construction or operation of the wind farm. An ecologically significant proportion of the population of the species is not considered to occur within the subject land. Turbine strikes are not considered likely to occur at a regular rate or be a regular occurrence as this species typically flies well above RSA height, with a steep flight trajectory. However, a potential was identified for rare occurrence within the subject land where flocks may pass through during movements between areas of suitable foraging habitat. Therefore, detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species.<br>Local and nomadic flight paths were assessed for waterbird species to assist in turbine placement planning. All WTGs have been placed more than 400 metres from identified and mapped wetlands and wetland like habitat, including Condoulpe Lake and Harveys Lake. An analysis of multispectral imagery data, available satellite imagery and historic |

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| SIC assessment for listed migratory species |
|---|
| imagery was undertaken, this assessment determined it is unlikely that wetland habitat that may support this species would occur within 400 metres of any proposed turbine during seasonal/annual rainfall events (refer Section 9.1.2). In the event of a major flood, leading to wetland habitat within 400 metres of a proposed turbine, mitigation focussed on the affected turbine(s) would occur to allow analysis of the conditions against collision risk for this species. It is important to note that, the scenario, where curtailment of a turbine occurs due to mass expansion of wetland conditions within the subject land is considered to have the potential to occur only in very rare and limited circumstance. This mitigation has been included to ensure due diligence of all potential worst-case scenarios have been considered for migratory species. Detailed mitigation measures, and avoid/minimise steps outlined within this BDAR will be incorporated within the BBAMP, with detailed monitoring and triggers outlined for collision risk for the life of the project. |
| **Conclusion.** |
| The project is unlikely to significantly impact this species, turbine strikes are not considered likely to occur at a rate or regular occurrence as this species typically flies well above RSA height, with a steep flight trajectory. Detailed mitigation and adaptive management measures have been committed to as part of the project to reduce the potential collision risk for this species and minimise potential disruption of the species' lifecycle.<br>This assessment has found the project is unlikely to:<br>• Substantially modify, destroy or isolate an area of important habitat for a migratory species.<br>• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.<br>• Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species. |

## Appendix 5.9. Gull-billed Tern – Migratory

### Distribution

This species occurs throughout Australia with records occurring across most areas excluding arid deserts (ALA 2024). Globally this species occurs on all continents excluding Antarctica (Birdlife Australia 2024).

### Habitat requirements

Within Australia this species utilises freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodplains, sewage farms, irrigated crops and flooded grasslands (Birdlife Australia 2024). This species breeds within Australia, typically between September – May, forming large colonies to breed on islets in temporary lakes and saltmarshes of interior Australia and drier coastal regions. Nests are formed on sand ridges and mud banks as shallow depressions scraped in the ground lined with minimal vegetation (Morcombe 2002).

### Survey observations

Surveys for this species were completed over two years of Bird Utilisation Surveys over summer, autumn, winter and spring completed for the subject land by Nature Advisory. These surveys did not detect this species, despite periods of above average rainfall and flooding events increasing the quantity and availability of water within the subject land and surrounding landscape. Extensive records of this species are located north-east of Balranald within areas of floodplain. Records are located at Yanga Lake approximately 6 kilometres north of the subject land, and Lake Poon Boon located around 20 kilometres south of the subject land (NSW DCCEEW 2024b).

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**Table A 26 SIC assessment for Gull-billed Tern**

| SIC assessment for listed migratory species |
|---|
| **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.** |
| **No.** The project is unlikely to incur major disturbance to local riparian areas within the subject land and will not involve a disturbance to the key riparian/wetland areas likely to be used by this species within the broader landscape between areas of key habitat such as the Wakool River and Yanga Lake, as such, it will not substantially modify or destroy the availability or quality of important foraging habitat for this species.<br>The proportion of flights made at RSA heights is unknown, however, known flight behaviour suggests that the species may spend a considerable proportion of flights at RSA height. Therefore the project has some potential to increase fragmentation via macro (wind farm) scale or meso (individual turbine) scale avoidance behaviour, which could impact connectivity or the require the use of additional resources to avoid the project area when travelling between areas of habitat. It cannot be said however that the project would be likely to isolate an area of important habitat, such as wetlands along the Murray / Edward / Wakool Rivers or the Lowbidgee floodplain, as movements around (and even through) the wind farm will not be prevented. Further detail assessment is provided in Sections 6 and 8.3.5. |
| **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.** |
| **No**. The subject land is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.** |
| **No.** An assessment made by Nature Advisory for this species in relation to the project (Nature Advisory 2023e) determined this species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. The proportion of flights made at RSA heights is unknown, however, known flight behaviour suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat within or adjacent to the subject land near turbines could pose a risk to these species, as they may fly at RSA height in this context.<br>Gull-billed Tern is considered a common, widespread and secure species, that has a distribution that extend beyond Australia and cover large portion of the world. Although the population trend of the Gull-billed Tern is unknown, it is not thought to be decreasing at a concerning rate (Nature Advisory 2023e). For the project to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the species, impacts would have to occur to a very large number of birds, over a long and consistent period. This is highly unlikely to occur, based on the species not being recorded during two years of survey, and the ephemeral nature of the habitats that may on occasion bring larger numbers of birds into close proximity to the operational wind farm.<br>Local and nomadic flight paths were assessed for waterbird species to assist in turbine placement planning. All WTGs have been placed more than 400 metres from identified and mapped wetlands and wetland like habitat, including Condoulpe Lake and Harveys Lake. An analysis of multispectral imagery data, available satellite imagery and historic imagery was undertaken, this assessment determined it is unlikely that wetland habitat that may support this species would occur within 400 metres of any proposed turbine during seasonal/annual rainfall events (refer Section 9.1.2). In the event of a major flood, leading to wetland habitat within 400 metres of a proposed turbine, mitigation focussed on the affected turbine(s) would occur to allow analysis of the conditions against collision risk for this species. It is important to note that, the scenario, where curtailment of a turbine occurs due to mass expansion of wetland conditions within the subject land is considered to have the potential to occur only in very rare and limited circumstance. This mitigation has been included to ensure due diligence of all potential worst-case scenarios have been considered for migratory species. Detailed mitigation measures, and avoid/minimise steps outlined within this BDAR will be incorporated within the |

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| SIC assessment for listed migratory species |
| --- |
| BBAMP, with detailed monitoring and triggers outlined for collision risk for the life of the project. |
| **Conclusion.** |
| The project is unlikely to significantly impact this species, as the project is unlikely to:<br>• Substantially modify, destroy or isolate an area of important habitat for a migratory species.<br>• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.<br>• Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species. |

# Appendix 5.10. Caspian Tern – Migratory

## Distribution

Within Australia, the Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat, with breeding occurring in all states to some degree. Globally this species is found in North America, Africa and Eurasia (Cwth DCCEEW 2024a).

## Habitat requirements

Within Australia, this species occurs in sheltered coastal embayments including harbours, lagoons, inlets, bays, estuaries and river deltas, areas with muddy or sandy margins are preferred. This species also occurs on near-coastal and inland terrestrial wetlands. Artificial wetlands are also used, including reservoirs, sewage ponds and saltworks (Cwth DCCEEW 2024a)..

This species breeds in Australia, utilising low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky inlets. Nests are constructed in the open, or in low sparse vegetation consisting of a scraped hollow in the ground lined with vegetation, small stones, feathers or shells (Cwth DCCEEW 2024a).

## Survey observations

Surveys for this species were completed over two years of Bird Utilisation Surveys over summer, autumn, winter and spring completed for the subject land by Nature Advisory. These surveys did not detect this species, despite periods of above average rainfall and flooding events increasing the quantity and availability of water within the subject land and surrounding landscape. This species has been recorded north-west, north and north-east of Balranald in lakes, including Yanga Lake, floodplain areas and terrestrial wetland habitat. South of the subject land, this species has been recorded at Lake Poon Boon, Lake Poomah and Lake Wollare around 20-25 kilometres from the subject land.

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**Table A 27 SIC assessment for Caspian Tern**

| SIC assessment for listed migratory species |
|---|
| **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.** |
| **No.** The project is unlikely to involve major disturbance to local riparian/wetland areas within the subject land and will not incur a disturbance to the key riparian areas likely to be used by this species within the broader landscape between areas of key habitat such as the Wakool River and Yanga Lake, as such, it will not substantially modify or destroy the availability or quality of important foraging habitat for this species.<br>The proportion of flights made at RSA heights is unknown, however, known flight behaviour suggests that the species may spend a considerable proportion of flights at RSA height. Therefore the project has some potential to increase fragmentation via macro (wind farm) scale or meso (individual turbine) scale avoidance behaviour, which could impact connectivity or the require the use of additional resources to avoid the project area when travelling between areas of habitat. It cannot be said however that the project would be likely to isolate an area of important habitat, such as wetlands along the Murray / Edward / Wakool Rivers or the Lowbidgee floodplain, as movements around (and even through) the wind farm will not be prevented. Further detail assessment is provided in Sections 6 and 8.3.5. |
| **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.** |
| **No**. The subject land is already located within a highly modified environmental, dominated in land used for cropping agricultural activities. As a part of the construction and operation management of the project a Weed and Pest Management Plan will be implemented to prevent spread of invasive species. |
| **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.** |
| **No.** An assessment made by Nature Advisory for this species in relation to the project (Nature Advisory 2023e) determined this species considered nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters. The proportion of flights made at RSA heights is unknown, however, known flight behaviour suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat within or adjacent to the subject land near turbines could pose a risk to these species, as they may fly at RSA height in this context.<br>Caspian Tern is considered a common, widespread and secure species, that has a distribution that extend beyond Australia and cover large portion of the world, and is thought to be increasing globally (Nature Advisory 2023e). For the project to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the species, impacts would have to occur to a very large number of birds, over a long and consistent period. This is highly unlikely to occur, based on the species not being recorded during two years of survey, and the ephemeral nature of the habitats that may on occasion bring larger numbers of birds into close proximity to the operational wind farm.<br>Local and nomadic flight paths were assessed for waterbird species to assist in turbine placement planning. All WTGs have been placed more than 400 metres from identified and mapped wetlands and wetland like habitat, including Condoulpe Lake and Harveys Lake. An analysis of multispectral imagery data, available satellite imagery and historic imagery was undertaken, this assessment determined it is unlikely that wetland habitat that may support this species would occur within 400 metres of any proposed turbine during seasonal/annual rainfall events (refer Section 9.1.2). In the event of a major flood, leading to wetland habitat within 400 metres of a proposed turbine, mitigation focussed on the affected turbine(s) would occur to allow analysis of the conditions against collision risk for this species. It is important to note that, the scenario, where curtailment of a turbine occurs due to mass expansion of wetland conditions within the subject land is considered to have the potential to occur only in very rare and limited circumstance. This mitigation has been included to ensure due diligence of all potential worst-case scenarios have been considered for migratory species. Detailed mitigation measures, and avoid/minimise steps outlined within this BDAR will be incorporated within the BBAMP, with detailed monitoring and triggers outlined for collision risk for the life of the project. |

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| SIC assessment for listed migratory species |
| --- |
| **Conclusion.** |
| The project is unlikely to significantly impact this species, as the project is unlikely to:<br>• Substantially modify, destroy or isolate an area of important habitat for a migratory species.<br>• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.<br>• Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species. |

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# Appendix 6. Assessment of impacts to planted native vegetation

Where only part of the subject land contains planted native vegetation, the streamlined assessment module provided in Appendix D of the BAM may be used to assess that part of the development, activity, clearing or biodiversity certification proposal.

Vegetation within the central area of the subject land, and along the Sturt Highway within the town of Balranald (potential impacts to one or two trees only) is considered to be 'planted native vegetation' in accordance with Appendix D of the BAM (Figure 6). Following implementation of D.1 – Decision-making key (outlined in the table below), an assessment of the habitat values this vegetation provides to threatened species was undertaken in accordance with D.2 – Assessment of planted native vegetation for threatened species habitat.

The planted native vegetation within the subject lands comprises *Eucalyptus costata* and *E. dumosa* native indigenous mallee trees and native vegetation in Balranald comprises native non-indigenous Eucalypts *Eucalyptus* sp.



**Photo 1 Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing north.**

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**Photo 2** **Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing south.**



**Photo 3** **Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing south-west.**

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**Photo 4** **Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing north-east.**




**Photo 5** **Planted native indigenous mallee trees within the subject land facing west (note tree guards).**

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**Photo 6** **Planted native indigenous mallee trees within the subject land facing south.**




**Photo 7** **Planted native indigenous mallee trees within the subject land facing north-west (note tree guards).**

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**Photo 8** **Planted native indigenous mallee trees within the subject land facing west (note tree guards).**

Assessment of the planted native vegetation within the subject land in accordance with Appendix D of the BAM is provided in Table A 28 below.

**Table A 28 Planted native vegetation – BAM streamlined assessment D.1**

| Decision Key | | |
|---|---|---|
| **1. Does the planted native vegetation occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal?** | | **Planted native non-indigenous Eucalypts:** No. The planted native vegetation occurs as a single row of vegetation, not as part of a mosaic of planted and remnant native vegetation - Go to question 2<br>**Planted native indigenous mallee trees:** Yes. The planted native vegetation is not part of a mosaic of planted and remnant vegetation. Go to question 2 |
| **2. Is the planted native vegetation:** | a. planted for the purpose of environmental rehabilitation or restoration under an existing conservation obligation listed in BAM Section 11.9(2.), and | **Planted native non-indigenous Eucalypts:** No |
| | b. the primary objective was to replace or regenerate a plant community type or a threatened plant | **Planted native non-indigenous Eucalypts:** No – Go to 3 |

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| Decision Key | | |
|---|---|---|
| | species population or its habitat? | |
| **3. Is the planted/translocated native vegetation individuals of a threatened species or other native species planted/translocated for the purpose of providing threatened species habitat under one of the following:**<br>• **a. a species recovery project**<br>• **b. Saving our Species project**<br>• **c. other types of government funded restoration project**<br>• **d. condition of consent for a development approval that required those species to be planted or translocated for the purpose of providing threatened species habitat**<br>• **e. legal obligation as part of a condition or ruling of court. This includes regulatory directed or ordered remedial plantings (e.g. Remediation Order for clearing without consent issued under the BC Act or the Native Vegetation Act)**<br>• **f. ecological rehabilitation to re-establish a PCT or TEC that was, or is carried out under a mine operations plan, or**<br>• **g. approved vegetation management plan (e.g. as required as part of a Controlled Activity Approval for works on waterfront land under the NSW Water Management Act 2000)?** | | **Planted native non-indigenous Eucalypts:** No – Go to 4 |
| **4. Was the planted native vegetation (including individuals of a threatened flora species) undertaken voluntarily for revegetation, environmental rehabilitation or restoration without a legal obligation to secure or provide for management of the native vegetation?** | | **Planted native non-indigenous Eucalypts:** No – Go to 5 |
| **5. Is the native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, horticultural or plantation forestry purposes? This includes examples such as: windbreaks in agricultural landscapes, roadside plantings (including street trees, median strips, roadside batters), landscaping in parks, gardens and sport fields/complexes, macadamia plantations or tea tree farms?** | | **Planted native non-indigenous Eucalypts:** Yes – The vegetation was likely planted as street tree roadside plantings. The vegetation must be assessed in accordance with D2- Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied). |
| **6. Is the planted native vegetation a species listed as a widely cultivated native species on a list approved by the Secretary of the Department (or an officer authorised by the Secretary)?** | | N/A |

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**Planted native indigenous mallee trees**

In accordance with section D.1 (of Appendix D of the BAM), If the planted native vegetation occurs in an isolated patch and not within a mosaic with existing native vegetation, an evidence-based justification must be provided for this in the BDAR.

The planted patch of native indigenous mallee trees occur within the subject land as an isolated patch (centre of photo) (Photo 9). The vegetation within a PCT closest to the mallee trees is a patch of PCT 58 Black Oak - Western Rosewood open woodland which does not comprise mallee trees as a major or minor component.



**Photo 9 Aerial imagery of planted native indigenous mallee trees within the subject land.**

These mallee trees were identified in-field as Ridge-fruited Mallee *Eucalyptus costata* and White Mallee *E. Dumosa*. The only PCTs with Ridge-fruited Mallee and *E. dumosa* as a component found within the same IBRA Subregion as these mallee trees (South Olary Plain) is PCT 171 Spinifex linear dune mallee and PCT 172 Deep sand mallee. However, these two PCTs occur west and north of the subject land and not within the local region. Aerial imagery from 1997 only displays the two larger mallee trees and aerial imagery from 1990 does not display these mallee trees as being present confirming these trees were planted (after 1990 and 1997) (Photo 10 & Photo 11).

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**Photo 10** **1997 aerial imagery of planted native indigenous mallee tree area within the subject land (only two trees present at this time) (NSW Government 2023).**

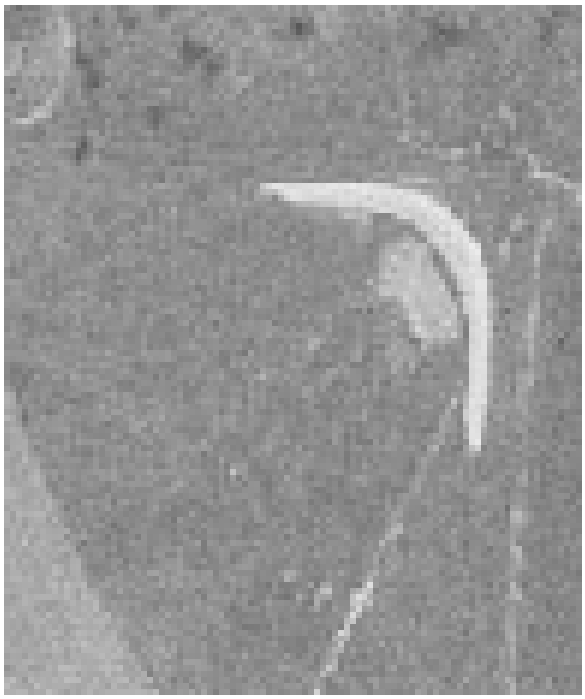


**Photo 11** **1990 aerial imagery of planted native indigenous mallee tree area within the subject land (no trees present at this time) (NSW Government 2023).**

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**Planted native non-indigenous Eucalypts**

In accordance with Section D.2 (of Appendix D of the BAM), the assessor must assess the suitability of the planted native vegetation (in this case only the planted native non-indigenous Eucalypts) for use by threatened species and record any incidental sightings or evidence (e.g. scats, stick nests) of threatened species credit species using, inhabiting or being part of the planted native vegetation:

- Survey effort within areas of planted native vegetation included specific assessment of the vegetation alongside the Sturt Highway. Flora species presence and composition was noted as was the presence of habitat features such as tree hollows, woody debris, nest box, evidence of soil/ground disturbance, or other habitat features that could possibly support threatened species.
- Habitat features were found to be highly limited due to the location of the trees and the generally high level of disturbance associated with the surrounding urban/town landscape, subject to high levels of edge effects.
- No evidence of potential use by threatened species was recorded.
- Threatened species present in the locality that could potentially utilise the marginal habitat provided by the planted native vegetation include highly mobile aerial species that could potentially utilise the larger trees and the blossom they provide during foraging activities across their larger home ranges. Any impacts to threatened species associated with the removal of this planted native vegetation is considered negligible.

The areas of planted native vegetation have not been excluded from the assessment of indirect impacts (Section 8.2), prescribed impacts (Section 8.3), and mitigation measures included in Section 9 are relevant to minimising impacts to biodiversity values related to the planted native vegetation.

No impacts considered potentially Serious and Irreversible Impacts are relevant to the planted native vegetation.

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# Appendix 7. Streamlined assessment module – Scattered trees assessment

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**Requirements for application of Streamlined assessment module – Scattered trees assessment**

As outlined in Appendix B of the BAM (DPIE 2020a) - an assessment of the impact of clearing scattered trees can be made using this module where:

- The impacts of clearing or development proposals are for vegetation that meets the definition of scattered trees, and
- The scattered tree is not a threatened species itself nor does it have any record of candidate species credit species (flora or fauna) incidentally using it, and
- The impact is unlikely to be serious or irreversible.

As only part of the subject land contains scattered trees, this module has been used to assess only the impacts associated with the portion of the project impacting upon scattered trees.

Scattered trees are defined under the BAM if the trees meet any of the three definitions provided in Appendix B. The definition relevant to the current assessment is as follows:

- Scattered trees are defined as species listed in the tree growth form group that have a percent foliage cover that is less than 25% of the benchmark for tree cover for the most likely plant community type and occur on Category 2-regulated land and are surrounded by Category 1-exempt land.

Table A 29 below provides information on the tree cover benchmarks for the PCTs relevant to this assessment.

**Table A 29 Tree cover benchmark data for relevant PCTs**

| PCT | Tree cover benchmark value | 25% of benchmark value | Min. $m^2$ cover of 400 $m^2$ plot (assuming 100% PFC) |
|---|---|---|---|
| **PCT 16 – Black Box grassy open woodland wetland of rarely flooded depressions** | 128 % | 32 % | 128 $m^2$ |
| **PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises** | 5 % | 1.25 % | 5 $m^2$ |
| **PCT 23 – Yarran tall open shrubland on sandplains and plains** | 5 % | 1.25 % | 5 $m^2$ |
| **PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams** | 20 % | 5 % | 20 $m^2$ |
| **PCT 170 – Chenopod sandplain mallee woodland/shrubland** | 53 % | 13.25 % | 53 $m^2$ |

As outlined in Table A 29 above, for a tree to meet the cover value requirement to be assessed under the scattered tree module, each tree would need to support a cover value of between 1.25 % and 32 % of a standard 20 metre x 20 metre floristic plot. Assuming 100 % Projected Foliage Cover (PFC), this would equate to a canopy area of between 5 square meters and 128 square meters depending on the species and the PCT.

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All trees recorded as scattered paddock trees are considered to meet the above requirements, based on none of the PFCs being 100%, and likely closer to a maximum of 50% for individual trees, leading to all trees meeting the requirements.

Furthermore, all trees mapped as scattered paddock trees occur on Category 2-regulated land and are surrounded by Category 1-exempt land.

**Map the scattered tree vegetation zone and determine the assessment class**

The follow data collection steps must be undertaken to map the scattered tree vegetation zone and determine the assessment class of each tree:

- Map scattered trees proposed to be removed by the project.
- Identify the genus and species of each tree.
- Assign each tree into one of the following classes:
  - Class 1: trees that are <20 cm DBH and without hollows.
  - Class 2: trees that are ≥20 cm DBH and less than the large tree benchmark for the most likely plant community type, or trees that are <20 cm DBH that contain at least one hollow.
  - Class 3: trees that are greater than or equal to the large tree benchmark for the most likely plant community type.
- Record any sightings (e.g. in hollows) or evidence (e.g. scats) of threatened species (flora or fauna) using the scattered trees.

Table A 30 provides a list of the scattered trees recorded within the subject land and likely to be impacted by the project.

Scattered trees were recorded on-ground using handheld uncorrected GPS devices, and as such to account for potential GPS error, a 10 metre buffer was applied to the development footprint when selecting scattered trees considered impacted by the project.

Furthermore, a number of trees (or clusters of trees) were found not to meet the requirements for mapping as scattered trees when on-ground assessment was completed. This was largely due to trees being present in groups/clusters that comprised a combined cover value too high to be considered as a scattered tree defined by the BAM. This resulted in a number of small clusters being mapped as the 'Paddock Tree' vegetation zones, as outlined in Section 3.3 above.

Mapped scattered trees are illustrated on Figure 23.

**Table A 30 Mapped scattered trees likely to be impacted by the project**

| Tree ID | Species | Class | Number of hollows |
|---|---|---|---|
| **1** | *Casuarina pauper* | 3 | 0 |
| **2** | *Casuarina pauper* | 3 | 1 |
| **3** | *Casuarina pauper* | 3 | 1 |
| **4** | *Casuarina pauper* | 3 | 0 |
| **5** | *Casuarina pauper* | 3 | 2 |

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| Tree ID | Species | Class | Number of hollows |
|---|---|---|---|
| **6** | *Eucalyptus dumosa* | 3 | 1 |
| **7** | *Acacia melvillei* | 3 | 0 |
| **8** | *Casuarina pauper* | 3 | 3 |
| **9** | *Eucalyptus largiflorens* | 3 | 1 |
| **10** | *Eucalyptus largiflorens* | 2 | 2 |
| **11** | *Casuarina pauper* | 3 | 3 |
| **12** | *Casuarina pauper* | 3 | 2 |
| **13** | *Callitris gracilis* | 3 | 1 |
| **14** | *Eucalyptus socialis* | 2 | 0 |
| **15** | *Alectryon oleifolius* | 3 | 1 |
| **16** | *Acacia melvillei* | 3 | 1 |
| **17** | *Eucalyptus dumosa* | 3 | 1 |
| **18** | *Eucalyptus largiflorens* | 2 | 1 |
| **19** | *Alectryon oleifolius* | 3 | 1 |
| **20** | *Eucalyptus largiflorens* | 3 | 1 |
| **21** | *Eucalyptus largiflorens* | 3 | 2 |
| **22** | *Alectryon oleifolius* | 3 | 1 |
| **23** | *Alectryon oleifolius* | 3 | 1 |
| **24** | *Alectryon oleifolius* | 3 | 0 |
| **25** | *Alectryon oleifolius* | 3 | 1 |
| **26** | *Alectryon oleifolius* | 3 | 0 |
| **27** | *Casuarina pauper* | 3 | 4 |
| **28** | *Alectryon oleifolius* | 3 | 3 |
| **29** | *Callitris gracilis* | 3 | 1 |
| **30** | *Callitris gracilis* | 3 | 1 |
| **31** | *Callitris gracilis* | 3 | 2 |
| **32** | *Callitris gracilis* | 3 | 1 |
| **33** | *Alectryon oleifolius* | 3 | 1 |
| **34** | *Callitris gracilis* | 3 | 3 |
| **35** | *Callitris gracilis* | 3 | 3 |
| **36** | *Callitris gracilis* | 3 | 1 |

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| Tree ID | Species | Class | Number of hollows |
|---|---|---|---|
| **37** | *Alectryon oleifolius* | 3 | 0 |
| **38** | *Alectryon oleifolius* | 3 | 1 |
| **39** | *Casuarina pauper* | 3 | 1 |
| **40** | *Eucalyptus oleosa* subsp. *oleosa* | 2 | 0 |
| **41** | *Alectryon oleifolius* | 3 | 0 |
| **42** | *Alectryon oleifolius* | 3 | 1 |
| **43** | *Callitris gracilis* | 3 | 1 |
| **44** | *Alectryon oleifolius* | 3 | 1 |
| **45** | *Alectryon oleifolius* | 3 | 1 |
| **46** | *Callitris gracilis* | 3 | 3 |
| **47** | *Callitris gracilis* | 3 | 3 |
| **48** | *Alectryon oleifolius* | 3 | 1 |
| **49** | *Alectryon oleifolius* | 3 | 1 |
| **50** | *Eucalyptus largiflorens* | 3 | 1 |
| **51** | *Alectryon oleifolius* | 1 | 0 |
| **52** | *Casuarina pauper* | 3 | 0 |
| **53** | *Alectryon oleifolius* | 3 | 0 |
| **54** | *Alectryon oleifolius* | 1 | 0 |
| **55** | *Casuarina pauper* | 3 | 1 |
| **56** | *Callitris gracilis* | 3 | 2 |
| **57** | *Alectryon oleifolius* | 3 | 0 |
| **58** | *Eucalyptus dumosa* | 2 | 0 |
| **59** | *Eucalyptus largiflorens* | 2 | 1 |
| **60** | *Eucalyptus dumosa* | 3 | 4 |
| **61** | *Casuarina pauper* | 3 | 1 |
| **62** | *Eucalyptus dumosa* | 2 | 1 |
| **63** | *Callitris gracilis* | 3 | 1 |
| **64** | *Alectryon oleifolius* | 3 | 1 |
| **65** | *Acacia melvillei* | 1 | 0 |
| **66** | *Alectryon oleifolius* | 2 | 0 |
| **67** | *Alectryon oleifolius* | 3 | 0 |

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| Tree ID | Species | Class | Number of hollows |
|---|---|---|---|
| **68** | *Casuarina pauper* | 3 | 0 |
| **69** | *Acacia melvillei* | 1 | 0 |
| **70** | *Callitris gracilis* | 3 | 1 |
| **71** | *Casuarina pauper* | 1 | 0 |
| **72** | *Casuarina pauper* | 1 | 0 |
| **73** | *Alectryon oleifolius* | 2 | 1 |
| **74** | *Alectryon oleifolius* | 3 | 0 |
| **75** | *Alectryon oleifolius* | 2 | 1 |
| **76** | *Eucalyptus dumosa* | 2 | 0 |
| **77** | *Acacia melvillei* | 1 | 0 |

Table A 31 provides a summary of the numbers and classes of scattered trees likely to be impacted by the project. As outlined in Section B.3 of the BAM, no further assessment is required for Class 1 scattered trees, as they are considered to support negligible biodiversity value.

**Table A 31 Mapped scattered trees likely to be impacted by the project**

| Class | No. trees impacted |
|---|---|
| **1** | 7 |
| **2** | 11 |
| **3** | 59 |

### Assessment of entities at risk of a serious or irreversible impact

The BAM requires the identification of all species at risk of a SAII that would be impacted on by the proposed clearing of the scattered trees.

No such entities exist as part of the current assessment.

### Determine the offset requirements

Table A 32 provides the project's offset associated with the proposed clearing of scattered trees, as calculated in accordance with Section B5 of the BAM. The offset requirement is also presented as a BAM Credit Summary Report provided below.

The BAM Calculator case number for the scattered tree assessment is 00044469/BAAS18138/23/00044470. Credit reports are provided in Section 11.

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**Table A 32 Offset credit calculations for impacted scattered trees**

| PCT | Class | Contains hollows | No. of trees | Credit required |
|---|---|---|---|---|
| **PCT 16 - Black Box grassy open woodland wetland of rarely flooded depressions** | 3 | Yes | 4 | 4 |
| | 2 | Yes | 3 | 2 |
| **PCT 21 - Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises** | 3 | Yes | 14 | 14 |
| **PCT 23 - Yarran tall open shrubland on sandplains and plains** | 3 | Yes | 1 | 1 |
| | 3 | No | 1 | 1 |
| **PCT 58 - Black Oak - Western Rosewood open woodland on deep sandy loams** | 3 | Yes | 24 | 24 |
| | 3 | No | 12 | 9 |
| | 2 | Yes | 2 | 2 |
| | 2 | No | 1 | 1 |
| **PCT 170 - Chenopod sandplain mallee woodland/shrubland** | 3 | Yes | 3 | 3 |
| | 2 | Yes | 2 | 2 |
| | 2 | No | 3 | 3 |
| **Totals** | | | **66** | |

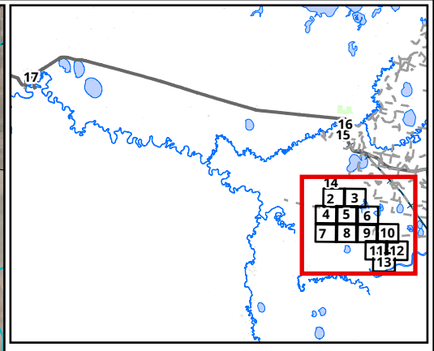
## Threatened ecological communities

Vegetation within the subject land was found to represent two TECs listed under the NSW BC Act, both of which can occur as single trees. As such trees representing PCT 21 and PCT 23 are considered to represent their associated TECs. Further information is provided in Table A 33 below.

**Table A 33 Summary of BC Act TECs represented as scattered trees**

| BC Act TEC | Listing status | PCT | Impacts |
|---|---|---|---|
| ***Acacia melvillei* Shrubland in the Riverina and Murray-Darling Depression bioregions** | Endangered | PCT 23 - Yarran tall open shrubland on sandplains and plains | • 5 scattered paddock trees |
| **Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions** | Endangered | PCT 21 - Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises | • 14 scattered paddock trees |

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**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia homalophylla*
- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus gracilis*
- *Eucalyptus largiflorens*
- *Eucalyptus socialis*
- Other

**Paddock Trees - To be removed**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*
- *Eucalyptus oleosa* subsp. *oleosa*
- *Eucalyptus socialis*
- Other

**Figure 23.1 Scattered trees mapped within the subject land**

0 1,000 2,000 3,000 4,000 N

Meters

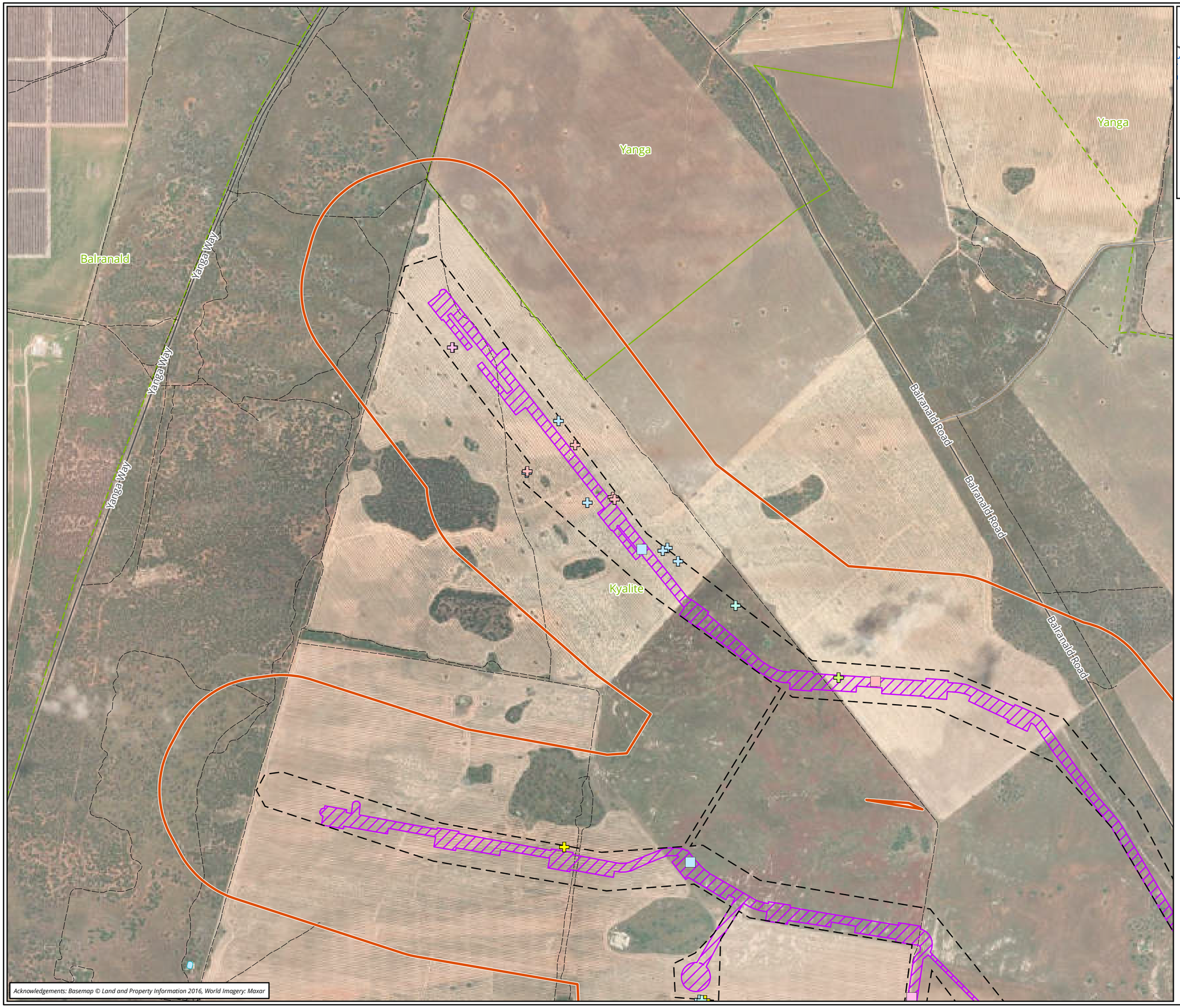
Scale: 1:80,000 @ A3

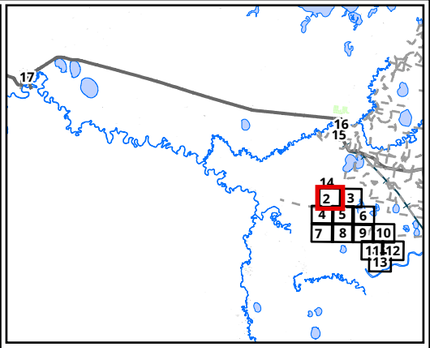
*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics*




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Casuarina pauper*

**Figure 23.2 Scattered trees mapped within the subject land**

0 230 460 690 920 N

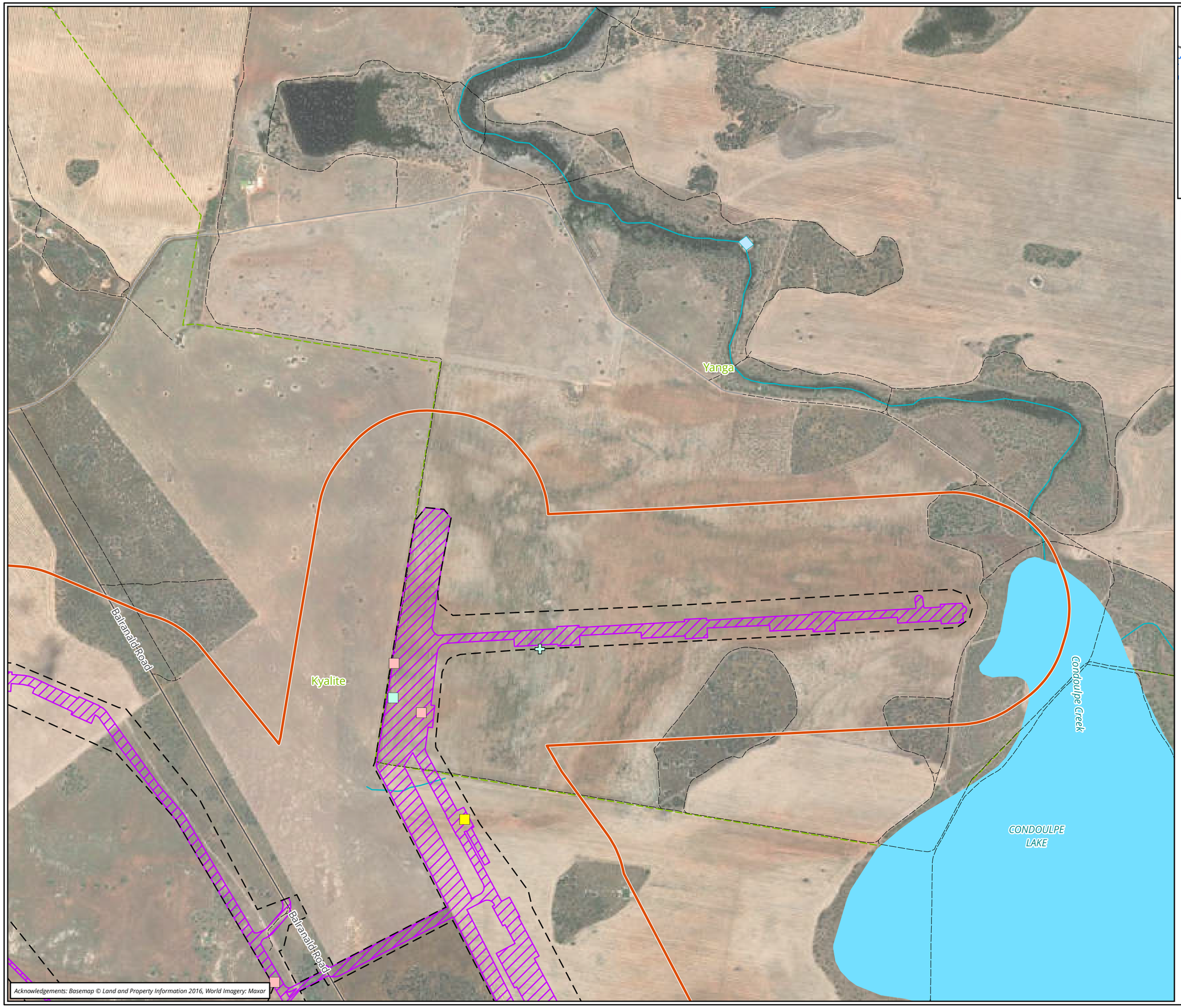
Meters

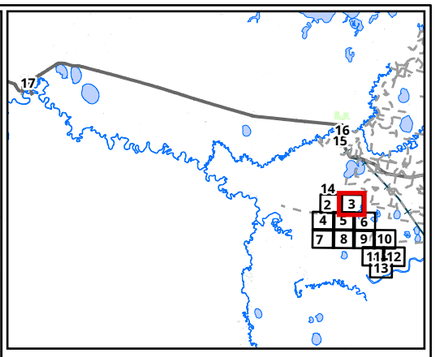
Scale: 1:18,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Eucalyptus largiflorens*

**Paddock Trees - To be removed**

- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus largiflorens*

**Figure 23.3 Scattered trees mapped within the subject land**

0 230 460 690 920

Meters

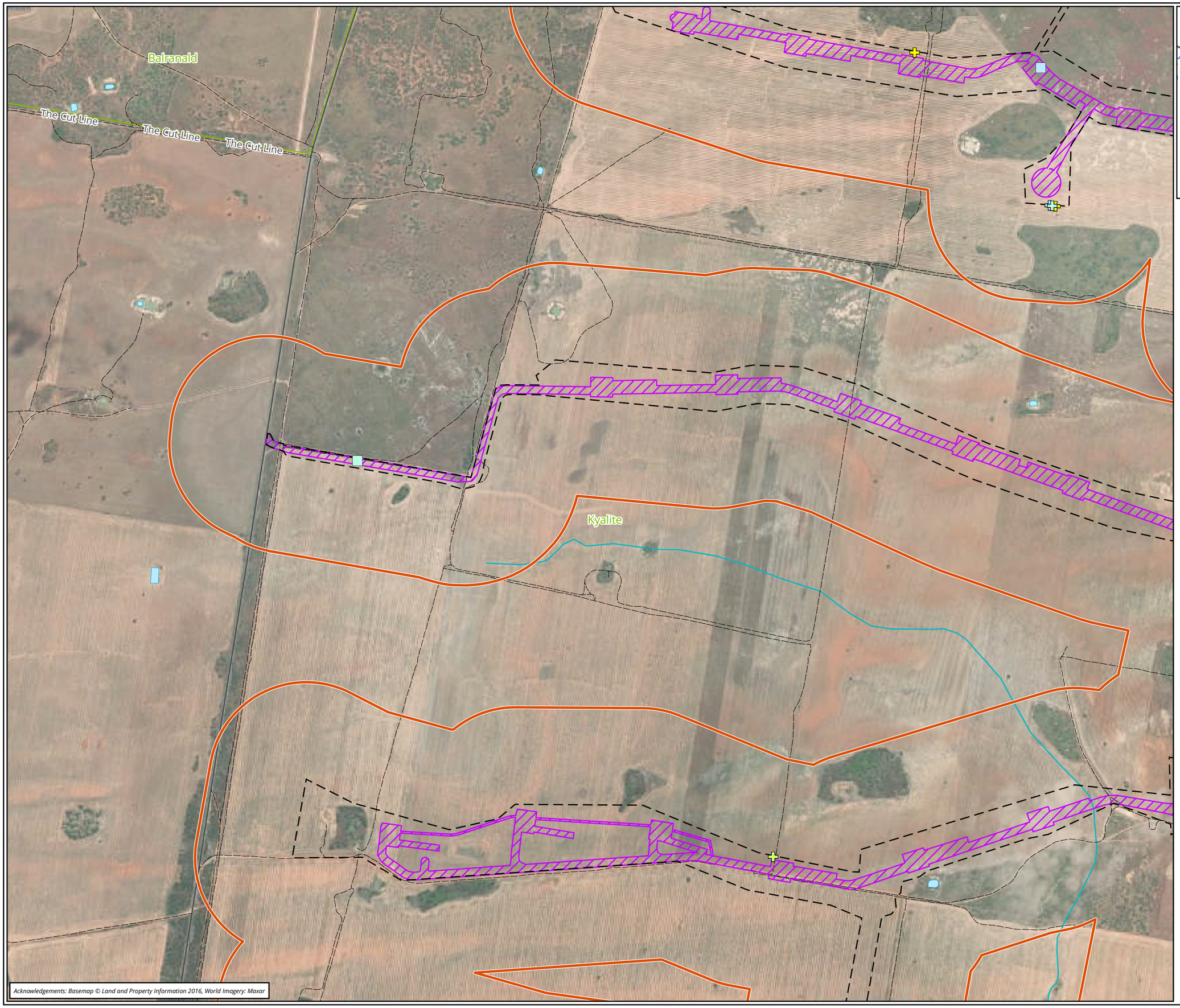
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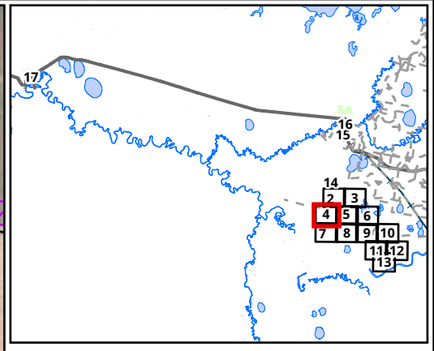
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Alectryon oleifolius*
- *Eucalyptus largiflorens*

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 23.4 Scattered trees mapped within the subject land**

0 230 460 690 920

Meters

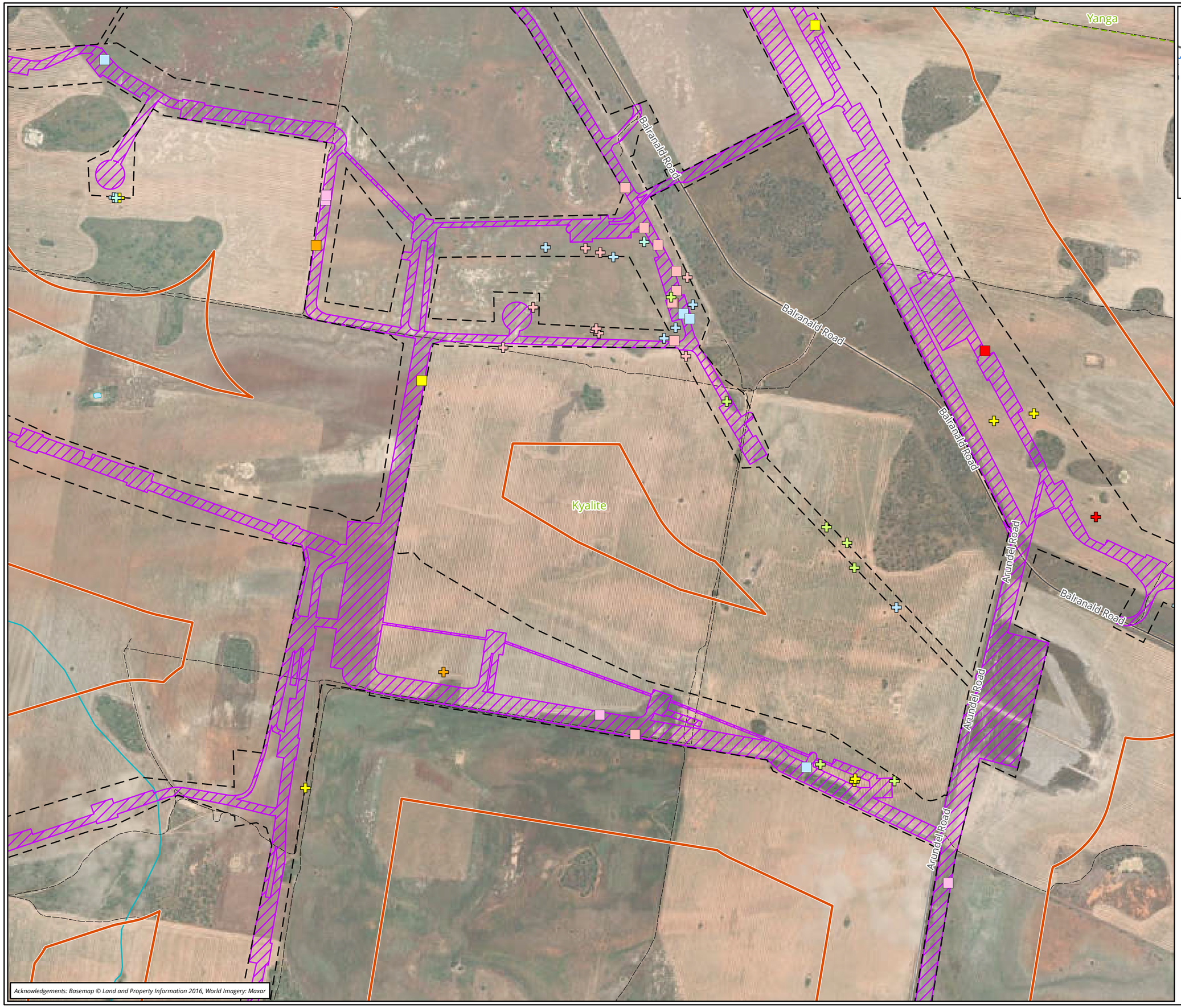
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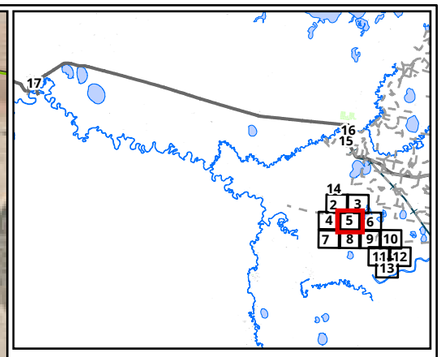
*Coordinate System: GDA2020 MGA Zone 54*

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biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*
- *Eucalyptus socialis*
- Other

**Paddock Trees - To be removed**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus socialis*

**Figure 23.5 Scattered trees mapped within the subject land**

0 230 460 690 920 N

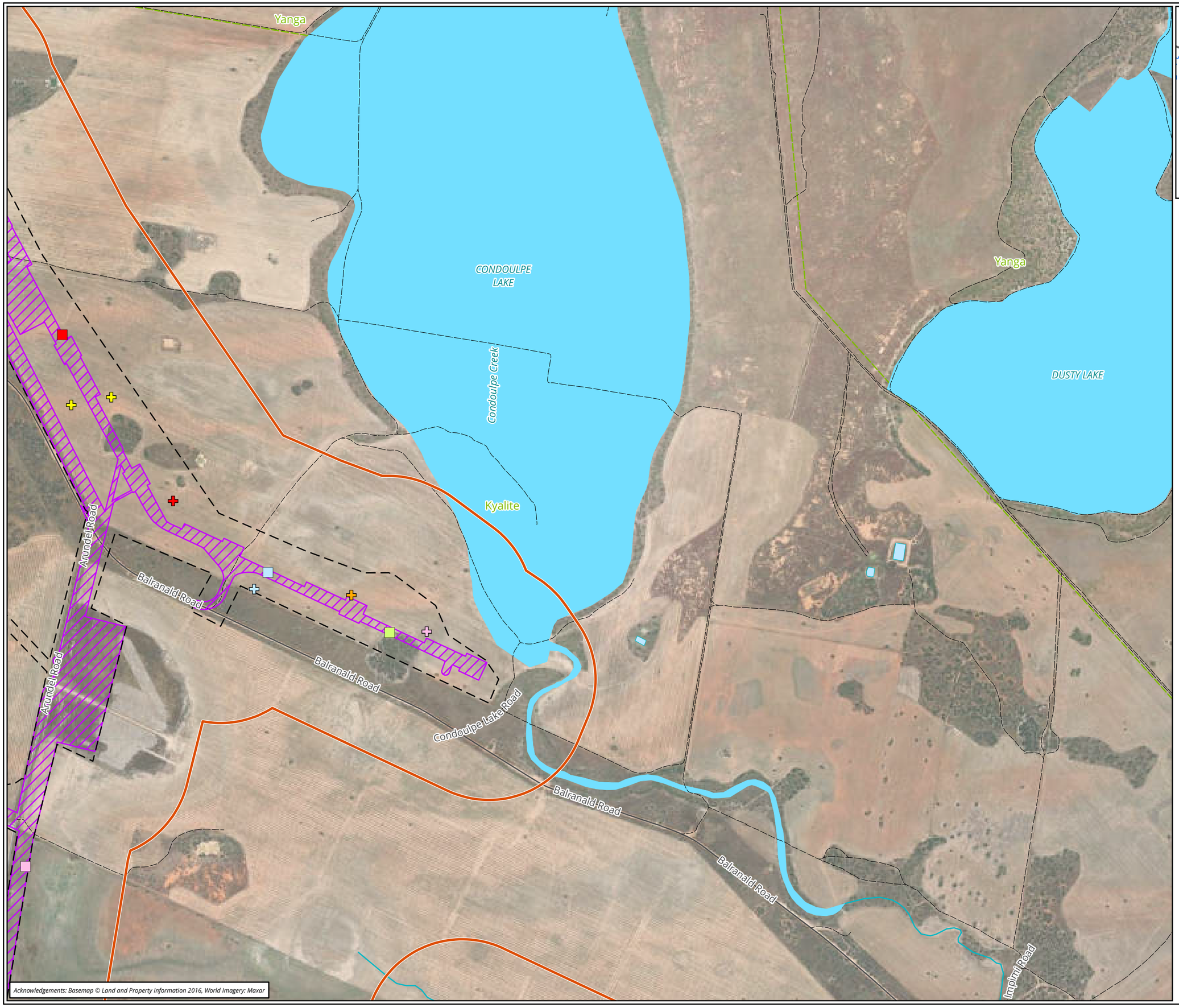
Meters

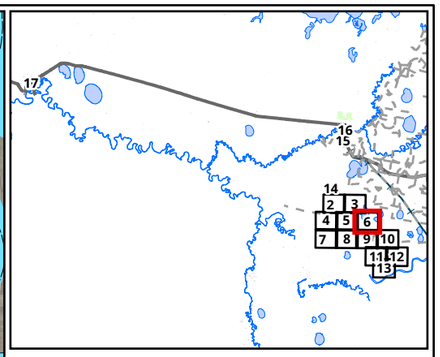
Scale: 1:18,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Eucalyptus dumosa*
- *Eucalyptus socialis*

**Paddock Trees - To be removed**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Eucalyptus socialis*
- Other

**Figure 23.6 Scattered trees mapped within the subject land**

0 230 460 690 920 N

Meters

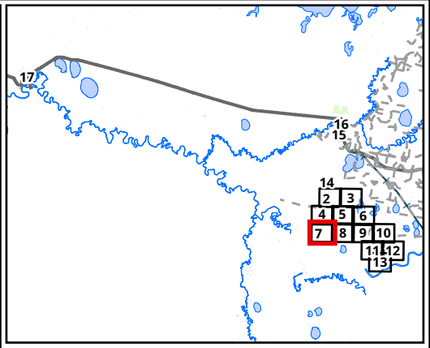
Scale: 1:18,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Casuarina pauper*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Acacia melvillei*
- Other

**Figure 23.7 Scattered trees mapped within the subject land**

0 230 460 690 920 N

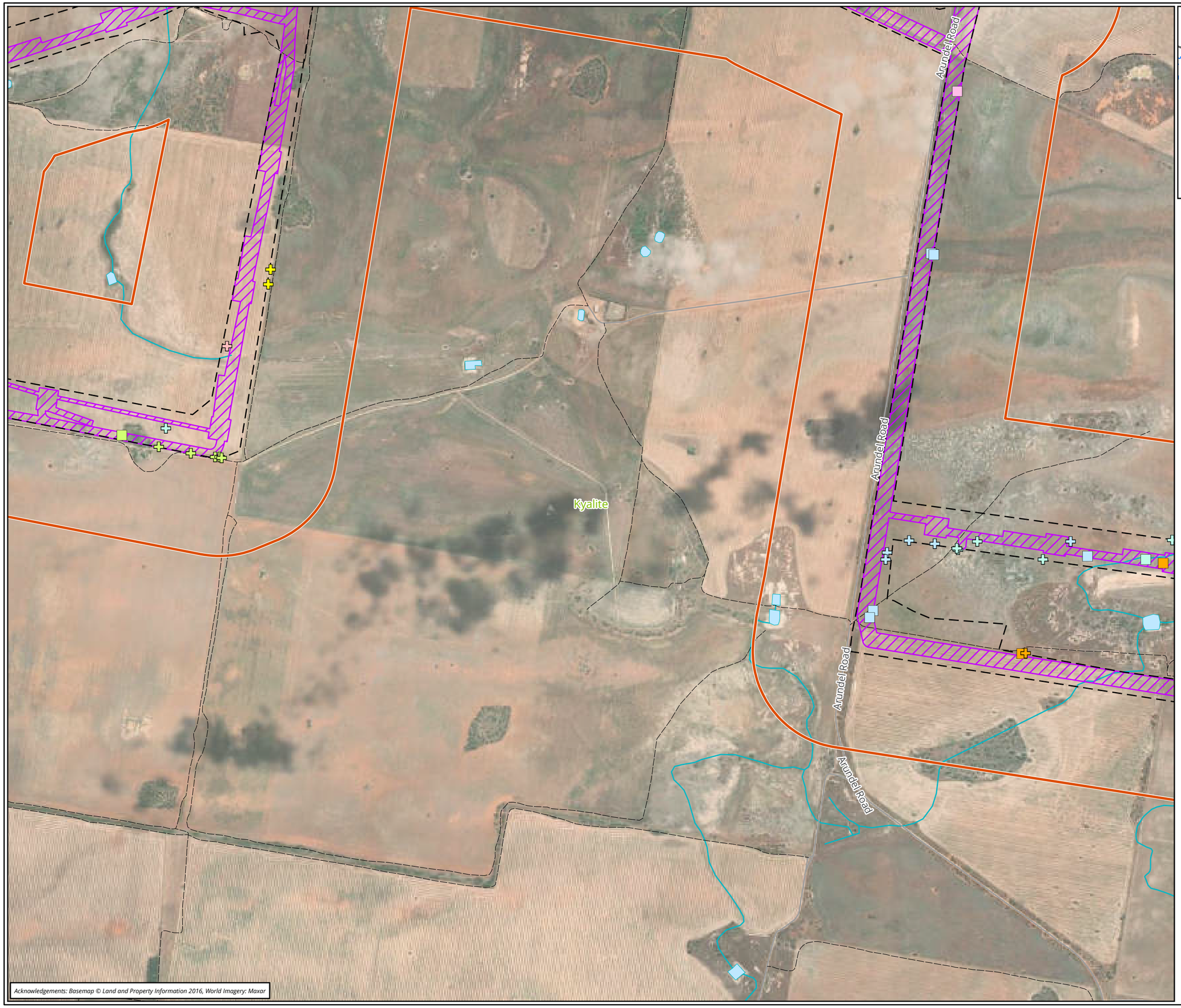
Meters

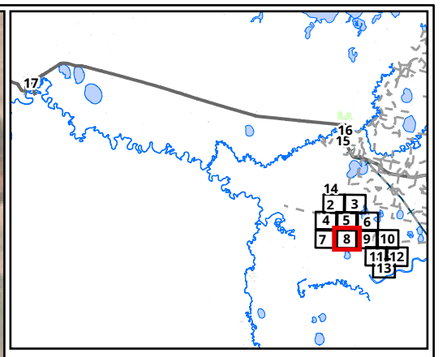
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*Coordinate System:*
*GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*
- Other

**Figure 23.8 Scattered trees mapped within the subject land**

0 230 460 690 920

Meters

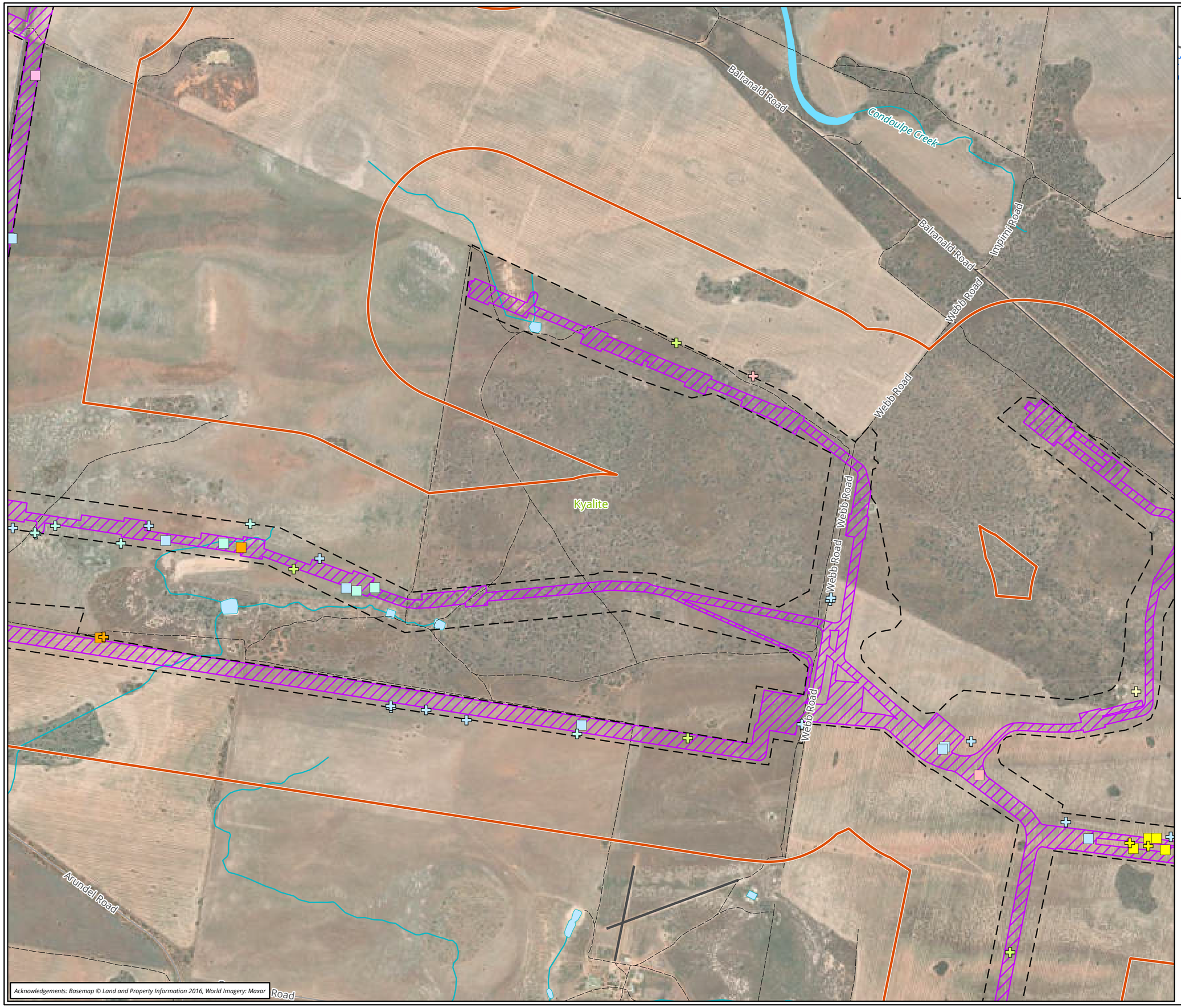
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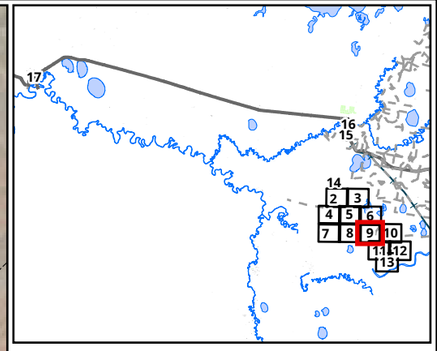
*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
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Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia homalophylla*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*

**Figure 23.9 Scattered trees mapped within the subject land**

0 230 460 690 920

Meters

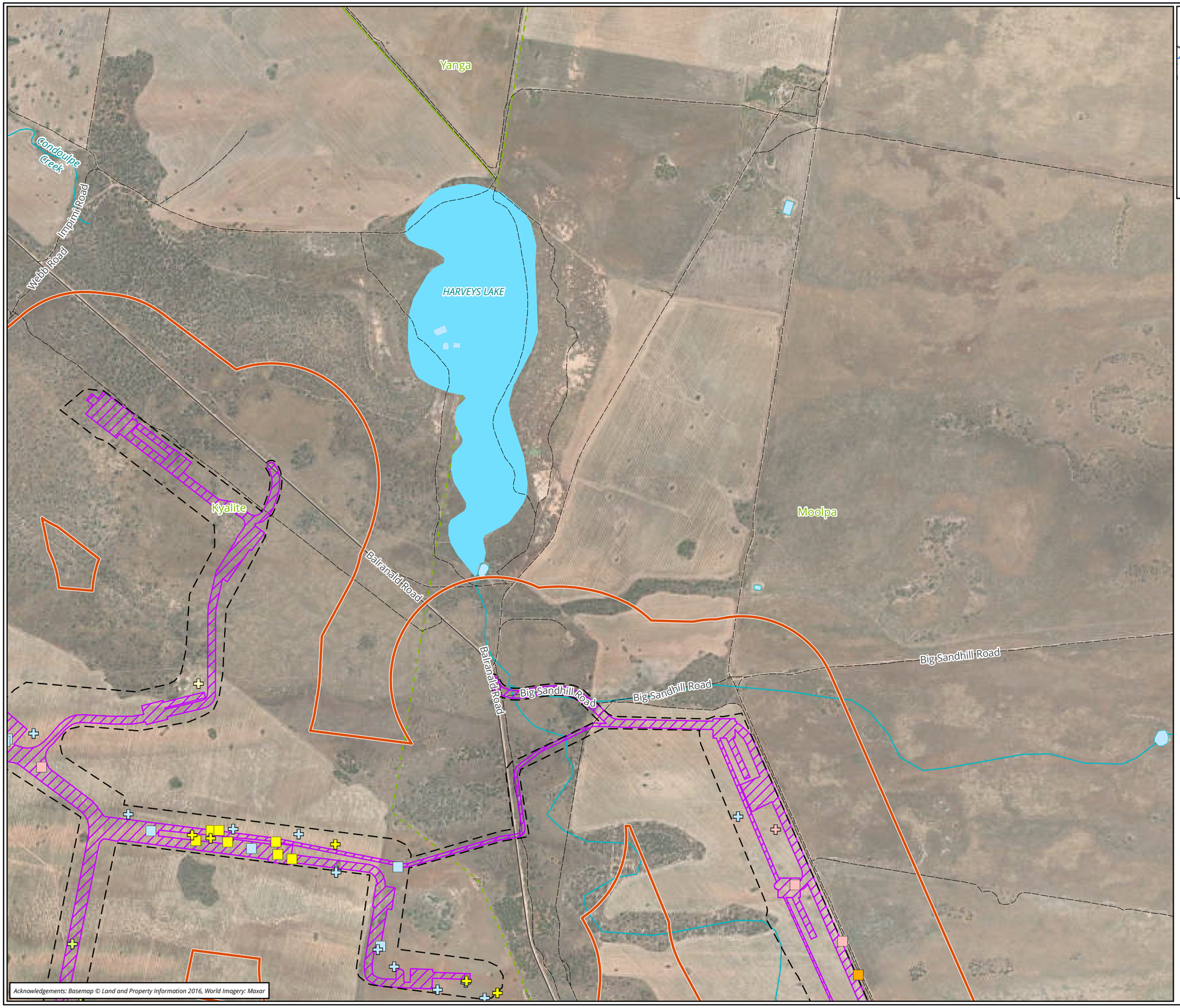
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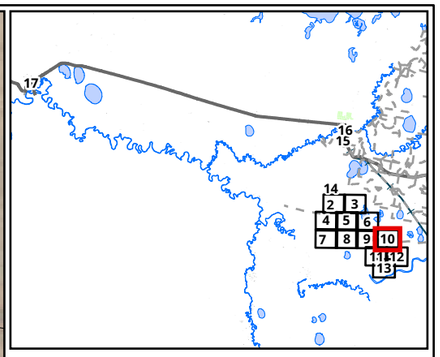
*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia homalophylla*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- Other

**Paddock Trees - To be removed**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*

**Figure 23.10 Scattered trees mapped within the subject land**

0 230 460 690 920 N

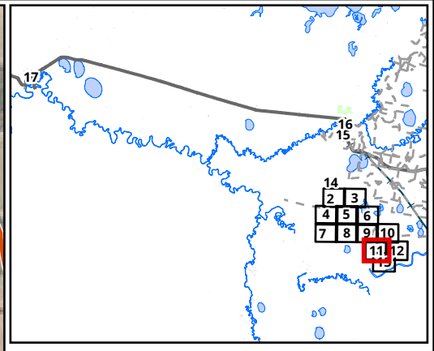
Meters

Scale: 1:18,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Eucalyptus gracilis*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Eucalyptus largiflorens*
- *Eucalyptus oleosa* subsp. *oleosa*

Webb Road

Moolpa

Balranald Road

Kyalite

*Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Maxar*

**Figure 23.11 Scattered trees mapped within the subject land**

0 230 460 690 920 N

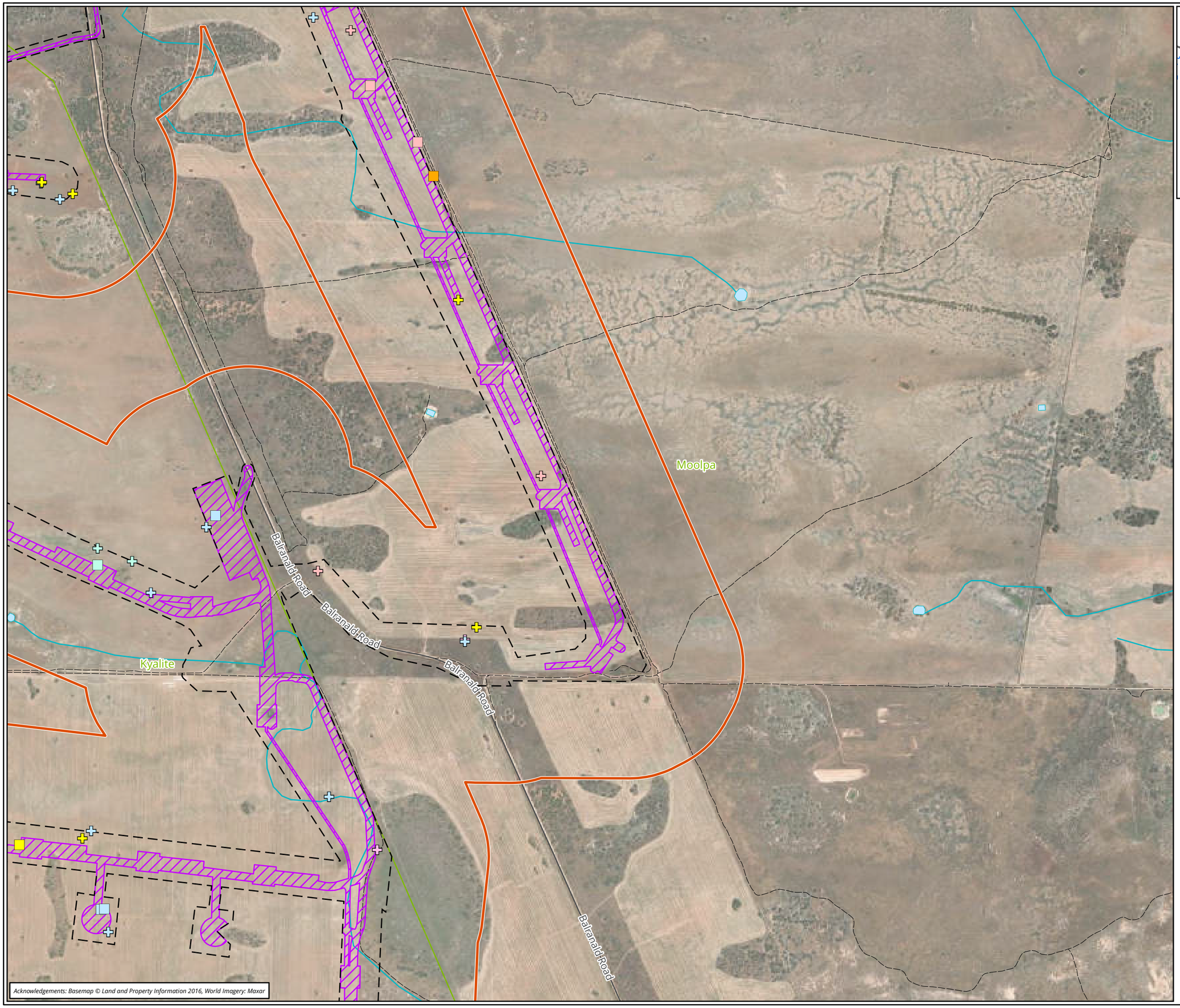
Meters

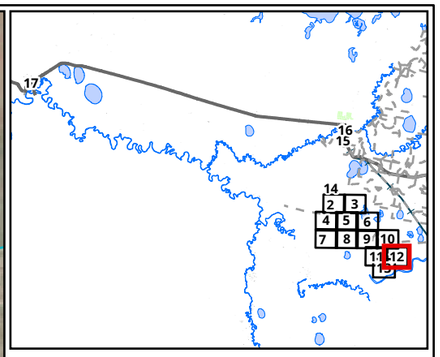
Scale: 1:18,000 @ A3

*Coordinate System:*
*GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus largiflorens*

**Paddock Trees - To be removed**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus dumosa*
- *Eucalyptus largiflorens*

**Figure 23.12 Scattered trees mapped within the subject land**

0 230 460 690 920 N

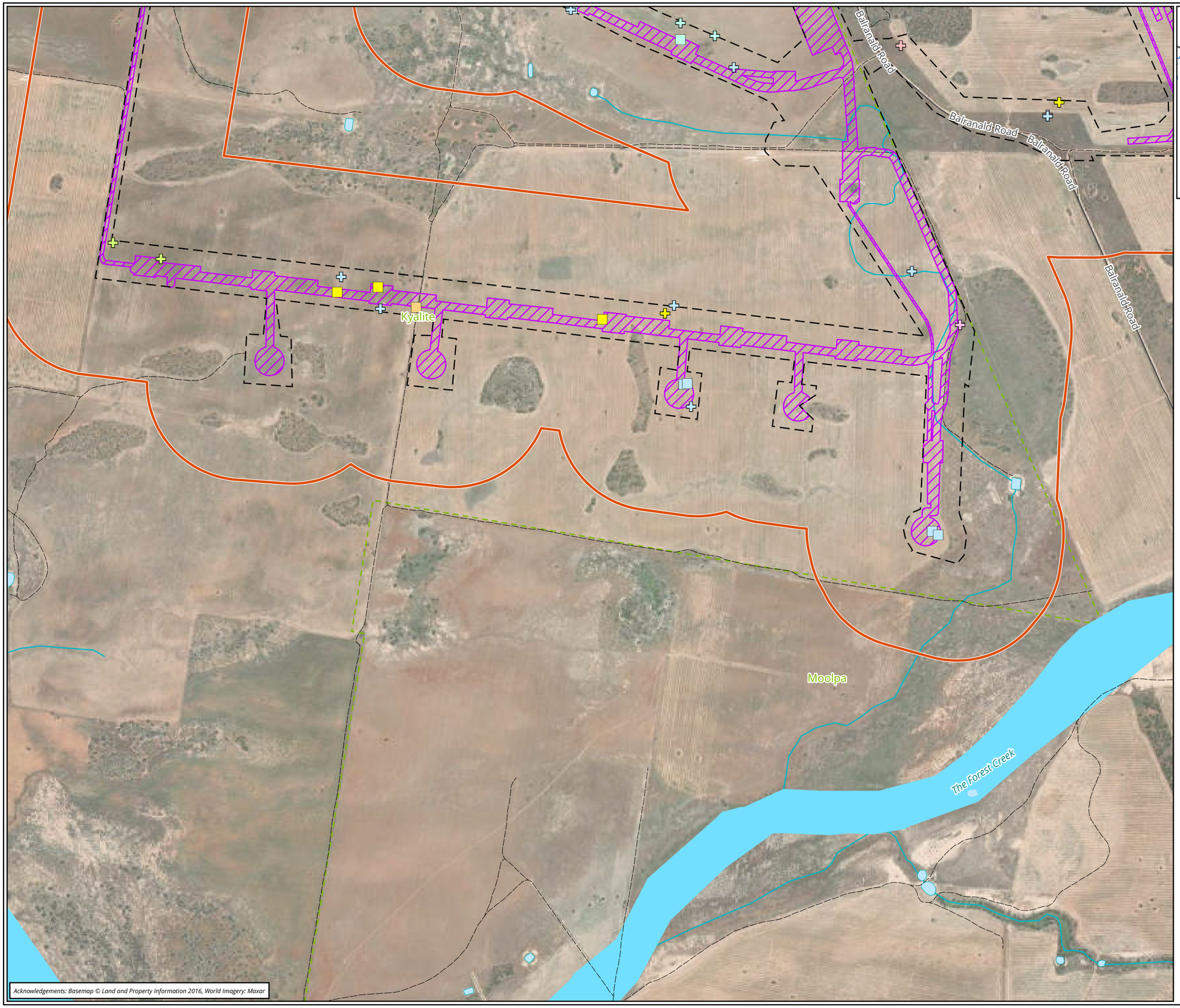
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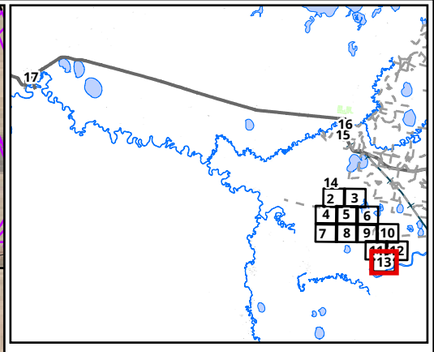
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*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Paddock trees - Retained**

- *Acacia melvillei*
- *Alectryon oleifolius*
- *Callitris gracilis*
- *Casuarina pauper*
- *Eucalyptus largiflorens*
- Other

**Paddock Trees - To be removed**

- *Alectryon oleifolius*
- *Callitris gracilis*
- *Eucalyptus largiflorens*
- *Eucalyptus oleosa* subsp. *oleosa*

**Figure 23.13 Scattered trees mapped within the subject land**

0 230 460 690 920 N

Meters

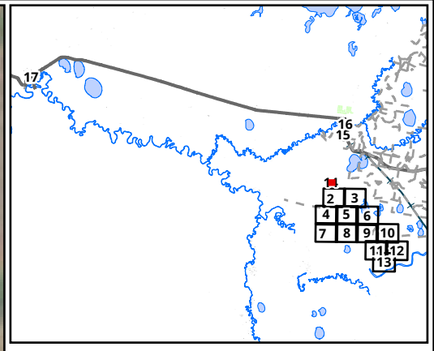
Scale: 1:18,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

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## Figure 23.14 Scattered trees mapped within the subject land

0 25 50 75 100

Meters

Scale: 1:2,000 @ A3

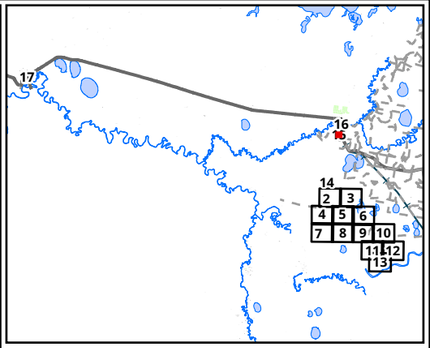
*Coordinate System:*
*GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

**Figure 23.15 Scattered trees mapped within the subject land**

0 25 50 75 100

Meters

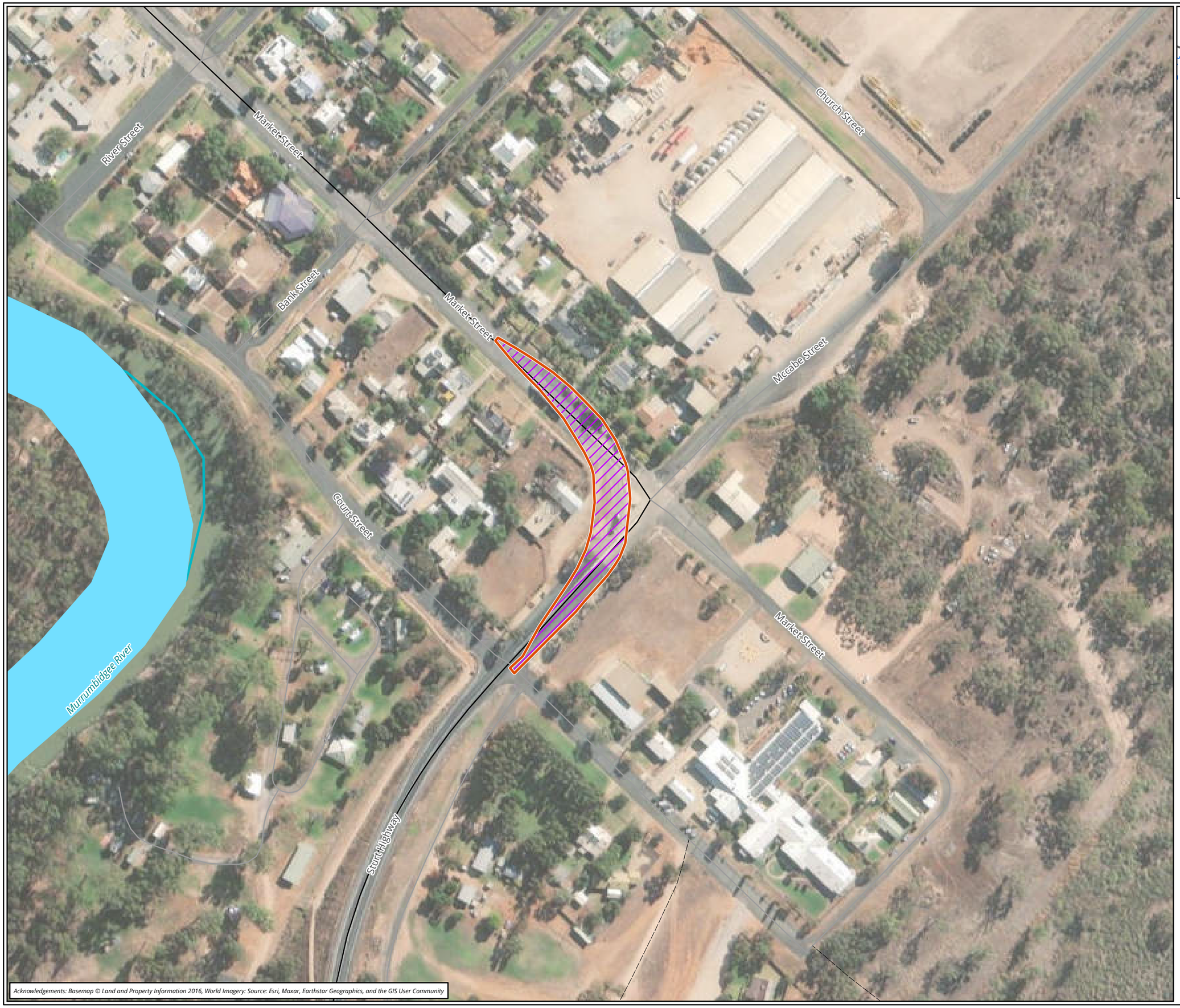
Scale: 1:2,000 @ A3

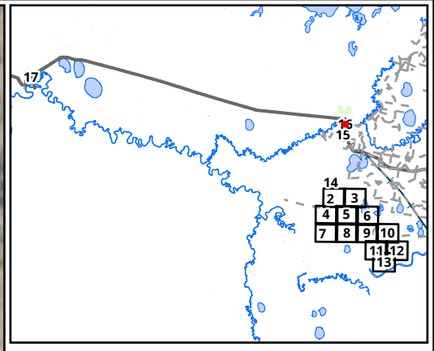
*Coordinate System: GDA2020 MGA Zone 54*

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GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

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**Figure 23.16 Scattered trees mapped within the subject land**

0 25 50 75 100 N

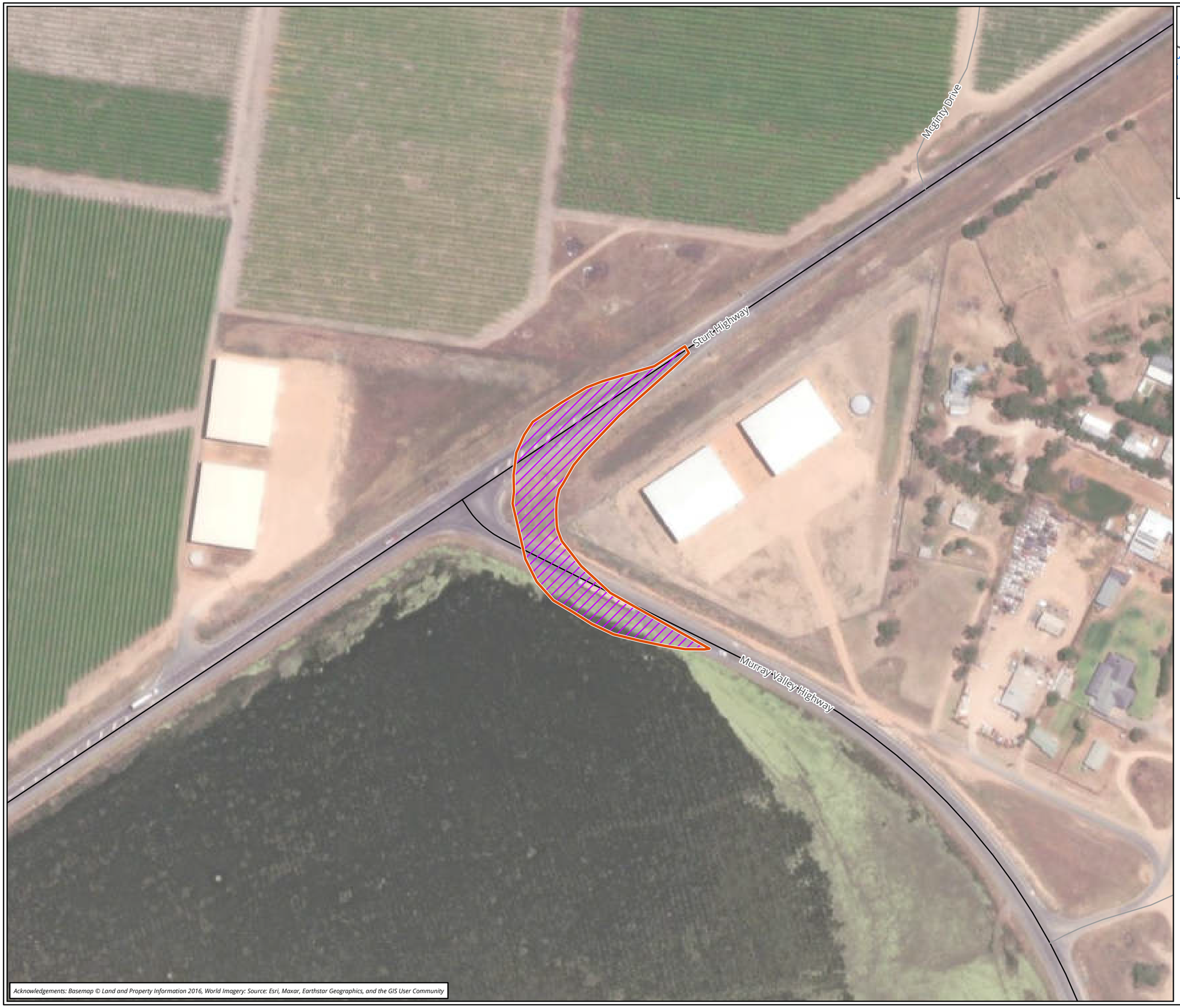
Meters

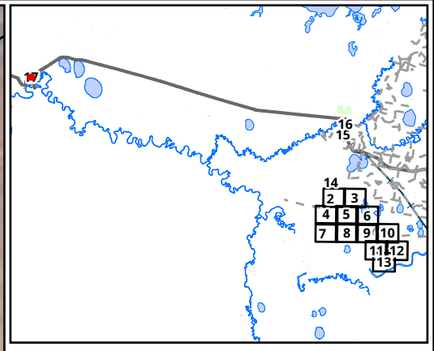
Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees




**Legend**

- Subject land
- Development corridor
- Development footprint

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**Figure 23.17 Scattered trees mapped within the subject land**

0 25 50 75 100

Meters

Scale: 1:2,000 @ A3

*Coordinate System: GDA2020 MGA Zone 54*

N

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Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 10 +.aprx
Layout: 37502_F23_Scatteredtrees

# Appendix 8. Bird and Bat Adaptive Management Plan - Working draft

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**Junction Rivers Wind Farm**

# Bird and Bat Adaptive Management Plan

**WORKING DRAFT FOR BDAR SUBMISSION**

Prepared for Umwelt (Australia) Pty Ltd on behalf of Windlab Pty Ltd

16 May 2024

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## Document information

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|---|---|
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*We pay our respects to the Traditional Custodians and Elders past and present and honour their connection to Country and ongoing contribution to society.*


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# Glossary

| | |
|---|---|
| **BAM** | NSW Biodiversity Assessment Method 2020 |
| **BBAMP** | Bird and Bat Adaptive Management Plan |
| **BBUS** | Bird and bat utilisation surveys |
| **BC Act** | *Biodiversity Conservation Act 2016* |
| **BCS** | New South Wales Department of Climate Change, Energy, the Environment and Water Biodiversity Conservation Science |
| **BCT** | New South Wales Department of Planning and Environment's Biodiversity Conservation Trust |
| **BDAR** | Biodiversity Development Assessment Report |
| **BOS** | Biodiversity Offsets Scheme |
| **BRW** | Biodiversity risk weighting |
| **Cth DCCEEW** | Australian Government Department of Climate Change, Energy, the Environment and Water |
| **DCDB** | Digital cadastral database |
| **Development footprint** | The area of land that is directly impacted by the proposal |
| **DPE** | Former NSW Department Planning and Environment |
| **DTDB** | Digital topographic databases |
| **EIS** | Environmental Impact Statement |
| **EP&A Act** | NSW *Environmental Planning and Assessment Act 1979* |
| **EPBC Act** | *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* |
| **GIS** | Geographic Information System |
| **IBRA** | Interim Biogeographic Regionalisation of Australia |
| **LGA** | Local Government Area |
| **Locality** | Area located within 60 km radius from the subject land |
| **NDWI** | Normalized Difference Water Index |
| **NPWS** | National Parks and Wildlife Service |
| **REZ** | Renewable Energy Zone |
| **RTE** | Real Time Expansion |
| **SEARs** | Secretary's Environmental Assessment Requirements |
| **SCADA** | Supervisory Control and Data Acquisition |
| **SSD** | State Significant Development |
| **TARP** | Trigger Action Response Plan |
| **WHS** | Work Health and Safety |
| **WTG** | Wind turbine generators |

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# 1 Introduction

## 1.1 Project background

Windlab Pty Ltd (Windlab), proposes to develop a wind farm (the project) at Balranald Road (the study area) located approximately around 15 kilometres south of Balranald, and 12 kilometres north of Kyalite in New South Wales (NSW) (Figure 1).

The Junction Rivers Wind Farm (referred to henceforth as the wind farm) is located in the proposed South-West Renewable Energy Zone (REZ) and would involve the construction and operation of up to 96 wind turbine generators (WTGs) and associated ancillary infrastructure including a Battery Energy Storage System (BESS). The wind farm is proposed to have a generating capacity of approximately 750 megawatts. The expected operational life of the project is 30 years, at which point the site would be decommissioned or re-powered.

The project is classified as State Significant Development (SSD) and is being assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). A Biodiversity Development Assessment Report (BDAR) (Biosis 2024a) is being prepared for the project to be submitted to the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW), as part of the Environmental Impact Statement (EIS) for the Development Application (DA). Secretary's Environmental Assessment Requirements (SEARs) were issued for the proposed Junction Rivers Wind Farm on 21 December 2021 (SSD-30448824).

The project has also been declared a Controlled Action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), (referral number 2023/09603) with the Controlling Provisions including listed threatened species and communities and listed migratory species.

Biosis Pty Ltd was commissioned by Windlab to prepare the Bird and Bat Adaptive Management Plan (BBAMP) for the project to be submitted to NSW DCCEEW as a technical appendix of the BDAR. The BBAMP is to be prepared in accordance with available state and federal guidelines.

## 1.2 Land to which this plan applies

The BBAMP applies to the entire wind farm. The wind farm is located at Balranald Road located approximately located around 15 kilometres south of Balranald, and 12 kilometres north of Kyalite in NSW (Figure 1).

The wind farm (Figure 1) occurs within:

- Murray Darling Depression and Riverina Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion and Murrumbidgee and South Olary Plain IBRA subregions.
- Murrumbidgee catchment and Murray catchment.
- Murray Local Land Services (LLS) Management Area.
- Murray River Council (formerly Wakool Shire) Local Government Area (LGA).

## 1.3 Purpose and objectives of this BBAMP

This BBAMP has been prepared in accordance with the recommendations outlined in the project Secretary's Environmental Assessment Requirements (SEARs). The project SEARs issued on 21 December 2021 require the project to assess specific biodiversity issues, including:

> *Assess the impacts of the development on birds and bats, including blade strike, low air pressure zones at the blade tips (barotrauma), alteration to movement patterns, and cumulative impacts of other wind farms in the vicinity.*

Supplementary SEARS issued following declaration of the project as a Controlled Action on 19 December 2023 re-iterated the above objective and did not outline additional objectives.

Additional objectives may be outlined following issue of Conditions of Consent for the project after the EIS is assessed.

The NSW Biodiversity Assessment Method (BAM) requirements for a BBAMP in relation to impacts are considered uncertain at the time of development of the project's BDAR (Biosis 2024a). Impacts considered uncertain relate to potential bird and bat collision with operational turbines, and an adaptive management approach is required to minimise and mitigate potential operational impacts.

In addition the preparation of the BBAMP is in line with recommendations of the BDAR (Biosis 2024a), as follows:

> *A BBAMP will be prepared to measure any operational impacts on bird and bats species and ensure suitable mitigation and adaptive management strategies are implemented. The plan will:*
>
> - *Address the prescribed impacts associated with blade strike impacts and include development of trigger levels to manage impacts during operation of the project.*
> - *Provide guidance and develop a framework for monitoring of impacts, including baseline and ongoing monitoring requirements, including for nesting sites on man-made structures.*
> - *Utilise survey data and complete statistical analysis of species and develop triggers for number of species incidents.*
> - *Develop strategies on consultation with NSW DCCEEW (BCS) for reducing bird and bat collision risk.*

It should be noted that NSW-specific guidelines for wind farms are yet to be formally published and released, and future policy guidance may influence the scope and content of this BBAMP.

The overall objectives of the BBAMP are to provide an effective monitoring program and strategy to manage and mitigate operational issues relating to bird and bat impacts (specifically microbats) for the wind farm, to monitor and assess for impacts considered uncertain at the time of approval, and prescribe additional compensatory measures for residual prescribed impacts, if required. Additionally, the framework aims to provide certainty to the consent authority and stakeholders prior to approval that measures for minimising biodiversity impacts during operation have been clearly defined that address potential prescribed impacts that cannot be quantified prior to approval.

Nature Advisory Pty Ltd (Nature Advisory) has completed bird and bat utilisation surveys (BBUS). Biosis has utilised this third-party data to prepare the BBAMP with appropriate collision mitigation procedures that reflect Nature Advisory's findings and impact assessment conclusions. Therefore, BBAMP has been guided by the collision risk assessment completed by Nature Advisory and turbine risk assessment completed as

part of the BDAR and importantly, it has been informed by site-specific baseline data, to build an adaptive management approach that will minimise the risk of any significant impact to resident, nomadic and migratory bird and bat species and ensure a viable local population is maintained for relevant threatened or at-risk species.

The BBAMP includes the following key objectives:

- Detail the methodology and results of baseline, site-specific data relevant to threatened and at-risk bird and bat species.
- Detail the measures that would implement on site for minimising bird and bat strike during operation of the development.
- Define trigger levels for further investigation of the potential impacts of the project on particular bird or bat species or populations.
- Detail the Trigger Action Response Plan (TARP) to monitor and report on the effectiveness of these measures, and any bird and bat strikes on the site.
- Provision of an adaptive management program that would be implemented if the development is found to be having an adverse impact on a particular threatened or at-risk bird and/or bat species.
- Provisions for the reporting of data to regulatory agencies.

Following project approval, the BBAMP would be updated to address any consent conditions specific to turbine strike or project layout issued in the conditions of consent.

## 1.4 Roles and responsibilities

Meeting the objectives of this BBAMP is ultimately the responsibility of Windlab and future operators of the wind farm. Ensuring implementation of this BBAMP will require ongoing involvement from regulatory bodies including NSW DCCEEW and Cth DCCEEW to ensure compliance with the performance criteria set out in this BBAMP.

A suitably qualified ecologist should be engaged by Windlab to ensure the bird and bat survey methodology outlined in the BBAMP is followed and implemented adequately. The ecologist would also be required to review the BBAMP and prepare reports relevant to the bird and bat monitoring program.

Implementation of novel technological approaches to reduce collision risk to microbats (smart curtailment), will require ongoing collaboration between the equipment manufacturers, engineers and ecologists to be successful. It is the responsibility of Windlab to engage with relevant experts to implement the proposed strategies.

## 1.5 Sources of information

Sources of information used in the BBAMP include relevant databases, spatial data, literature and previous site reports, including:

- NSW Biodiversity Assessment Method (BAM) (DPIE 2020).
- Onshore Wind Farms - interim guidance on bird and bat management (DAWE 2022).
- Records of flora and fauna from within 25 kilometre/s (the locality) collated as part of the BDAR (Biosis 2024a) from the following databases and datasets:
  - Cth DCCEEW Protected Matters Search Tool for matters protected by the EPBC Act.
  - NSW BioNet – the database for the Atlas of NSW Wildlife, NSW DCCEEW, for species, populations and ecological communities listed under the BC Act.
- Previous reports prepared for the project, including:
  - *Junction Rivers Wind Farm BDAR* (Biosis 2024b).
  - *Scoping Report Junction Rivers Wind Farm* (Niche Environment and Heritage 2021).
  - *Junction Rivers Wind Farm Spring 2021 Survey Report* (NGH Consulting 2022).
  - *Junction Rivers Wind Farm Bird and Bat Baseline Report* (Nature Advisory 2023a).
  - *Junction Rivers Wind Farm Initial Bird and Bat Risk Assessment* (Nature Advisory 2023b).
  - *Junction Rivers Wind Farm Bat Utilisation Survey* (Nature Advisory 2022a).
  - *Junction Rivers Wind Farm Bird Utilisation Survey – Year One* (Nature Advisory 2022b).
  - *Junction Rivers Wind Farm Autumn Bird Utilisation Surveys* (Nature Advisory 2022c).
  - *Junction Rivers Wind Farm Summer Bird Utilisation Surveys* (Nature Advisory 2022d).
  - *Junction Rivers Wind Farm Regent Parrot Targeted Assessment Report* (Nature Advisory 2023c).
  - *Junction Rivers Wind Farm Regional Review of Waterbirds in the Riverina* (Nature Advisory 2023d).
  - *Junction Rivers Wind Farm Preliminary Literature Review on Habitat Use of the Australasian Bittern in the Riverina* (Nature Advisory 2023e).
  - *Junction Rivers Wind Farm Biodiversity Development Assessment Report* (Biosis 2024a).

Base map data was obtained from NSW Land and property information (LPI) 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB).

The following spatial datasets were utilised during the development of this report:

- Interim Biogeographic Regionalisation of Australia (IBRA) Version B7.
- Spatial data associated with *Riverina Region Version v1.2 – VIS_ID 4469* (DPIE 2016) vegetation mapping.

**Figure 1 Location of the wind farm**

Figure to include: - HOLD POINT

- Wind farm boundary
- Development footprint
- Turbine layout\
- Waterways and buffers
- IBRA subregions

# 2 Baseline information

## 2.1 Pre-construction bird and bat surveys

Windlab engaged Nature Advisory to provide baseline data (pre-construction) on threatened bird and microbat species as well as non-threatened species considered at moderate or greater risk of collision impacts from the development (at-risk species) for the project between February 2021 and October 2022 (Nature Advisory 2023a).

Surveys for birds and bats within the study area were undertaken in accordance with:

- NSW *Biodiversity Assessment Method* (BAM) (DPIE 2020).
- *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2010a).
- *Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2010b).
- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (OEH 2018).
- *Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2010b).
- *Onshore Wind Farms - interim guidance on bird and bat management* (DAWE 2022).

One of the key objectives for the collection of detailed baseline data was to gather adequate replicable information on the existing bird and bat species abundance and activity (site utilisation) prior to commencement of operation of the wind farm.

The methods used and results for all baseline surveys are set out in Appendix 2. Investigations of the site utilisation patterns of bird and bat species at the wind farm have been established as a Before-After-Control-Impact (BACI) assessment design. Surveys prior to construction of the facility include Before and Control components. Studies after commissioning of the wind farm provide After, Control and Impact components. The BACI design is intended to be able to measure changes that may result from operation of the wind farm. Annual reviews of the results of the BACI studies will be used to refine the adaptive framework of this BBAMP for management of the wind farm.

The cumulative results of the baseline surveys have informed the current plan and its adaptive framework for management of the wind farm, particularly in respect of the risk assessment process set out below. The baseline investigations have documented species of birds and microbats present, and the risk assessment has been applied to them. Note that the BBAMP does not consider the impact on flying-foxes (e.g., Grey-headed Flying-fox *Pteropus poliocephalus,* noting that this species was not identified at the wind farm and is considered unlikely to occur). The adaptive approach will permit application of the risk assessment process to address any identified new or altered risks for known species or for any additional species found to be using the wind farm.

The locations of all bird and bat utilisation survey points are identified in the maps at Appendix 1. These include eight impact survey points representative and randomised across all associated turbine sites and

two control sites located at least 500 metres away from impact points in areas of similar habitat (Nature Advisory 2023a).

Bat echolocation calls were recorded by Nature Advisory (Nature Advisory 2023a) using automated ultrasonic bat detectors. The principal objective of the surveys was to determine the species diversity of microbats within the wind farm. More detailed analysis was also undertaken to compare spatial and temporal changes in bat activity across the site. The methods for bat surveys are detailed in Appendix 2.

Surveys for birds and bats have been undertaken at a series of point locations that provide a sample of habitats and environments for birds and bats, providing point locations at which relevant species are detected. Species of birds and bats 'of concern' have been outlined within the BDAR, results of this assessment are discussed further within Section 3 of this management plan.

There is potential that collision risk for various species may differ between turbines, and this will continue to be monitored as part of investigations of both bird and bat utilisation (i.e., continuation of baseline monitoring) and of bird and bat collisions, as set out in this plan. In accordance with the adaptive management framework, responsive actions will be implemented as necessary. We note, that the international and Australian literature includes a number of studies of raptors that have demonstrated that presence and even rates of utilisation are poor predictors of collision risk (Madders & Whitfield 2006, de Lucas et al. 2008, Ferrer et al. 2011, Hull & Cawthen 2013).

## 2.2 Additional survey recommendations

Additional pre-construction surveys are recommended to be undertaken within the wind farm to bolster available bird and bat utilisation data and further clarify species risk, turbine risk and mitigation measures. Further survey findings are to be incorporated into the BBAMP as part of annual reporting (Section 6.5.2) and subsequent BBAMP revision (Section 6.5.3).

### 2.2.1 Bird surveys

#### Stick nest searches

A stick nest survey should be undertaken within 200 meters of turbines once final turbine layout is known (i.e., post micro-siting). This will help to identify any at-risk species that will be impacted by the project.

### 2.2.2 Microbat surveys

#### Bat utilisation surveys

Microbat surveys have been undertaken by Nature Advisory as part of the BBUS work completed for the project. Draft bird and bat utilisation guidance has been provided by BCD for projects within the SW REZ (NSW DCCEEW 2023a). This guidance recommends bat utilisation surveys are completed over summer, autumn, winter and spring for a two-year period as a minimum. As such, it is recommended that additional bat utilisation surveys are completed to inform the collision risk of the project. Additional bat utilisation surveys are recommended to be undertaken prior to construction. Methods utilised can be consistent with those outlined in Appendix 2.2, with the following amendments:

- Collection of data over additional survey periods, including one summer survey, two autumn surveys, two winter surveys and one spring survey.
- Collection of data at height (see below for additional information).

### Ultrasonic surveys on at height

Further microbat survey is recommended to be undertaken to assess for impacts relating to the likelihood of bat species being impacted by turbine strike and possibly barotrauma, the rate of impact per turbine per year, and the impacts to the bioregional populations. This relates not only to bats resident within (or adjacent to) the wind farm, but those that may fly through the site from surrounding habitats, such as local cave/karst systems.

Additional surveys would consist of deployment of acoustic devices at height (i.e., on meteorological masts, once installed) within the wind farm to determine the activity level of bats at different elevations. These detectors should be fitted with an omni-directional microphone capable of detecting and recording calls within a 100-metre radius in all directions. This capability will allow for the detection of calls from ground level to a total height of 200 metres, capturing a large area within the potential rotor swept path of the wind turbines.

# 3 Bird and bat impact risk assessment

## 3.1 Approach to risk assessment

### 3.1.1 Qualitative risk assessment

A risk assessment has been undertaken for the project by Nature Advisory (2023b). A risk matrix has been developed and applied for individual species of birds and bats that incorporates probability that the wind farm might alienate birds or bats from habitats at the wind farm and the likelihood that particular species might collide with turbines. Risks are ranked as; negligible, low, moderate, high or severe on the basis of a set of defined likelihood and consequence factors.

The species that have been the subject of this risk assessment (Nature Advisory 2023b) include the following:

- Species listed as threatened under Commonwealth or state legislation.
- Species known to be vulnerable to collision with turbines based on collision data (Nature Advisory data) from other wind farms in eastern Australia.
- Species for which a population concentration, or a population of significance, occurs on the site and that species may exhibit risk behaviour and potentially interact with the operation of wind turbines.

The risk assessment has also been applied to additional species of raptors and some bats that are not threatened. Risk assessment for these additional species was undertaken particularly because it is considered that their flight behaviours may put them at a greater risk of collisions than most other taxa.

The risk assessment was based on an early design with 107 turbines with a rotor radius of 100 metres, a rotor swept height of between 50–300 metres (hub located at 200 metres), and a total rotor swept area of 31,416 square metres. It is important to note that the final project design has a reduced risk, with 96 turbines, rotor radius of 82.5 metres, rotor swept height 57.5–231.5 metres (hub located at 150 metres), and a total rotor swept area of 21,382.5 square metres.

The risk matrix outlined by Nature Advisory entails five risk levels, assigned based on the likelihood, as shown in Table 1 below, alongside descriptions of likelihood and consequence factors for birds and bats. The qualitative risk assessment matrix used to inform the significance of impact potential is outlined within Table 2. The risk assessment is summarised in Appendix 3.1 for birds and Appendix 3.2 for bats.

**Table 1 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike for birds and microbats**

| Likelihood | Criteria | Consequence | Criteria |
|---|---|---|---|
| **Rare** | An event may occur only in unusual circumstances (less than 5%). The risk event is only theoretically possible or would require exceptional circumstances to occur. | **Negligible** | Occasional individuals lost but no reduction in population viability. |
| **Unlikely** | It is less probable than not that the risk event could occur in any year (< 50%). | **Low** | Repeated loss of small number of individuals but no reduction in population viability. |
| **Likely** | It is equally probable that the risk event could or could not occur in any year (50%). | **Moderate** | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. |
| **Almost Certain** | It is more probable than not that the risk event could occur in any year (>50%) | **High** | Major loss in number of individuals, leading to reduction in population viability for between five to 10 years. |
| **Certain** | It is very probable that the risk even could occur in any year (>95%). | **Severe** | Extreme loss in number of individuals, leading to reduction in population viability for a period of at least 10 years. |

**Table 2 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for birds and microbats**

| Likelihood | Consequence | | | | |
|---|---|---|---|---|---|
| | Negligible | Low | Moderate | High | Severe |
| **Rare** | Negligible | Negligible | Negligible | Low | Low |
| **Unlikely** | Negligible | Negligible | Low | Moderate | High |
| **Likely** | Negligible | Low | Moderate | High | High |
| **Almost certain** | Negligible | Low | Moderate | High | Severe |
| **Certain** | Negligible | Low | High | Severe | Severe |

### 3.1.2 Collision risk modelling

Collisions of birds and bats with wind turbines have been documented to occur at various frequencies around the world. Quantitative modelling to estimate the number of collision mortalities of threatened and non-threatened taxa is widely used as part of environmental impact assessments for proposed wind energy facilities (Masden & Cook 2016). Collision risk modelling for birds has not been undertaken for this project.

The only alternative to a quantitative modelling approach is one of qualitative subjective judgement. All the benefits of using mathematical modelling outlined above are difficult, if not impossible to achieve with a purely qualitative assessment.

## 3.2 Collision risk

The risk assessment indicates that collision or barotrauma due to interaction by birds or bats with turbines represents a greater risk than does the possibility that the wind farm might alienate birds or bats from their habitats, or that it might present a barrier to their movements. Empirical evidence from operational wind farms in Australia supports this approach, as collisions by some species certainly occur, but there is no known documentary evidence for wind farm infrastructure resulting in alienation of Australian species of birds or bats. For that reason, this BBAMP is substantially concentrated on management to reduce effects of turbine collisions.

Measures to avoid and minimise such impacts have been included throughout the development of the design for the Project, in consultation with NSW DCCEEW and other relevant stakeholders. These project updates that have resulted in changes to turbine spacing and locations, as well as the incorporation of buffer areas on important ecological features (such as Condoulpe Lake) are considered to substantially reduce the potential for barrier effects and collision risk across the wind farm.

For that reason, this BBAMP is substantially concentrated on management to reduce effects of turbine collisions. There remains provision within the BBAMP however, to monitor and assess any residual impacts related to barrier effect, and an adaptive management framework in place to respond to any identified impacts.

This BBAMP is applicable to all the taxa listed in Appendix 3. It also applies to any species subsequently found to occur at the site and that are listed as:

- Threatened or migratory under provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Threatened on schedules of the *NSW Biodiversity Conservation Act 2016* (BC Act).
- Non-threatened species of 'at-risk' birds and bats that were not previously known or predicted for the site and/or have not been the subject of a risk assessment.

For the purpose of this BBAMP, these are collectively termed 'at-risk species'.

### 3.2.1 Bird collision risk assessment

An impact assessment to migratory species and any resident raptors that may be subject to indirect impacts associated with blade strike during the operational phase of the project is required during the approval phase of the project. As outline above, Nature Advisory was commissioned to complete a Bird and Bat Risk Assessment (Nature Advisory 2023b) to inform the overall biodiversity impact assessment for the proposed wind farm. This assessment identified species or groups of birds and bats considered at potential risk of collision with turbines, and the potential impact on bird and bats subject to disturbance and/or barrier effects posed by constructed wind turbines. The outcome of these assessments enables the targeted assessment of key species to be considered in the preparation of the impact assessment for the wind farm.

A risk matrix was developed by Nature Advisory (Nature Advisory 2023b) and applied for individual species of birds and bats that incorporates probability that the wind farm might alienate birds or bats from habitats at the wind farm, or between habitats as a result of the wind farm, and the likelihood that particular species might collide with turbines. Likelihood of risks are ranked as Rare, Unlikely, Likely, Certain and Almost Certain. Consequence of risk are ranked and Negligible, Low, Moderate, High and Severe on the basis of a set of defined likelihood and consequence factors (Table 2).

### 3.2.2 Microbat collision risk assessment

Project impacts on bats are primarily focused on the potential for collisions with turbines. 'Collision' is used here in reference to incidents in which a bat physically strikes, or is struck by, the moving blades of a turbine and to the potential for barotrauma. Barotrauma in bats was described by Baerwald et. al. (2008) as the fatal effect on an animal's respiratory tract due to its encountering a rapid change in air pressure close to a moving turbine blade. The effect has since been questioned as it has been shown to be difficult to diagnose and may have been confused with traumatic injury associated with direct collisions (Rollins et al. 2012).

The reasons that bats may fly in close proximity to wind turbines are not fully understood. Some techniques intended to deter bats from approaching wind turbines have been tried overseas. The great majority of them are experimental and they have not been widely applied to commercial wind energy facilities and there is no body of peer-reviewed rigorous evidence for their performance. At present a 'best practice' mechanism for deterrence of bats in Australian environments is not available.

A range of microbat species recorded within the project area occur at varying frequencies and are known to fly at heights above ground level that put them at risk of collision with the turbine rotor blades. Based on the specifications of the turbine options being considered for the operational phase of the project at the time of the Nature Advisory assessment, the worst-case scenario turbine will result in a rotor swept area a rotor swept height of between 50–300 metres (hub located at 200 metres), and a total rotor swept area of 31,416 square metres.

Ultrasonic bat detectors do not provide absolute abundance data, as it is not possible to distinguish between multiple individuals flying past the detector, or one individual making repeated passes. Similarly, call data does not provide information on the behaviour of the bat such as the direction or height of flight. Species abundance or flight frequencies therefore cannot be determined from bat call data. The number of calls recorded provides a comparable index of activity to estimate the foraging selectivity of bats between habitat types across the site.

As a consequence, there are also no available methods to model or forecast potential numbers of collisions that might occur. Records of bat echolocation calls are the best available method to consistently determine species of bats present and to provide a representation of the variable activity of a given species. It should be noted that bat calls may not be an accurate surrogate measure of bat flight activity and that detection and recording of echolocation calls are subject to a variety of limitations.

Assessment of potential impacts to microbats as a result of turbine strike has therefore been undertaken by way of a qualitative risk assessment used to determine the likelihood of impact and the potential consequences of any impact that may occur and is provided in Appendix 3.2.

## 3.3 Summary of collision risk

Based on the tables in Appendix 3, a total of 35 species, including 32 species of birds and three species of bats, are considered to be at more than a negligible risk of impact from turbine collisions as a result of the project.

No bird or bat species have been assessed as being subject to Moderate or higher risk of impact resulting from blade strike. Moderate risks relate to either an expectation for more frequent collisions with turbines due to a species proclivity for flights within rotor swept height, or more substantial impacts to local populations due to individuals comprising a more significant and/or substantial portion of the local population.

A full list of species considered to be at-risk is summarised Table 3 and Table 4.

It should be noted that all species assessed are considered to have no more than a negligible risk of impact from barrier effect for the proposed wind farm layout.

As impacts associated with blade strike to the above species cannot be quantified and are considered uncertain, adaptive management is required allowing for ongoing monitoring of bird and bat mortality, continual testing of the assumptions of the impact assessment, and implementation of adaptive management measures to reduce measured impacts.

It should be noted that the vast majority of bird and bat species recorded or have the potential to utilise the vegetation within or surrounding the subject land are considered to have a low or negligible risk of collision mortality, with no significant broader impacts to regional populations anticipated.

There are no bird or bat species that are considered to be subject to be a high risk of collision mortality.

**Table 3 Species determined to be at-risk through qualitative risk assessments**

| Common name | Scientific name | Threat listing | | Risk Assessed Species Risk Conclusion |
|---|---|---|---|---|
| | | EPBC Act | BC Act | |
| **Birds** | | | | |
| **Black Falcon** | *Falco subniger* | - | VU | Low |
| **Black Kite** | *Milvus migrans* | - | - | Low |
| **Black-shouldered Kite** | *Elanus axillaris* | - | - | Low |
| **Brown Falcon** | *Falco berigora* | - | - | Low |
| **Brown Goshawk** | *Accipiter fasciatus* | - | - | Low |
| **Fork-tailed Swift** | *Apus pacificus* | Mi | - | Low |
| **Little Eagle** | *Hieraaetus morphnoides* | - | VU | Low |
| **Pink Cockatoo** | *Lophochroa leadbeateri* | EN | VU | Low |
| **Nankeen Kestrel** | *Falco cenchroides* | - | - | Low |
| **Peregrine Falcon** | *Falco peregrinus* | - | - | Low |
| **Regent Parrot (eastern subspecies)** | *Polytelis anthopeplus monarchoides* | VU | EN | Low |
| **Wedge-tailed Eagle** | *Aquila audax* | - | - | Low |
| **Whistling Kite** | *Haliastur sphenurus* | - | - | Low |
| **White-bellied Sea-Eagle** | *Haliaeetus leucogaster* | - | VU | Low |

| Common name | Scientific name | Threat listing | | Risk Assessed Species Risk Conclusion |
|---|---|---|---|---|
| | | EPBC Act | BC Act | |
| **Bats** | | | | |
| **Gould's Wattled Bat** | *Chalinolobus gouldii* | - | - | Low |
| **White-striped Freetail-bat** | *Austronomus australis* | - | - | Low |
| **Yellow-bellied Sheathtail-bat** | *Saccolaimus flaviventris* | - | VU | Low |

**Table 4 Species not subject to qualitative risk assessment determined to be at-risk**

| Common name | Scientific name | Listing status | | Recorded in subject land |
|---|---|---|---|---|
| | | EPBC Act | BC Act | |
| **Australian Pelican** | *Pelecanus conspicillatus* | - | - | Yes |
| **Australasian Bittern** | *Botaurus poiciloptilus* | EN | EN | No |
| **Australasian Darter** | *Anhinga novaehollandiae* | - | - | No |
| **Australasian Shoveler** | *Anas rhynchotis* | - | - | No |
| **Pied Cormorant** | *Phalacrocorax varius* | - | - | No |
| **Black Swan** | *Cygnus atratus* | - | - | Yes |
| **Blue-billed Duck** | *Oxyura australis* | - | VU | No |
| **Caspian Tern** | *Hydroprogne caspia* | Mi | - | No |
| **Great Cormorant** | *Phalacrocorax carbo* | - | - | Yes |
| **Grey Teal** | *Anas gracilis* | - | - | No |
| **Gull-billed Tern** | *Gelochelidon nilotica* | Mi | - | No |
| **Little Black Cormorant** | *Phalacrocorax sulcirostris* | - | - | No |
| **Little Pied Cormorant** | *Microcarbo melanoleucos* | - | - | No |
| **Australian Wood Duck** | *Chenonetta jubata* | - | - | Yes |
| **Pacific Black Duck** | *Anas superciliosa* | - | - | No |
| **Pink-eared Duck** | *Malacorhynchus membranaceus* | - | - | No |
| **Straw-necked Ibis** | *Threskiornis spinicollis* | - | - | Yes |
| **Whiskered Tern** | *Chlidonias hybrida* | - | - | No |

## 3.4 Turbine risk assessment

The potential risk of impact to threatened species associated with turbine placement, barriers to movement and potential collision with turbine blades, has been assessed on a per turbine basis (Appendix 3). Factors considered when assessing the risk associated with the turbines prior to any operational mitigation measures and strategies being implemented include:

- Proximity to potential microbat roosts.
- Distance to foraging habitat post construction.
- Connectivity and likely movement pathways:
- Presence of raptor nests.
- Fauna sightings within the development footprint and surrounds.
- Presence of hollow-bearing trees.
- Proximity to National Park estates, travelling stock reserves and conservation reserves.
- Canopy buffer to rotor swept height.

The preliminary turbine layout was influenced by consideration of potential biodiversity impacts, as outlined in the scoping report (Niche Environment and Heritage 2021), and outlined in detail within Section 7 of the BDAR. Rigorous avoid and minimise steps have been undertaken by Windlab and include but are not limited to:

- Remove turbines north of the transmission line to increase the buffer with the National Park Estate.
- Reduction of turbines from 107 down to 96.
- Avoidance of key high value biodiversity areas identified, including TECs, travelling stock reserves and threatened species habitat through re-design of infrastructure placement.
- Minimise the number of potential crossings of ephemeral water courses required for access tracks and/or cables.
- Sighting such that the majority of WTGs are located in dry-land cropping paddocks, with approximately 90% of the development footprint allocated within Category 1 – exempt land.
- Avoidance of key waterbodies and placement of all WTGs are place more than 400 m from areas of potential wetland.
- Relocation of WTGs to increase separation between rotor swept areas and allow for greater turbine free flyways and reduction in barrier effect and potential collision risks.

The Draft Turbine Risk Assessment and Avoidance Guidance (NSW DCCEEW 2023b) relating to the potential consequences of turbine strike has been adapted to include the level of risk each species is considered to be at from collision with turbines in the context of the subject land. The recommended turbine consequence severity rating included in the BCD guidance applies a 'one size fits all' approach based on threat status and gives no consideration to potential frequency of impact (turbine strike) or local population dynamics. Nor does it consider species listed as Migratory under the EPBC Act. It is important to consider

these and other factors when determine how severe the consequences on one (or more) turbines strike may be to any given species.

The adapted BCD turbine strike consequence severity rating is provided in Table 5 below.

**Table 5 Adapted BCD turbine strike consequence matrix**

| Threat status (BC Act or EPBC Act) | Bird or bat species 'at-risk' rating | | | | |
|---|---|---|---|---|---|
| | Negligible | Low | Moderate | High | Severe |
| At-risk (non-threatened) | Negligible | Minor | Moderate | Moderate | Major |
| Migratory | Negligible | Minor | Moderate | Major | Severe |
| Vulnerable | Negligible | Minor | Moderate | Major | Severe |
| Endangered | Minor | Moderate | Major | Severe | Severe |
| Critically Endangered or potential SAII | Minor | Major | Major | Severe | Severe |

Turbine strike likelihood has been assessed relative to the criteria outlined in the Draft Turbine Risk Assessment and Avoidance Guidance (NSW DCCEEW 2023b), with adjustments made to the recommended criteria to better suite site conditions and to focus on potential flightpaths of at-risk species.

Turbine strike likelihood criteria, developed for the project are presented in Table 6 below. The following turbine parameters have been included as the 'worst case scenario' turbine being considered for the project:

- Hub height: 200 metres.
- Blade length: 100 metres.
- RSA height: 49 metres (minimum) – 300 metres (maximum).

**Table 6 Turbine strike likelihood criteria**

| Key habitat features | |
|---|---|
| • Key wooded habitats for at-risk species that occur on both sides of a turbine, such that flights between habitat features/patches are more likely to occur within, or in close proximity to, RSA.<br>• Patches are ≥1 ha in area providing larger, higher quality habitat likely to be used more frequently, by more birds and bats, and more regularly by resident species.<br>• Lakes, wetlands and larger watercourses on one (or both) side of a turbine increasing the risk of collisions from fauna flying into or out of the habitat feature. Relevant for flood years only.<br>• Migratory or nomadic species habitual flight path, or key local flyways | |
| **Buffer distance to habitat feature** | **Likelihood of turbine strike** |
| **Key habitat features occur within 200 m buffer from blade tip.** | **Probable**<br>An event is expected to occur in most circumstances (>95%). |
| **Buffer distance to habitat feature** | **Likelihood of turbine strike** |
| **Relevant habitat features occur within 200 m to 500 m buffer from blade tip.** | **Possible**<br>An event could occur during most circumstances (>50% - <95%). |
| **Relevant habitat features occur within 500 m to 1000 m buffer from blade tip.** | **Unlikely**<br>An event could occur during some circumstances (>5 - <50%). |
| **Relevant habitat features occur greater than 1000 m from blade tip.** | **Rare**<br>An event may occur only in unusual circumstances (<5%). |

Turbine risk combines the results of the assessment of turbine strike consequence and turbine strike likelihood and has again been based on the Draft Turbine Risk Assessment and Avoidance Guidance (NSW DCCEEW 2023b). Adjustments have again been made to the recommended risk rating to better reflect the habitats, aerial fauna, and movements patterns within the subject land, as well as the conclusions of the risk assessments undertaken for all at-risk species.

The turbine risk assessment matrix applied to the project is outlined in Table 7.

**Table 7 Turbine risk assessment matrix**

| Likelihood criteria | Consequence criteria | | | |
|---|---|---|---|---|
| | **Minor** | **Moderate** | **Major** | **Severe** |
| **Rare** | Low | Low | Moderate | High |
| **Unlikely** | Low | Moderate | High | High |
| **Possible** | Moderate | Moderate | High | Very high |
| **Probable** | Moderate | High | Very high | Very high |

The final turbine risk assessment results are presented in Appendix 3. Table 8 below summarises then number of turbines within each risk category for the project.

**Table 8 Turbine risk assessment summary**

| Turbine risk | No. of turbines | Comments |
|---|---|---|
| **Low** | 36 | - |
| **Moderate** | 52 | Three turbines (WTG 19, WTG 28, WTG 29) considered Moderate risk only during flood years and collision risk for Australasian Bittern and other seasonal wetland species is elevated above average years. |
| **High** | 8 | Two turbines (WTG 18, WTG 30) considered High-risk only during flood years and collision risk for Australasian Bittern and other seasonal wetland species is elevated above average years |
| **Very High** | 0 | - |

Additional operational mitigation strategies have been developed for higher risk turbines and with tier triggers outlined in Section 4.3. The remaining turbines have been assessed as low risk however will also be subject to additional mitigation strategies to reduce potential impacts to threatened species.

Following the implementation of stringent safeguards, including mitigation measures, triggers, curtailment strategies and monitoring periods, it is anticipated that the overall turbine risk for collision and barrier effect impacts will be low.

# 4 Significant impact and trigger levels

Information in this section is provided as part of the TARP.

## 4.1 Guiding principles for determining significance of impacts

While the most desirable outcome for the project is that the wind farm will operate without any negative effect on birds and bats, it is recognised that some impact is likely to occur. The overarching objective will be that the wind farm does not have a significant impact on the viability of the population of any species. It is worth noting that density dependence is an important ecological concept of relevance for consideration of effects on viability of wildlife populations. In essence, the size of any natural population is regulated by availability of resources to support it. This will include food, breeding sites, roost sites and mating opportunities, all of which in combination represent 'habitat' for the species in question.

Where an impact removes habitat, the population will be reduced as a direct consequence. However, where the key resources for the species are not reduced and the population is otherwise stable, the mortality of one individual makes resources available to another whose survival prospects are improved, and the net result is that the size of the population is not altered. Construction and operation of the wind farm will have little impact on resource availability for most species of birds and bats. Mortalities due to turbine collisions can be expected to function in accordance with density dependence, with little influence on the equilibrium of affected populations.

Various guidelines published by the Commonwealth for application of the EPBC Act offer some principles of value in consideration of impacts on populations. Significant impact guidelines for threatened and migratory species listed under the EPBC Act are contained in *Matters of National Environmental Significance: Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013), which also provides criteria for what might constitute a 'significant impact'. However, the criteria are not quantifiable in numbers of individual animals. Six species listed under the EPBC Act were identified as potentially being 'at-risk'.

The *EPBC Act Policy Statement 2.3 Wind Farm Industry* (DEWHA 2009) provides some further explanation and examples relative to potential effects of the wind industry. The following excerpt is useful in its indication that the risk should be considered as proportional to the population size of particular species:

> *An activity that affects, or is likely to affect, a small number of individuals usually would not be expected to have a significant impact on the species as a whole. However, when a species or community is in small numbers nationally, or its distribution or habitat is limited, or if the habitat has particular importance for the species, the activity could have a significant impact. In general, this would apply to species or communities that are most at-risk of extinction and are, as such, listed as critically endangered or endangered.*
>
> *An action is likely to have a significant impact on a species listed as vulnerable where it significantly affects an important population of that species. An example might be where a wind farm is proposed on an island or headland, or near a wetland, that has a key breeding population of a bird species listed as vulnerable. The breeding frequency and success rate for that species would also be relevant considerations.*

Three of the at-risk species for the project are covered by the *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE 2015), nonetheless it provides further guidance in that it considers that a

significant impact would entail mortalities equalling or exceeding 1% of the population of a species and that further investigation would be required if it equalled or exceeds 0.1% of the population.

## 4.2 Defining performance criteria

The Commonwealth guidance documents clearly indicate that the level of impact that may be significant is based on the measure of change experienced by the population of a threatened or migratory species. This population approach is ecologically meaningful as it responds appropriately to the population sizes of different species. Ideally, it would be possible to consider a number of turbine collision mortalities for a particular species as a proportion of its entire population, then determine numbers and frequency of collisions that would warrant management response(s) according to whether they represent an ecologically important influence on the population's viability (Smales 2017). That approach requires good estimates for the population sizes of relevant species; however, accurate population estimates are not available for any of the at-risk species for the project.

It is considered to be extremely unlikely that bird and bat fatalities due to collisions by any species in the wind farm will be sufficient to represent a significant impact on the species overall population (e.g., equal to or exceeding 1% of the population of any species). However, in the absence of numerical population data for each species, pre-determined trigger levels will be applied that are substantially below the numbers of collision mortality events that are considered likely to represent a significant impact on the viability of the overall population of any species (i.e., 1% of the population). This approach is precautionary and considered the most appropriate means of effectively measuring impacts to any at-risk populations or species during the operational phase of the development, allowing for adaptive mitigation responses to proactively avoid any likelihood of impacts, let alone significant impacts, to species. Alerts, trigger levels and adaptive management actions will apply where the number of collisions in a defined period represents a low, but uncertain potential to result in a negative effect on the local population of a species.

These trigger levels are detailed in Section 4.3 below.

## 4.3 Trigger levels for management responses to bird and bat collisions

Trigger levels are for numbers of bird and bat fatalities detected during carcass searches (see Section 6.2). It is important to note that the number of fatalities detected by searches will almost certainly not represent the total number of animals killed, because searches rarely detect all carcasses and because some carcasses will be removed by scavengers before they can be found. These effects are well known and there is an existing science for determining estimates of total mortalities from numbers of mortalities detected during searches (Huso et al. 2017). While estimation of total numbers of collision fatalities is important and will be undertaken for the proposed wind farm, the small numbers of collisions that generally occur at wind farms in Australia most often result in estimates of total mortality with very large confidence intervals (CIs), usually using 95% CI. For that reason, extrapolated estimates of total mortality do not provide a sound basis for use as trigger levels.

At a minimum, and pending results of detailed baseline data, the following definitions (Table 9) are considered a trigger-level alert and if realised would warrant an increased focus on areas of concern if they were to occur. Mitigation measures relevant to each alert level are described in Section 7.

**Table 9 General investigation and monitoring triggers for bird and bat strike**

| Tier | Type | Trigger | Mitigation |
|---|---|---|---|
| **Tier 1 alert** | Threatened species | Where any carcass; feather spot; or injured individual (likely caused as a result of turbine collision) is found under or close to (<120 m from) a wind turbine during any single mortality search or incidentally by wind farm personnel. | Tier 1 mitigation instigated |
| | Non threatened 'at-risk' species | Where three or more carcasses; feather spots; or injured individuals (likely caused as a result of turbine collision) of a single species are found under or close to (<120 m from) a wind turbine during any single mortality search or incidentally by wind farm personnel. | |
| | Other protected species | Where ten or more carcasses; feather spots; or injured individuals (likely caused as a result of turbine collision) of a single species are found under or close to (<120 m from) a wind turbine during any single mortality search or incidentally by wind farm personnel. | |
| | Other | An at-risk or threatened species is recorded nesting within 200 m of an operational turbine blade tip. | |

The following definitions (Table 10) are considered an unacceptable impact and require detailed investigation. The results of this investigation would be used to inform any temporary and/or permanent mitigation measures required. Adaptive management responses for the below triggers are detailed in Section 4.6.

**Table 10 General investigation and monitoring triggers for bird and bat strike**

| Tier | Type | Trigger | Mitigation |
|---|---|---|---|
| **Tier 2 impact** | Non threatened 'at-risk' species | • Where population* numbers are known:<br>– Any impact that is likely to reduce the total species' population by more than 1% over a two-year period; or<br>• Where population numbers are not known:<br>– Five or more carcasses of one non-threatened at-risk species identified in the tables in Section 6.1.6 of the BDAR (Biosis 2024a) are found under or close to (<120 m from) a wind turbine within a two month cycle** or during incidental searches.<br>• Where three or more Tier 1 alerts for non-threatened 'at-risk' species are triggered in a six-month period. | Tier 2 and 3 mitigations instigated |
| **Tier 3 impact** | Threatened species | • Where population* numbers are known;<br>– Any impact that is likely to reduce the total species' population by more than 1% over a five-year period; or<br>• Where population numbers are not known;<br>– Where three or more carcasses, feather spots; or injured individuals (likely caused as a result of turbine collision) of a single species are found under or close to (<120 m from) a wind turbine within a two-month cycle** or during incidental searches.<br>• Where three or more Tier 1 alerts for threatened species are triggered in a six-month period. | |

***Population relevant to the operation of the wind farm will be determined (where possible) in consultation with NSW DCCEEW via a detailed monitoring plan and based on baseline and ongoing utilisation survey data and dependent on species-by-species basis.**

****A two-month cycle is the search of all turbines split across a two-month period i.e., 48 turbines in one month, the remaining 48 the following month.**

Mitigation measures are outlined below to reduce the number of Tier 1, Tier 2 and Tier 3 impacts. Broadly, these will include general mitigation measures and specific trigger related mitigation, including but not limited to, those demonstrated in Table 11 below.

**Table 11 Mitigation measures**

| Type | Mitigation considerations and response |
|---|---|
| **General** | • Ongoing reassessment of species risk levels and thus relevant trigger-levels. See Section 6.5.3.<br>• Periodic review of the turbine mitigation strategy and monitoring program every two years. See Section 6.5.3.<br>• Incorporate any operational mitigation measures developed during the preparation of the Biodiversity Management Plan (BMP) relating to active nests/ nest trees.<br>• Minimising availability of raptor perches on infrastructure within close proximity to turbines and overhead powerlines. See Section 5.4.<br>• Installation of marker balls, flags or rotating markers on transmission lines to prevent collisions and deter perching. See Section 5.4 and Section 7.1.3.<br>• Prompt animal carcass removal within 200 m of a turbine (within 24 hours of discovery) to minimise raptor scavenging opportunities and reviewed annually. See Section 5.6.<br>• Participation on local (site-based) and co-ordinated (LLS and National Parks and Wildlife Service [NPWS]) feral animal control programs (i.e., European Rabbits *Oryctolagus cuniculus*, wild Dogs *Canis lupus familiaris* and European Foxes *Vulpes vulpes*) and in line with carcass removal protocols. See Section 5.5.<br>• Investigation of feasibility and suitability of potential deterrents or evolving technologies (Section 5), such as:<br>– Ultrasonic technologies, such as the SMART system by Wildlife Acoustics (Section 5.2.1).<br>– Radar (or optical sensor) or live camera technologies for automatic, reactive and temporary curtailment of turbines at high-risk turbines (Section 5.2.1).<br>– Avoiding or limiting the use of artificial lighting (synchronising flashing red light if required) on turbines and other infrastructure within close proximity to turbines, unless required for avian safety (or other similar) purposes (Section 5.3.2).<br>– Consider novel deterrent techniques related to blade visibility (i.e., painting one blade a different colour, Section 5.2.2).<br>– Use of 'acoustic lighthouse' to deter avian activity by broadcasting, for example, audible frequencies of 4–6 kHz in front of turbine towers to encourage avoidance behaviour (as detailed in Boycott et al. (2021), Section 5.2.1).<br>• Maintenance of a minimum 400 metre setback buffer between the blade tip of operational turbines and suitable wetland habitats determined to provide suitable habitat for certain 'at-risk' species (Section 5.1.1):<br>– During rare flood events it is possible that habitat provided by larger ephemeral waterbodies such as Condoulpe Lake may increase in area such that suitable habitat for At-risk waterbirds occurs in close proximity to operational turbines.<br>– Turbines will be curtailed to reduce the risk of turbine collision when suitable habitat occurs within 400 m of a blade tip of a turbine.<br>– End of curtailment would be determined via field survey confirmation that birdlife and habitat value had reduced significantly enough back to pre-flood conditions for operation of the turbines to not increase collision risk for at-risk species. Further information is provided in Section 9.1.2 of the BDAR (Biosis 2024a).<br>• A 100-metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable Regent Parrot foraging and roosting habitat and along the known movement corridor along the western boundary of the subject land. A slight overlap remains adjacent to WTG 48, however Windlab is committed to micro-siting this turbine outside the recommended setback. See Section 5.1.2. |

| Type | Mitigation considerations and response |
|---|---|
| | • Annual reporting to include triggers relating to the re-assessment of the mitigation strategies to be implemented over the following year of operation where Tier 1 and/or Tier 2 and 3 triggers have occurred (See Section 6.5.2, Section 7 and Section 7.2):<br>– Additional triggers will be developed that consider the actual/extrapolated impacts to bird and bat species calculated across the preceding year and include associated mitigation measures and potential additional offsets for the following year of operation. |
| **Tier 1 alert mitigation and response** | • Initiate rapid assessment framework for Tier 1 alerts within the BBAMP to identify the most effective mitigation measures to be implemented (Section 7 and Section 7.2), including but not limited to:<br>– Increased monitoring of a relevant turbine(s) for a seven-day period following a Tier 1 alert to determine a one-off event, or a potential ongoing event. See Section 7.1.1.<br>– Increased frequency of carcass removal, or increased use of other methods of deterrence (where relevant). See Section 7.1.1.<br>– Consideration of mobile radar installation or use of 'acoustic lighthouses' for a minimum seven-day period for automatic, reactive and temporary curtailment of turbines relating to a Tier 1 alert for medium to large threatened or at-risk bird species. See Section 7.1.2.<br>– In the case of at-risk or threatened species nesting within 200 m of an operational turbine blade tip, the nesting event will be allowed to occur, with increased monitoring, potential for temporary curtailment in line with Tier 2 and Tier 3 recommendations until removal of the nest following the breeding event can be undertaken. Any mitigation is to be consistent with project approval conditions. See Section 7.1.1 and Section 7.1.7.<br>– The assessment is to determine possible causes of alert and identify if additional mitigation is required. See Section 7 and Section 7.2. |
| **Tier 2 and 3 impact mitigation and response** | • Initiate rapid assessment framework for Tier 2 and Tier 3 triggers within the BBAMP to identify the most effective mitigation measures to be implemented. See Section 7 and Section 7.2.<br>• Consider temporarily ceasing operation of a turbine(s) relevant to the impact trigger event during the rapid investigation. See Section 7.1.7.<br>• Increased daily carcass searches for 14 days following discovery of a Tier 2 or Tier 3 trigger, to be undertaken within the subsequent four weeks of the trigger event by a suitably trained ecologist, environmental advisor and/or detector dog services. See Section 7.1.1.<br>• The assessment is to determine possible causes of the impact and identify the additional mitigation measures required to be implemented to minimise recurrence of the impact (as far as is practicable). See Section 7.<br>• Pending an investigation into Tier 2 or Tier 3 impacts being detected, the following (but not limited to) mitigation options may be required in consultation with Windlab, suitably qualified ecologists, wind farm subject matter experts and NSW DCCEEW (Section 7 and Section 7.2):<br>– Implementation, increase, or relocation of collision risk reduction technologies such as SMART curtailment (microbats) or avian detection systems (birds). See Section 5.2.1, Section 5.3, Section 7.1.2, and Section 7.1.4.<br>– Implementation of low-wind speed, nocturnal curtailments to reduce the potential for microbat collision during periods of highest activity. See Section 5.2.1, Section 7.1.2, and Section 7.1.4.<br>– Temporary turbine shut down during periods of low visibility (i.e., fog), if suspected as the cause of collision(s). See Section 7.1.7.<br>– Consider novel deterrent techniques related to blade visibility (i.e., painting one blade a different colour). See Section 5.2.2.<br>– Use of 'acoustic lighthouse' to deter avian activity by broadcasting, for example, audible frequencies of 4–6 kHz in front of turbine towers to encourage avoidance behaviour (as detailed in Boycott et al. (2021)). See Section 5.2.1.<br>– Short-term seasonal shutdowns (e.g., based on migratory periods, ephemeral wetland flood events, or nesting events). For example, in the case of an at-risk species or |

| Type | Mitigation considerations and response |
|---|---|
| | threatened species nesting within 200 m of a turbine, the nesting event will be allowed to occur, with increased monitoring and/or temporary curtailment. See Section 7.1.7.<br>– Short-term shutdowns where there is a delay in getting the necessary personnel to site to undertake increased turbine monitoring and relevant assessments. See Section 7.1.7.<br>– Immediate reassessment of current mitigation strategy being implemented and if required adjustment (or inclusion if not being implemented for the specific turbine) to reduce the potential for reoccurrence of the unacceptable impact. This reassessment may be required on a temporary or permanent basis. See Section 7 and Section 7.2. |

## 4.4 Trigger levels for barrier effects

Although the overall risk of barrier effects and altered flight behaviour based on the information available and literature review is considered low, adaptive management, additional mitigation and compensatory measures may be required should a residual impact resulting from barrier effects occur.

If after the five-year ongoing monitoring period, there is a noted discernible statistical reduction or anomaly in abundance or activity of an at-risk or threatened species, additional investigations into possible causes would occur. If it is determined that the operational wind farm was a key factor, additional assessment against key relevant Test of Significance criteria or Significant Impact Criteria would be used to quantify or measure the level of impact, and if determined that an event resulting from barrier effects warranted additional mitigation, compensatory measures or species specific offsetting, these would be employed in consultation with NSW DCCEEW, Windlab, the project ecologist and Cth DCCEEW.

## 4.5 Monitoring of performance

Assessment against performance criteria and trigger thresholds will require a program of ongoing operational monitoring of bird and bat site utilisation as prescribed in Section 6.1, as well as a regime of searches for dead birds and bats under turbines to monitor collisions as detailed in full in Section 6.2.

## 4.6 Adaptive management framework

A post-commissioning monitoring study is set out below. Its results will be used to inform subsequent decisions about the requirement for any modified or additional management actions aimed at further reduction of effects on threatened and at-risk species. Contingency measures and corrective actions are outlined in Section 7.1 and a framework for their application provided in Section 7.2.

Within three months of the completion of each year of all activities set out in this BBAMP, a report will be prepared and submitted to NSW DCCEEW. The report will provide results of all investigations and studies related to effects of the proposed wind farm on bird and bat at-risk species. In collaboration with NSW DCCEEW, the results will be considered to determine whether any changes to processes or management actions are required. Any such changes will be focussed on improvements to reduce impacts on bird and bat at-risk species, specifically, in the event that detected collisions with turbines by any such species have reached or exceeded trigger levels set out herein.

Appropriate mitigation measures can be prepared only if a cause, or causes, of ecologically significant impacts on the relevant species is known. If a cause is not readily apparent, then investigation of the reason(s) for the impact must be undertaken prior to proposal of a mitigation strategy. Advice from NSW DCCEEW will be sought with regard to design and implementation of any such investigations and of an

ultimate mitigation strategy, if required. NSW DCCEEW will be notified within 10 working days of determination by Windlab or the contracted qualified ecologist that a trigger level for any at-risk species is detected. Liaison with NSW DCCEEW will commence to determine a strategy aimed at reducing the incidence of collisions as soon as is practical thereafter. A decision framework for actions to be taken following a trigger level event is provided in Section 7.2.

Any mitigation strategy will be tailored to the needs of the particular species affected and will be formulated if and when the nature and cause(s) of the impact are known. It will be submitted to NSW DCCEEW and will be implemented when approved. The BBAMP deliberately avoids being overly prescriptive as to the exact mitigation measures to be implemented to allow for novel technologies to be explored and for mitigation measures to be truly adaptive, whereby management measures are tailored to the circumstances of the impact trigger and a rigorous program of monitoring can be determined to test any management measures implemented.

Commencement of wind farm operation is defined as the date when all of the following have occurred:

- All turbines are commissioned and tested.
- All turbines have been handed over from the Supply and Installation Contractor to the Developer.
- Australian Energy Market Operator testing is complete (grid compliance testing).

# 5 Preventative mitigation measures

This section details the ongoing, preventative mitigation measures committed to by Windlab, to manage operational risks of the wind farm and minimise impacts to birds and bats. As part of the adaptive management framework of the BBAMP, the below mitigation measures are subject to change throughout the duration of the BBAMP based on the results of monitoring surveys, technological advances, or new alternative mitigation measures that may be more effective or appropriate for the site.

## 5.1 Setbacks

### 5.1.1 Setbacks from wetland habitat

A key strategy to minimise the potential for at-risk waterbird species, such as Australasian Bittern, Australian Pelican and Blue-billed Duck, to collide with operational turbine blades is the implementation and maintenance of a minimum 400 metre buffer between suitable large wetland habitats and operational blade tips. Suitably large ephemeral wetlands, in proximity to the operational wind farm, with the potential to increase sufficiently in the area of suitable habitat available during flood years are considered to be restricted to Condoulpe Lake. Other waterbodies such as Dusty Lake, Harveys Lake, Lake Talbetts and The Forrest Creek occur too far from the wind farm to pose an increased collision risk, and Condoulpe Creek is also unlikely to provide sufficient habitat value, in close enough proximity to operational turbines.

The frequency with which Condoulpe Lake could flood and result in the presence of wetland habitat for at-risk species within 400 metres of an operational turbine is not expected to be high. Condoulpe Lake flooded in summer 2022/2023, towards the end of the triple La Niña event that brought increased rainfall to south-eastern Australia between September 2020 and February 2023. Water in the lake was at its highest levels between January and February 2023, after flooding in the upper reaches of the broader catchments reached the local area. However, water levels and thus any associated wetland habitats did not occur within approximately 1 kilometre of proposed turbine (blade) locations. Plate 1 below displays Normalized Difference Water Index (NDWI) multi-spectral imagery from the online Copernicus Data Space Ecosystem browser (Copernicus 2024) of Condoulpe Lake from 10 January 2023, when the lake was near maximum inundation over the summer 2022/2023 period. NDWI is most appropriate for viewing and mapping of waterbodies (Copernicus 2024), with blue areas representing water in the landscape, ranging through white to green areas that do not represent standing water. It can be seen from the 1075 metre diameter buffer rings overlaying the NDWI imagery, that the water was no closer than approximately 1 kilometre from the proposed locations of the blade tips during maximum inundation.

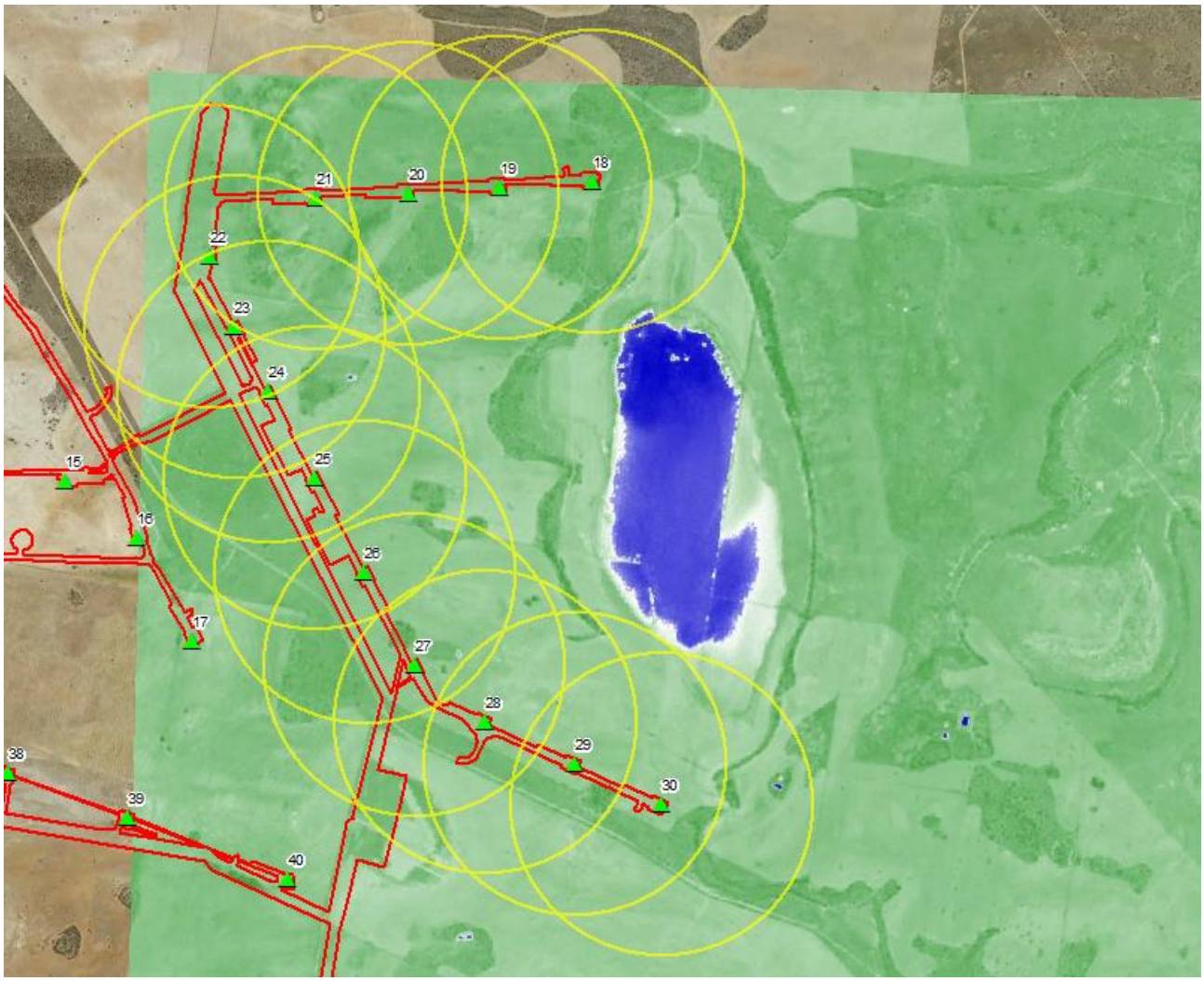



**Plate 1 NDWI imagery of Condoulpe Lake from January 2023 illustrating wetland habitat during flooding remains approximately 1 km from operational turbine blades**

For water and associated wetland habitats to reach within 400 metres of the blade tips, a significant weather event would need to occur, the frequency of which would be unlikely to occur multiple times in the expected 30-year lifetime of the project. La Niña conditions over three consecutive summers, as contributed to the water levels observed in summer 2022/2023, are rare and have only occurred three times since 1950 (in 1973-76, 1998-2001, and 2020-2023) (ARC 2022).

Details of catchment-scale flood event monitoring requirements that would trigger additional monitoring of habitats in proximity to the operational wind farm (i.e., Condoulpe Lake) are included herein – HOLD POINT.

Threshold triggers for further investigation and potential implementation of seasonal event-based mitigation strategies to maintain the minimum 400 metre setbacks are included herein – HOLD POINT.

Additional mitigation strategies may include; increased monitoring of turbines and habitats to detect the presence of target at-risk species (Section 7.1.1), installation of deterrent measures such as acoustic lighthouses (Section 7.1.2), installation of mobile (or fixed from commissioning) automatic detection systems to monitor for the species presence (Section 5.2.1) and implement temporary turbine shutdowns, or longer-term turbine shutdowns until such time as floodwaters and habitat have receded back to >400 metres from the blade tips (Section 7.1.7).

Thresholds for the end of increased mitigation to determine when suitable wetland habitats were no long present within the critical 400 metre setbacks are included herein – HOLD POINT.

### 5.1.2 Setbacks from threatened species habitat

A key strategy to minimise the potential for at-risk parrot species, such as Regent Parrot *Polytelis anthopeplus monarchoides*, to collide with operational turbine blades is the implementation and maintenance of a minimum 100 metre buffer between suitable foraging and roosting habitats, and along the known movement corridor along the western boundary of the wind farm, and operational blade tips.

## 5.2 Turbine mitigation for birds

### 5.2.1 Automated avian detection systems

Technology related to smart curtailment systems for birds are advancing at a rapid rate. Automated avian detection systems allow for detection of bird species and the triggering of curtailment of select turbines. Automated detections system are being used in Australia and around thew world as new and innovative technology available to operational wind farms to reduce potential bird and bat collisions. A recent peer-reviewed paper published by Orsted (an offshore wind energy developer) and DHI (a water software development and engineering firm) provides a catalogue and assessment of available monitoring technologies for birds and bats at offshore wind farms, with a focus on managing the risk of collision (Skov et al. 2023). Whilst the focus of the paper relates to offshore wind farms, the technologies reviewed have application potential onshore, and at the Junction Rivers site. The assessment includes a comparison of the multiple applications for the following technologies:

- Radar (2D and 3D)
- Digital camera
- Accelerometer
- Acoustic equipment, such as 'acoustic lighthouse' to deter avian activity (broadcasting audible frequencies of 4–6 kHz in front of turbine towers to encourage avoidance behaviour, as detailed in Boycott et al. (2021)).
- Large-scale survey platform and large-scale telemetry

Table 12 below provides an overview of the results of the comparison and provides insight into the suitability of the various technologies available depending on the desired application and mitigation requirements.

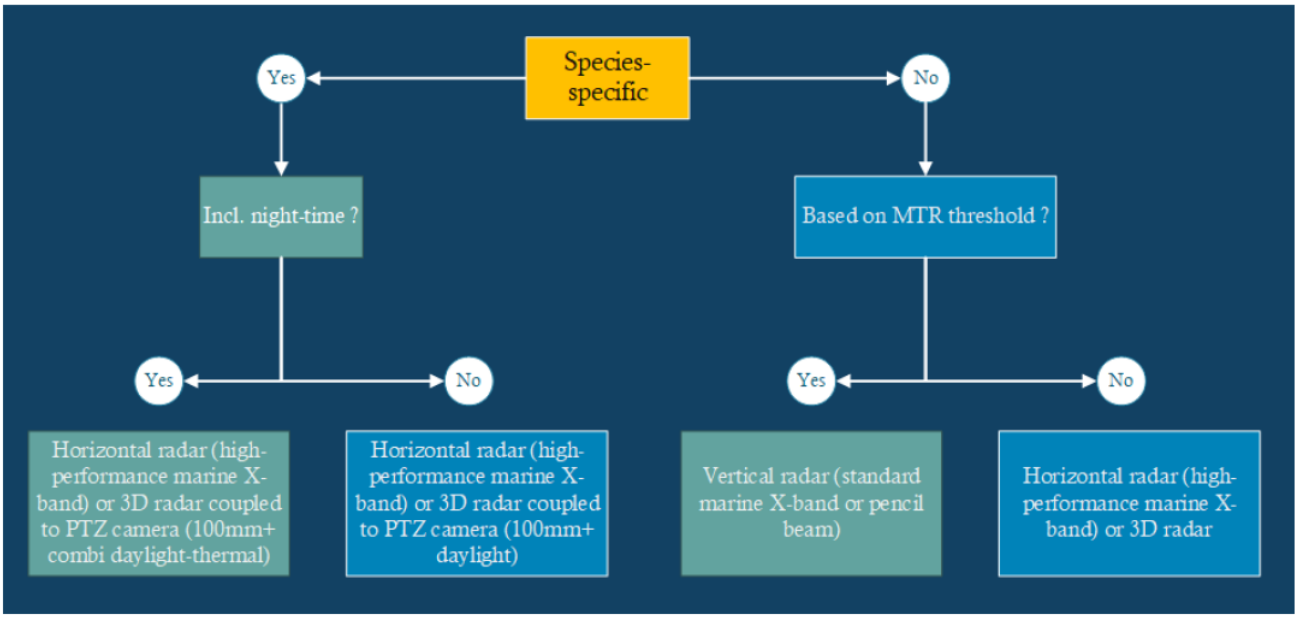
The paper goes on to recommend the combination of technologies considered to best meets the aims of the mitigation. For example, if the mitigation objective was to remotely shut down a turbine to prevent collision with a certain highly at-risk species, Skov et al. (2023) recommend the following combination of technologies (Graph 1).

The applicability and use of automated detection systems at the wind farm requires further critical assessment, however assuming the site is suitable for installation of such technologies, automated detection systems may be a valuable method to avoid potential collisions for at-risk species. The effectiveness of any installed automated system would be monitored using carcass search methods as detailed in Section 6.2.1.

**Table 12 Scoring system applied in the assessment of monitoring technologies (Skov et al. 2023)**

| | | Implementation | | | Density | | Species | | | | Avoidance | | | Collision | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | Equipment | Retrofit | Installation Complexity | Cost of equipment | Flux outside OWF[1] | Flux inside OWF[1] | Distribution and behaviour | Species id | Flight speed | Flight height | Macro avoidance | Meso avoidance | Micro avoidance | Collision rate | Shutdown |
| Radar | 3D Radar[2] | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▼ | ▼ | ▲ |
| | 2D Radar[2] | ● | ▼ | ● | ▲▲ | ▲▲ | ▲ | ▼ | ▲▲ | - | ▲▲ | ▲▲ | ▼ | ▼ | ▲ |
| | Radar coupled to camera[2] | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ |
| | Radar with fixed antenna[2] | ● | ● | ● | ● | ● | ▼ | ▲ | ● | - | ▲ | ▲ | ▼ | ▼ | ● |
| Camera | Fixed camera[2] | ▲ | ▲ | ▲ | - | - | ▼ | ▲ | ▼ | - | ▼ | ▼ | ▲▲ | ▲▲ | ● |
| | Dome with multiple fixed cameras | ● | ● | ▼ | - | - | ▲▲ | ▲▲ | ▼ | - | ▼ | ▼ | ▲▲ | ▲▲ | ● |
| | Moving camera | ▲ | ▲ | ● | - | - | ▲▲ | ▲▲ | ▼ | - | ▼ | ▼ | ▲▲ | ▲▲ | ● |
| Other | Accelerometer as single sensor | ▼ | ▼ | ▼ | - | - | - | - | - | - | - | - | - | ● | - |
| | Accelerometer coupled to camera | ▼ | ▼ | ▼ | - | - | - | - | - | - | - | - | - | ▲ | - |
| | Microphone[2] | ▲ | ▲ | ▲▲ | - | - | - | ▲▲ | - | - | - | - | - | - | ● |
| Survey Platform | Ship-based surveys | - | - | ▼ | ● | ● | ▲ | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Aerial visual surveys | - | - | ▼ | ▼ | ▼ | ● | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Aerial digital surveys | - | - | ▼ | ▼ | ▼ | ● | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | UAV/drone surveys | - | - | ▼ | ▼ | ▼ | ● | ▲▲ | - | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| Telemetry | Radio transmitters | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Satellite transmitters | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ● | ▼ | ▼ | ▼ |
| | Archival tags | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▲▲ | ▼ | ▼ | ▼ | ▼ |
| | Acoustic telemetry | ▼ | ▼ | ● | ▼ | ▼ | ▲▲ | ▲▲ | ▲▲ | - | ● | ▼ | ▼ | ▼ | ▼ |

| | |
|---|---|
| Very good | ▲▲ |
| Good | ▲ |
| Average | ● |
| Bad | ▼ |
| Not Available | - |




**Graph 1 Recommended solution for turbine shutdowns (MTR is migration traffic rate, and relates to birds flying per hour, per kilometre)**

### 5.2.2 Improving blade and turbine visibility

Bird and bat collisions with turbine blades can occur as a result of poor ability to recognise the presence of turbine blades during motion (motion smear). There is some evidence to show that improving blade and turbine visibility may assist in reducing collisions and therefore fatalities in birds. Visibility could be improved through the application of one turbine blade painted black, painting turbines with ultraviolet reflective covering, or the application of a pattern on the turbine blades.

A study undertaken in Norway on turbines with one of three painted blades found that the annual fatality rate was over 70% lower at painted compared to unpainted turbines for a range of birds (May et al. 2020). Of relevance to birds that fly below RSA, a study that investigated the impact of contrast painting turbine towers in Central Norway, found that there was a 48% reduction in Willow Ptarmigan *Lagopus lagopus* carcasses per search relative to unpainted turbines (Stokke et al. 2020). Conversely, a study in Norway has found no significant difference in the number of fatalities at turbines with one blade painted black (Jeninga et al. 2023).

A study on the visual acuity of two raptors (American Kestrel *Falco sparverius* and Red-tailed Hawk *Buteo jamaicensis*) found that these species are unable to resolve and localise turbine blades under some conditions and that patterns applied to turbine blades may reduce collisions (McIsaac 2000), however this study was limited to comparing the visual conspicuities of humans, rather than using a BACI method. A similar study on applying patterns to turbines to reduce motion smear for American Kestrels found that patterns can increase visibility of blades, which may prevent collisions by improving response time (Hodos et al. 2000).

A review of risk reduction strategies across multiple studies identified that painting turbines with ultraviolet reflective covering may be an effective risk reduction technique (Stickland et al. 2000). When assessed in further a preliminary study, use and fatality rates were lower for small birds and raptors at ultraviolet turbines compared to control turbines, but the risk was higher, and therefore measures should be evaluated further (Stickland et al. 2000).

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The cost and resources required to paint turbine blades can be minimised by undertaking it before construction. If implemented, monitoring should be undertaken to determine the effectiveness of this measure.

## 5.3 Turbine mitigation for microbats

### 5.3.1 Smart curtailment

Although blanket curtailment approaches are often successful in reducing bat fatalities, they also result in a reduced energy generation capacity and often coincide with periods of high electrical demand. This renders them potentially unsustainable in the long-term for many wind generation operations.

In an attempt to reduce bat fatalities while optimising energy production, more tailored strategies are being developed to increase the time during which turbines can continue operation and power production relative to blanket operational mitigation approaches. Smart curtailment approaches are being developed that use and combine information about real-time bat activity and environmental information, such as weather conditions, in order to guide curtailment decisions based on real-time risks to bats. Smart curtailment provides wind energy facilities with a pathway for reducing bat fatalities whilst also reducing curtailment time when compared to blanket curtailment techniques thereby maximising energy production whilst minimising impacts to bats.

Studies trialling the approach overseas have achieved significant reductions in bat mortality without the need for blanket curtailment of turbines at lower wind speeds (Hayes et al. 2019). However, there are no comparable studies available for Australian wind farms. Furthermore, overseas studies have often been used in conjunction with automated bat call identification software, which is not currently available for Australian bat species. Automated identification allows bat calls to be identified to species level in real-time and in a consistent, repeatable and time-efficient way.

Recent technological advances have seen the release of smart curtailment systems that are considered applicable to the project. For example, the SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics, allows ultrasonic detectors to be mounted to the nacelles of turbines and files containing probable bat call information to be transmitted in real-time via modems and the cellular network to a database system where the information can then be analysed. The SMART system allows for user defined alarms which match bat call parameters that can be directly input into curtailment decision-making processes in real-time.

Technology such as the SMART system provides real potential for a tailored curtailment approach at the project facility that would provide operational flexibility in allowing turbines to continue producing energy when they might otherwise be curtailed based only on wind speed information.

When the smart curtailment acoustic monitoring system is engaged, real-time monitoring of microbat activity would allow turbines to be curtailed when bat activity reaches a pre-determined threshold. The smart curtailment acoustic monitoring system can also be switched off when wind speeds reach thresholds above which bat activity (and therefore collision risk) are low. Under these circumstances, electricity generation would proceed without intervention until wind speeds fall below the pre-determined threshold. This approach has been the subject of a study by Hayes et al. (2019) that found implementing a similar acoustic monitoring and remote curtailment system when wind speeds were below 7.9 meters per second, without the use of blanket low wind speed curtailments, reduced bat fatalities by 85%.

The secondary component of the smart curtailment system ensures curtailment only occurs when microbat activity is present above pre-defined levels. Curtailment of turbines would only occur when bat activity is

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detected on the SMART system at or above the activity threshold triggers, at times when the systems are engaged. This allows for unimpeded operation of turbines when microbat activity is low for reasons such as cold/rainy weather, or reduced levels or duration of activity during the colder winter months.

This trigger threshold is designed to act as a starting point for an adaptive management approach that may require refinement following establishment and in-situ testing of the SMART system. As this is a novel technology in Australia, a level of trial and error will need to form part of the implementation of this approach, within the overarching aim of minimising collisions to bats whilst also maximising energy production of the facility.

The design of the smart curtailment system will be developed in conjunction with NSW DCCEEW, and the acoustic system supplier once turbines are selected and design of the project is finalised. As part of the implementation strategy consideration will be given to whether the acoustic detectors are required to be mounted on the turbine hubs, or whether an effective approach may be to design the monitoring system such that it is more preventative, and picking up bat activity better with detectors mounted on lower masts, such as at 40 meters high (between canopy and rotor swept height) on met masts near moderate risk turbines. Monitoring for activity below the swept path may be preventative to strike and monitoring further from the turbine could have a similar positive impact. As outlined above, it is proposed that the monitoring design be undertaken in conjunction with NSW DCCEEW and the acoustic system supplier once turbines are selected, the final design of the project is completed, and utilises the additional data the project proposes to collect.

It is important to note that this is a novel technology to Australian wind farms. Automated species analysis is currently widely used in both the United States and Europe, allowing real-time identification to species levels of microbat echolocation calls. This technology does not yet exist in Australia, thus limiting the flexibility of the SMART system to allow for species-level real-time identification as it can do in overseas contexts. The system is therefore currently limited to placing thresholds on overall bat activity only, rather than allowing real-time detection of at-risk species and curtailing turbines only when these have been detected. Development of this technology is underway however and could foreseeably occur by the time the wind farm is operational.

Furthermore, while mass bat fatalities at wind facilities in the United States have often been associated with seasonal migration that occurs along known migratory pathways, few truly migratory bats exist in Australia. Several cave-roosting species are known to undergo seasonal movements to maternity caves in order to birth their young in the warmer summer months, however these bats disperse into the landscape rather than undergoing a directional movement as with north-south seasonal migrations.

Most species recorded within the wind farm are likely to be resident, with potential to be active all year round. Although bats do enter periods of reduced activity over winter, in suitable conditions they are still likely to emerge for short periods even on cooler nights. Some species are known to enter torpor whereby their body temperature is reduced to conserve energy however, a true hibernation period whereby activity is predictably absent over any given period of time has not been observed amongst the species relevant to the wind farm.

The above limitations do not detract from the opportunity that smart curtailment systems present to better understand the interaction between microbats and wind energy generation facilities in the Australian context. By taking an experimental approach to the implementation of these emerging technologies, there is an opportunity to better understand the conditions under which bats are most at risk of collisions and apply this understanding to future wind energy developments. Implementing blanket curtailment, whereby cut-in speeds are prescribed based on either an arbitrary figure or on baseline surveys that may not be adequate predictors of operational activity, limits the potential to refine the conditions which allow for energy generation to be maximised whilst also minimising bat fatalities.

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As smart curtailment technology is still in its infancy, there are a number of logistical and technical hurdles to overcome prior to its application for the wind farm. A detailed implementation plan would need to be developed that would include, at a minimum:

- A review of the technical feasibility of the system.
- Compatibility with turbine operation systems.
- Assessment of the number and arrangement of detectors required.
- Detailed analysis to determine appropriate wind speed thresholds under which the system would operate.
- Detailed analysis to determine bat activity thresholds to trigger any mitigative curtailment actions.

A well thought out experimental design whereby mortality data could be compared between turbines with and without smart curtailment would further allow for the benefits of the system to be tested, and any learnings to be incorporated into both the adaptive management framework for the wind farm but also, to be applied to future wind energy developments where impacts to bats require consideration.

The need for adjustments to the curtailment strategy will be determined through regular monitoring on the efficacy of the current strategy. Adjustments may include additional curtailment measures if an unacceptable number of strikes are found to occur, however the option to reduce the level of curtailment will also be prescribed, if sufficient evidence can be provided that it is safe to do so. Such evidence may include few, to no, recorded bat strikes at a given turbine, combined with a comparison to the results of a trial period of reduced curtailment. As such, turbines currently assessed as low risk of impact may become curtailed in the future, or those turbines currently considered to present a moderate risk of impacts may be removed from the curtailment strategy or have curtailment strategies increased. All such changes would be guided by the monitoring and adaptive management processes outlined herein. Detailed monitoring on the efficacy of the smart curtailment strategies, along with responsive management triggers are detailed further in Section 6.

### 5.3.2 Minimising artificial lighting

Some species of bats are attracted to concentrations of insect prey that can occur near artificial lights. Turbines at the wind farm should not be lit and should avoid aviation warning lighting, to reduce the impact of artificial lighting on attraction of bats to turbines, unless required for avian safety (or other similar) purposes. If artificial lighting is required, the use of synchronising flashing red lights on turbines and other infrastructure within close proximity to turbines may be used.

## 5.4 Minimising raptor perch sites

The earliest wind farms used turbines with lattice towers that provided multiple perching opportunities for raptors and this attraction to those turbines was implicated in high rates of turbine collisions. As with all modern turbines, the towers to be used for the project are monopoles that offer no perching opportunities for raptors or other bird species.

Poles and wires of overhead powerlines can also provide perching and nesting sites for raptors. Where overhead powerlines are necessary, power poles have been chosen for their design aimed at restricting opportunities for raptors to use them as perches. This is of value to operation of the wind farm in minimising the risk of birds or their nests resulting in power outages.

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Trees and other features provide natural perching sites for raptors. It is not known whether these perches are used more frequently than any others, but from the variety of raptor species identified in the vicinity, there can be no doubt that raptors will use multiple natural sites as perches. It is not considered to be appropriate to remove natural perches or to otherwise actively attempt to discourage birds from using natural perches.

It is possible that raptors of various species may frequent favoured perch locations within 200 metres of a turbine during the operational life of the wind farm. Wind farm operations personnel will be provided with training in the basic identification of raptor species. If a potentially favoured raptor perch site is detected within 200 metres of a turbine, a qualified ecologist will be called in to confirm identity of the species and to ascertain whether the perch location represents heightened risk to a threatened species. If so, NSW DCCEEW will be notified and a strategy to reduce risk will be determined. Removal of the perch site may be considered if it is a dead tree and there is a reasonable likelihood of reducing risk by doing so.

## 5.5 Pest animal control

Pest animal control will be undertaken as part of routine environmental management of the wind farm and land managed by the wind farm operator. Species subject to control would include vertebrate pest animals such as feral deer, feral goats, feral pigs, foxes, rabbits, hares and wild dogs. Control of Rabbits and Hares around wind turbines is a specific action that may minimise collision risk for large raptors, as these are primary prey items. Section 5.6 provides detail of the requirements for removal of carcasses, including those of any pest species that may attract large raptors into the close proximity of turbines.

A pest animal control program will be implemented for the life of the wind farm. This plan would be developed in consultation with relevant stakeholders such as NPWS and LLS. Details around the timing, effort and methodology of pest control would be included in the BMP for the project, which would be developed prior to turbine commissioning.

Control of all pest species will be carried out in accordance with NSW legislation, policy and strategies administered by the Department of Primary Industries.

All site personnel (staff and contractors) will be inducted into a procedure for reporting the location of pest animals, particularly rabbit warrens or other sites of high rabbit density. The wind farm operator will be responsible for its obligatory requirements for control of pest animals on all land for which it has legal responsibility. The wind farm is likely to have legal agreements that cover specific areas including all its infrastructure, roads and hardstand areas. This condition is enforceable on land areas covered by those agreements. The wind farm operator will make all efforts to work collaboratively with adjacent land managers, including, where achievable, entry into formal agreements to provide for co-operative and coordinated detection and removal of large animals' carcasses from the area within 200 meters of all turbines.

## 5.6 Large animal carcass removal

The timely removal of carcasses of livestock and other larger animals, such as destroyed feral species, from the wind farm may help reduce the incidence of collision with turbines by raptors that routinely feed on carrion and may be attracted to carcasses. Carcasses of birds and bats that may have resulted from collisions with turbines are not to be removed as part of this process.

A carcass removal program will be implemented for the life of the wind farm and will apply to any carcass other than those of birds and bats, found anywhere within the wind farm site. All site personnel (staff and contractors) will be inducted into a reporting procedure that will apply during all wind farm operations,

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including collision carcass searches (see below). The wind farm will implement a routine for removal and burial or appropriate disposal of any carcass within 24 hours of its discovery. Any program of feral animal control on the wind farm will include the removal of all carcasses from the wind farm site. The wind farm has legal agreements that cover specific areas including all its infrastructure, roads and hardstand areas. This condition is enforceable on land areas covered by those agreements. The wind farm operator will make all efforts to work collaboratively with adjacent land managers, including, where achievable, entry into formal agreements to provide for co-operative and coordinated detection and removal of large animals' carcasses from the area within 200 metres of all turbines.

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# 6 Monitoring strikes and effectiveness of impact minimisation

The effectiveness of impact minimisation strategies can only be assessed through an ongoing operational monitoring program. It is important that bird and bat surveys continue once the wind farm becomes operational and that the survey methods used prior to construction are continued using the same methods so that results from before and after construction are appropriately comparable. The survey and study methods are set out in Appendix 2.

Assessment against trigger levels will require a program for monitoring collisions in a sample of years. This will entail a regime of searches for dead birds and bats under turbines as detailed in Section 6.2.

Management actions are summarised in Section 8.1, and compliance against performance criteria are detailed in Section 6.2.

## 6.1 Ongoing operational monitoring

Following the collection of baseline data and following commissioning of all turbines, ongoing monitoring would mirror the baseline surveys.

### 6.1.1 Bird surveys

Bird surveys should follow the methodology in Appendix 2 and Section 2.2 to ensure consistency with pre-construction surveys.

#### Optional interim bird survey program

Construction staging of the wind farm may result in clusters of turbines becoming operational at different times. During this period, bird surveys will be incrementally undertaken as more turbine clusters are fully constructed and commissioned. Where sites are not within turbine clusters, survey will commence once the full bird survey program is completed.

Where access to bird survey sites is not possible due to construction constraints, it is not advisable to replace established bird survey sites with alternative survey locations.

#### Operational bird survey program

Established survey points should be sampled in year one, three and five after the commencement of all turbines becoming operational. Sampling should occur at a minimum in spring and summer/autumn when bird activity is likely to be highest.

### 6.1.2 Microbat surveys

Microbat surveys will follow the methodology of the baseline surveys detailed in Appendix 2 and Section 2.2 to ensure consistency with pre-construction surveys.

The final locations of all bat utilisation survey points are yet to be determined until approval is finalised but will include a minimum of 10 ultrasonic full-spectrum detectors, replicating the six existing survey locations in the development corridor, with four additional sites, installed over 10 consecutive nights. One microbat

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detector should be installed at height on each met mast over 10 consecutive nights. Additionally, a further three control sites located between 500 to 1500 metres from the development (and operational) footprint would be installed. Baseline data collection will also include the recording of environmental variables such as wind speed, time, month, temperature, and precipitation to facilitate the development of smart curtailment strategies for the project.

As noted in section 2.2.2, it is recommended that additional bat utilisation surveys are completed to inform the collision risk of the project to meet the draft bird and bat utilisation guidance has provided by BCD for projects within the SW REZ (NSW DCCEEW 2023a). The remaining survey effort required includes one summer survey, two autumn surveys, two winter surveys and one spring survey.

#### Operational bat survey program

Bat surveys will be conducted in each season (summer, autumn, winter spring) in year one, three and five after commencement of all turbines becoming operational.

The specific timing of bat surveys is not prescribed, to allow flexibility in targeting surveys around migratory periods for relevant species in consultation with NSW DCCEEW to confirm the timing of peak migrations periods. Monitoring will be undertaken for a minimum of 10 nights each survey period.

Detectors would also be installed on the hubs of selected turbines as part of the smart curtailment program detailed in Section 5.3.1.

## 6.2 Monitoring of turbine collisions

The following important principles have guided the design of studies described here:

- To the extent possible, they should be simple and minimise extraneous variables.
- In order to maximise their potential to meet stated objectives, they should obtain the largest sample sizes that are practicable.
- They must be able to be implemented without significantly compromising the routine operation and management of the wind farm.

The monitoring program set out here is designed to provide information about trigger levels and to inform estimates of total annual numbers of collisions, with associated confidence intervals, for all bird and bat at-risk species.

Results of the study are intended to be used in calculating an annual estimate of total fatalities of species recorded, and to initiate adaptive management responses should any of the trigger levels detailed in Section 4.3 be met as a result of routine monitoring.

The results of monitoring will be used to assess the wind farm's annual performance relative to prescribed thresholds. Depending on the number of collisions detected, the study may also be able to provide information about variable usage of the site be different species.

### 6.2.1 Carcass search method

Purpose-trained dogs have been shown to be highly efficient at detecting carcasses (Mathews et al. 2013) and have been used for this purpose at a number of wind farms in in Australia. Using purpose-trained dogs obviates the need for formal transects to be established in the search zones, as dogs use scent to detect

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carcasses and are permitted to roam to do so. Every dog will be fitted with a GPS tracking device while undertaking searches. GPS tracks will be downloaded and maintained for future reference and used for analyses of search effort and coverage. GIS maps showing routes taken by dogs will be made available to NSW DCCEEW on request. The use of trained dogs is the preferred method for searches and will be used, provided appropriately trained dogs and handlers are available and landholders allow dogs onto the wind farm. Dog handler(s) must have demonstrated capacity to identify bird and bat species relevant to the Murray Darling Depression and Riverina region.

However, if the use of dogs is not practical in the wind farm the alternative is to use people. Human observers will search by walking transects through the search zones. Searches by people will be undertaken by ecologists with demonstrated capacity to identify bird and bat species of western NSW. Transects will be spaced 6 metres apart, or as near to 6 metres as is practical and observers will thus search the ground for 3 metres either side of each transect. Each observer will carry a hand-held GPS unit and record transects they walk. GPS tracks will be downloaded and maintained for future reference and used for analyses of search effort and coverage. GIS maps showing transects walked will be made available to NSW DCCEEW on request.

A minimum of 50% of carcass searches will be undertaken by purpose-trained dogs, where practical and authorised by landholders.

### 6.2.2 Fall zone and estimation for unsearchable zones

Hull and Muir (2010) provide the sizes of likely fall zones for different turbines and sizes of birds and bats based on ballistics theory. They note that distance from the base of a turbine is an important factor in dispersion of carcasses and that with increased distance the density of carcasses decreases. They provide modelled fall zones and radii for percentages of expected distribution for two size classes of birds and one for small bats. Huso and Dalthorp (2014) compared five estimators for the relationship of carcass density to distance from modern wind turbines. For all five estimators tested they found that density approached zero at about 70 meters horizontal distance from the turbine base.

The greatest capacity to detect carcasses is obtained from intensive searches of defined areas of the potential fall zones and the most valid estimates of mortality come from distance-based carcass-density models (Huso & Dalthorp 2014). Because the densities of carcasses diminish with horizontal distance from a turbine, searching of large areas including the outer extremities of potential fall zones were shown by those authors to add little to detection rates but to add very substantially and disproportionally to search effort. Hence, intensive searches of the portion of the fall zone in which the majority of carcasses will be found are the most effective and appropriate. The great majority of birds and bats that may be involved in turbine collisions are expected to be found within a radius of 70 metres of the bases of turbines.

Each turbine in the wind farm has a maximum hardstand of 100 metres x 115 metres. These clear areas will be readily searchable and searching them under all turbines in a given search regime will introduce a uniformity to the search regime that would not otherwise be available. Therefore, the search program will be confined to coverage of these clear areas out to 70 metres from the base of each turbine.

The inner search zone will be comprised of an area within a 70-metre radius of the turbine base (Figure 2). The outer search zone will encompass the area beyond the inner search zone, up to a 120-metre radius from the turbine base (Figure 2). The safe searchable areas beyond the hardstand will be mapped as part of the initial set up of mortality monitoring, and these areas will be used in statistical modelling of mortality rates.

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### 6.2.3 Turbines to be searched

All turbines would be subject to the carcass search regime across a two-month cycle. A two-month cycle is the search of all turbines split across a two-month period (i.e., 48 turbines in one month, the remaining 48 the following month).

### 6.2.4 Search duration and frequency

#### Interim carcass search program

Construction staging of the wind farm will result in clusters of turbines becoming operational at different times. There is likely to be an increased risk of turbine impacts to avifauna in the timeframe immediately following the commencement of commissioning of wind turbines, therefore incidental carcass searches must be undertaken during this time to monitor for these impacts.

The interim carcass search program will occur following completion of construction of turbine clusters, once all construction activities have been completed and exclusion areas have been removed, to allow safe access to turbines. Once the turbines are operational, an ecologist will undertake monthly inspections of turbines within each cluster, and incidental searches will be undertaken by site personnel and contractors following additional training.

The interim carcass search program will increase as more turbine clusters become operational, and continue until all turbines become operational, and the operational carcass search program below commences.

Although these searches are not as rigorous as the operational carcass search program, it is important that monitoring occurs as turbines are commissioned to ensure impacted fauna are recorded prior to the commencement of the operational carcass search program.

#### Operational carcass search program

The regime of carcass searching will run for five years and will commence when all turbines are commissioned and become operational at the wind farm. At the completion of the first year of the monitoring program results will be collated and an interim report will be prepared. The results will be provided to NSW DCCEEW and in collaboration with NSW DCCEEW a determination will be made about any changes to search duration and/or frequency that might be made to improve effectiveness of the monitoring program.

At the conclusion of the three-year low-risk turbine monitoring program and five-year moderate-risk turbine monitoring program, and after analyses of results including the outcome of any mitigation measures implemented, a review will be undertaken in collaboration with NSW DCCEEW to determine whether any further monitoring is warranted.

A primary purpose of the search regime is to ascertain the frequency at which collisions occur. This is necessary for use in extrapolations to estimate total fatality rates. For this reason, the monthly regime of searches includes a pulse in which two searches are undertaken with a short interval between them. The rationale for this is that there is a high probability that a carcass found on the second search will have collided in the period since the preceding search. This method provides a sound empirical basis for estimation of total collisions from the number of carcasses detected. In each month when a turbine is to be searched, one search will be undertaken followed by a second search three to seven days later (pulse search).

The search regime will provide increased confidence in the tier alert triggers, to ensure the appropriate mitigation responses are initiated.

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**Table 13 Monitoring requirements for carcass searches**

| Turbines | Monitoring schedule |
|---|---|
| **Pre-commissioning** | |
| **All operational turbine clusters** | • Monthly inspections by the project ecologist.<br>• Incidental inspections by site personnel. |
| **Following completion of construction and commencement of operation** | |
| **All** | • Monthly for the first six months following commissioning of turbines, however, must include the first spring/summer season following commissioning of turbines, and therefore may be extended in duration, including follow up pulse searches*. |
| **Low and moderate risk** | • Over a two-month cycle**, from six months up to three years following commissioning of relevant turbines, monthly searches in a randomised order including:<br>– 120 m search area (outer search zone) around relevant turbines, with a follow up 60 m pulse search (inner search zone) from October to March (6 in total).<br>– 120 m search area around relevant turbines, with no pulse searches required from April to September (6 in total).<br>• Following three years following commissioning of relevant turbines, a review of sampling frequency will be undertaken to inform adaptive management. |
| **High risk** | • Over a two-month cycle**, from six months to a minimum of five years following commissioning of relevant turbines, monthly searches in a randomised order including:<br>– 120 m search area (outer search zone) around relevant turbines, with 60 m pulse searches* (inner search zone) throughout.<br>• From five years following commissioning of relevant turbines, sampling frequency thereafter will be informed by a series of scavenger surveys and adaptive management. |

***A pulse search is a secondary search undertaken from three to seven days following the primary search to detect additional mortality of bats and birds.**

****A two-month cycle is the search of all turbines split across a two-month period i.e., 44 low/moderate risk turbines in one month, the remaining 44 low/moderate risk turbines the following month.**

### 6.2.5 Carcass data collection and management

During all searches, all species of birds and bats detected as carcasses or as bird featherspots, will be recorded on a data pro forma designed for the purpose (see Appendix 5 and Appendix 6). A featherspot is any collection of five or more feathers found grouped together in a manner that suggests a bird has died at the location.

Ideally, data will be collected on-site using electronic tablets which will maximise efficiency in data management. All information, including metadata for each turbine search will also be recorded irrespective of whether a carcass is found during a given search. All data will be entered into a single (backed-up) database to be maintained by the wind farm operator. Raw data will be available to relevant regulatory authorities on request. The database must include information on carcasses collected during the search program as well as pertaining to incidental findings or injured fauna. Records of whether carcasses have been retained, disposed of or sent-off site would also be included.

On finding a carcass, it will be photographed in situ and its location will be logged using a portable GPS device. Carcasses of all taxa, whether at-risk species or not, will be collected, labelled with relevant data details and frozen to permit any necessary investigations of cause of death and/or for use in future searcher efficiency or persistence trials. A freezer for this purpose will be available on-site. At the conclusion of the overall investigation, all specimens will be made available to the Australian Museum.

Retrieved carcasses of common species may be used later for scavenger trials and as the presence of human scent may influence scavenging rates, it is best to avoid direct human contact. Therefore, to avoid human

scent being imparted to a carcass, and for WHS reasons, gloves must be worn when handling bird and bat carcasses.

Handling and collection of carcasses will be undertaken as follows:

- The carcass must be photographed *in situ* upon discovery.
- Following collection, the carcass must also be photographed in such a way that it can be further identified such as on a white background, adequate lighting, and an indication of scale. For bats, images taken dorsally, ventrally and laterally as well as images showing the outstretched wing, tail, feet, face and male genitalia will assist identification.
- The carcass must be removed from the site by a person wearing rubber gloves.
- The carcass must be placed in a plastic bag and clearly labelled with the date, turbine number, species name (if known) and a unique specimen code.
- The bagged specimen must be placed in a second bag containing the completed dead or injured bat data sheet (Appendix 6).
- The specimen will be transported to a freezer for further identification or storage for carcass persistence trials.

If featherspots or carcasses are not able to be identified by the field surveyor, additional confirmation should be sought if there is potential it could be a threatened species or would trigger a non-threatened species impact trigger. This may include sending photos or the carcass to a species specialist or museum, or DNA testing. If the uncertain carcass can be readily dismissed as a threatened species, a confidence level for the identification could be assigned such as 'likely' or 'probable'.

At the conclusion of the carcass search program any carcasses of interest may be made available to a museum, used for carcass persistence trials at another location, or disposed of if deemed appropriate in consultation with NSW DCCEEW.

### 6.2.6 Carcass persistence trials

Carcasses of birds and bats that collide with turbines may be removed by scavengers or will ultimately disappear due to decomposition. Carcass persistence affects the detection of dead bats that collide with turbines and consequently influences estimation of the total number of fatalities for each species.

Trials to determine persistence time of carcasses are required to derive correction factors necessary to estimate total fatalities from the results of the carcass searches. Two persistence trials will be undertaken in each year of the monitoring regime (minimum of three years), one in spring and one in summer/autumn.

Remote cameras will be used to record persistence of carcasses placed on-site for the purpose. Carcasses for the trials will be sourced from bird and bat carcasses found at the site or from other local sources, such as road kills. It is vital that species used are representative of the bird and bat fauna of the wind farm, however, if the collection of carcasses is lower than the requirement for scavenger trial, carcasses will be supplemented with proxies in accordance with the approval of NPWS (Appendix 7).

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Carcasses used for trials will be individually marked to ensure they are not confused with collision carcasses. Data collected during carcass efficiency trials is to include:

- At the start of the trial period:
  - Carcass unique identification number.
  - Species.
  - Carcass size class.
  - Date and time of placement.
  - GPS coordinates.
  - Distance and direction to associated turbine.
  - Vegetation formation surrounding the potential fall zone.
- Throughout the trial period:
  - Date and time of the scavenger visit(s).
  - Presence or absence of the carcass.
  - Carcass condition (intact, partially scavenged, heavily scavenged).
  - Scavenger species (or probable scavenger).
  - Signs of scavengers in the area (e.g., tracks, scat).
  - Any changes to habitat or visibility.

An example data sheet is provided in Appendix 8.

Individual marking allows trial carcasses to be identified if they are simply moved by scavengers. Radio-frequency identification (RFID) microchips inserted into carcasses will be used to provide individual identification. Cameras used for the purpose will be set to take a photograph every hour (day and night) and also when triggered by movement and infrared. This method has been demonstrated in Victoria to be highly efficient and substantially reduces potential influence on scavengers, as may occur when human observers visit frequently to check carcasses. Cameras are deployed and left to operate for the duration of the trial as this entails substantially less effort than having people check carcasses daily. Cameras have the additional advantage of recording the precise time of carcass removal and the species of scavenger that removes a carcass. As a result of the precise documentation of the time of carcass removal there is no need to estimate the period of carcass persistence which is required when carcasses are checked only at an interval of several days. Censored analysis will be required when carcasses persist beyond the trial period (Klein & Moeschberger 2010).

The field of view for the cameras is limited and scavengers can simply move a carcass out of that view. To check for this, each trial will commence approximately one week before the next routine search for carcasses.

In each trial, a total of 10 carcasses of birds and 10 carcasses of bats will be distributed under 20 randomly chosen turbines across the wind farm. Each trial will run for up to one month, but cameras will be checked after two weeks to confirm their operation and at that point the trial may be terminated if the carcass has been removed or a second carcass may be placed to increase the sample size of the trial.

The results of these trials will permit average carcass persistence times to be determined. The resulting persistence rates will be used in analyses to estimate total numbers of collisions.

### 6.2.7 Searcher efficiency trials

Searchers do not routinely find all carcasses, so it is necessary to ascertain the efficiency of searches to determine and apply appropriate correction factors for carcasses missed and therefore inform estimation of total collision mortality for at-risk species.

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The efficiency of each dog or person undertaking searches will be determined by the use of blind trials. Without the prior knowledge of searchers, a known number of bat carcasses will be placed within search plots prior to routine searches. Carcasses will be placed in sufficient numbers, at a range of turbines and over sufficient time to permit the rate of carcass detection to be adequately determined. After the trial, the person who placed the carcasses will collect any that have not been detected and document whether any carcasses have been scavenged to ensure accuracy of the searcher efficiency trial. The number and type of carcasses found during the searcher efficiency trials will be compared with the known number and type of carcasses placed under the turbines.

Data collected during carcass efficiency trials is to include:

- Date, time and duration of survey.
- Name and description of searcher(s) (dog and/or human).
- GPS tracklog of search path.
- Prevailing weather conditions (e.g., temperature, wind speed and direction).
- For each trial carcass used:
  - Carcass unique identification number.
  - Species (genus and species).
  - Carcass size class.
  - Carcass condition at placement (intact, partially scavenged and/or decomposed).
  - Date and time of placement.
  - GPS coordinates.
  - Distance and direction to associated wind turbine.
  - Vegetation formation within the potential fall zone.
  - Found or missed by the searcher.

An example data sheet for searcher efficiency trials is provided in Appendix 9.

Two searcher efficiency trials will be undertaken for each searcher in each year of the monitoring regime, one in spring and one in autumn.

Carcasses for the trials will be sourced from bird and bat carcasses found at the site or from other local sources such as road kills. It is vital that species used are representative of the bird and bat fauna of the wind farm. Carcasses used for the purpose should be marked to ensure they are not confused with previously undetected collision carcasses, but in a manner that does not draw the attention of the searcher.

At any time that new search personnel or dogs are employed to undertake searches the rate of their detection ability must also be evaluated by a searcher efficiency trial as detailed herein.

### 6.2.8 Incidental finds of bird and bat carcasses

It is possible that during the life of the wind farm, bird and bat carcasses will be discovered incidentally by site personnel. Therefore, all site personnel will be trained on procedures for the event in which they encounter dead or injured birds and bats. Upon incidental discovery, carcasses and featherspots must be photographed in situ, however, the carcass or featherspot must be left where it was found to eliminate bias to detection rates of the official search regime. Any member of the site personnel who finds a carcass of a bird or bat must complete the relevant carcass data sheet (Appendix 6). Copies of carcass data sheets must be available on site for use by all site staff.

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## 6.3 Injured birds and bats

Injured birds and bats may be encountered during carcass searches or incidentally. Handling injured birds and bats requires specialist skill as there is the risk of injury to both animals and people and there is potential for disease transmission in some cases. Injured birds and bats will only be handled by person(s) authorised under the BC Act. To reduce the risk associated with Australian Bat Lyssavirus, any injured bats must be handled only by people who have up-to-date rabies vaccination (an appropriate level of antibodies for the rabies virus, based on vaccination, is considered to offer the best available protection against Australian Bat Lyssavirus). The details of any injured birds and bats found will be recorded on a dead or injured bird and bat data sheet (Appendix 5 and Appendix 6).

Assistance with injured wildlife may be required from local wildlife carers and local relevant veterinarians. This ensures that arrangements are in place for acceptance and treatment of any injured birds or bats. Arrangement must be kept current and current telephone numbers for local carers must be readily available to all site personnel (e.g., on their mobile phones). Where an injured animal can be readily captured it should be placed into a tied calico bag or a box and kept in a quiet and dark location while it is transported to a veterinarian for treatment. No staff are to handle injured bats. In the event that an injured animal cannot be readily captured site personnel should telephone relevant local carers or suitably qualified ecologists for assistance.

A data sheet must be completed as per Section 6.2.8 for any bird or bat suspected to have collided with a wind turbine (see Appendix 5 and Appendix 6).

## 6.4 Analyses of results

Trigger levels for management responses as defined in Section 4.3 for all at-risk species will be determined directly from results of collision mortality searches.

Estimates of the annual total number of collision mortalities for all at-risk species under Tier 2 and Tier 3 trigger levels will be undertaken using current best-practice science to account for searched areas, carcass persistence times and searcher efficiency rates. Along with the estimates, 95% CIs will be determined as a measure of variance around the estimates. Current best-practice for these analyses are provided by Huso et al. (2017) (see also Huso & Dalthorp (2014) and Dalthorp, Huso, & Dail (2017)). The analyses will be undertaken by a biometrician with a thorough understanding of the relevant science.

A report, including results and analyses, for each year of the study will be prepared and provided to NSW DCCEEW using the below calculation.

Trigger levels will be quantified as the:

- Mean number of detected strikes per species per turbine per annum.
- Total estimated number of strikes per species per turbine per annum, with 95% CI. Values will be calculated using all the necessary factors such as:
  - Proportion of turbines searched.
  - Portion of fall-zones searched.
  - Search frequency.
  - Average carcass persistence time.
  - Searcher efficiency rates.

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The need for adjustments to the curtailment strategy will be determined through regular monitoring on the efficacy of the current strategy as set out in the methods above.

Potential updates include the adaptive management measures described in Section 7.

## 6.5 Reporting

Requirements for reporting of results and actions pertaining to this BBAMP are as set out in relevant sections above and summarised in Section 6.5. Windlab will be responsible for submission of all relevant reports.

Windlab is committed to sharing all monitoring data with NSW DCCEEW and Cth DCCEEW annually and for this information to be made publicly available on the project's website. Windlab will do the following to ensure transparency in its operations including:

- Maintain a dedicated website about the project's compliance with the project's conditions of approval that is publicly available for the life of the approval. The webpage will include a copy of this plan, all monitoring results and documentation required under the conditions of approval and any other relevant information as directed by the approval authorities.
- Provide a copy of the documents published on the dedicated webpage to members of the public on request, within a reasonable timeframe.
- Maintain accurate records substantiating all activities associated with conditions of approval and this plan, including measures taken to implement the plan.
- Within three months of annual report approval, the report will be published on the project webpage.

### 6.5.1 Impact trigger reporting

NSW DCCEEW and/or Cth DCCEEW must be notified when impact triggers are met (Section 7.2) where the species is threatened under the BC Act or EPBC Act or considered at-risk (Section 3.3). The qualified ecologist in collaboration with Windlab would complete an investigation into likely causes of the trigger-level mortalities within 10 business days and submit the results of this investigation to NSW DCCEEW within 10 business days of the investigation report being completed by the qualified ecologist. This would include:

- The impact trigger level that was reached and the relevant turbines at which it occurred.
- Details regarding the incident, including:
  - Type of find (incidental or formal monitoring, human, dog).
  - Detection date.
  - Turbine number.
  - Distance from tower base.
  - GPS Coordinates.
  - Species.
  - Age (juvenile or adult) and sex.
  - Number of carcasses detected.
  - Map showing the strike location in relation to turbine.
  - Photographs of the carcass/featherspots.
- A discussion of the identified operational, land management, or ecological factors (environmental and seasonal) contributing to the impact trigger and an assessment on whether the event is likely to be rare

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or regular and the risk of the event constituting an adverse impact on the species at either a local or total population scale.

- A discussion on any proposed management interventions including rationale for selection of mitigation measures, timing and duration of implementation, and any monitoring that will be implemented to measure their effectiveness.
- Where no management interventions are proposed, justification for this must be provided.

### 6.5.2 Annual reports

Following each year of the monitoring program described in Section 6, the program findings will be compiled into an annual report and submitted to the Planning Secretary and NSW DCCEEW, and/or the Environment Minster and Cth DCCEEW within two months of survey completion. The report will include, but not be limited to:

- Results of the ongoing operational monitoring program for birds and microbats. This will include a summary of survey effort and methodology, data analysis and a discussion of the findings of the surveys including comparisons with baseline data and interpretation of the findings in the context of prevailing environmental conditions.
- Results of carcass persistence trials or searcher efficiency trials undertaken and commentary on the implications for the carcass search monitoring program.
- Results of the carcass search monitoring program including:
  - Total number, dates recorded and locations of carcasses/featherspots detected of each species.
  - Details of any carcass/featherspot detections that triggered Tier 1, Tier 2 and Tier 3 alerts.
  - Statistical analysis that provides estimates of the annual total number of collisions for each species, taking into account search area, effort, persistence times and detectability rates.
- Summary of any injured wildlife recorded and outcomes.
- Maps showing mortality monitoring undertaken, turbine layout, associated risk category, turbines monitored (including areas subject to higher frequency monitoring), and searcher coverage of all fall zones (GPS tracks).
- If implemented, description of any mitigation measures including the nature, timing and duration of these measures and the results of any monitoring to determine their effectiveness, and commentary on their success or otherwise.
- Reassessment of the mitigation strategies to be implemented over the following year of operation where Tier 1 and/or Tier 2 and 3 triggers have occurred, including consideration to the actual/ extrapolated impacts to bird and bat species calculated across the preceding year, as well as associated mitigation measures and potential additional offsets for the following year of operation. – Triggers recommended. HOLD POINT.
- Summary of any correspondence with NSW DCCEEW and/or Cth DCCEEW including any directions issued by either department on mitigation measures to be implemented.
- Discussion of environmental factors or significant events that may have influenced data collection (e.g., significant weather events such as drought or flooding).

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- A record of all activities associated with conditions of approval and this plan, including measures taken to implement the plan.
- Information about whether the outcomes of this plan have been or are on track to being met.

### 6.5.3 BBAMP review

The BBAMP will be reviewed in response to:

- An incident.
- Submission of relevant reporting (Section 6.5.1 and 6.5.2).
- Modification to the conditions of the Development Consent.

BBAMP reviews should consider the following:

- Ongoing process improvement and incorporation of new technology.
- Target species risk assessment updates based on actual turbine strike impacts, including monitoring data and incidental species sightings.
- Analysis of flight paths and habitat predictions and collisions to date compared against actual turbine strike impacts to date, including monitoring data and incidental species sightings.
- Re-analysis of individual turbine strike risk, including justification for any proposed changes to risk ratings.
- Improvements to the monitoring program including methods.
- Adjustments to impact thresholds and adaptive management plans.
- Unforeseen limitations and issues during operation.

Where the review results in the revision to the BBAMP, consultation with NSW DCCEEW and Cth DCCEEW will be undertaken as relevant, and the revised document will be submitted to the Planning Secretary and Cth DCCEEW for approval prior to its implementation.

Once approved, a copy of the revised document will be published on the project website.

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**Figure 2 Wind farm monitoring and management**

Figure to include: – HOLD POINT

- Wind farm boundary
- Development footprint
- Turbine layout – turbines colour-coded or labelled by preliminary risk rating as itemised in the BDAR
- Area of potential fall zones for each turbine
- Bird utilisation survey points
- Bat utilisation survey points
- Waterways and buffers
- Hollow-bearing trees
- Stick nests

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# 7 Adaptive management measures and corrective actions

A detailed decision framework has been developed for triggers and mitigation (in conjunction with the below mitigation framework) associated with both the threatened and non-threatened at-risk species, which will be finalised prior to commissioning of turbines.

It is not feasible to foresee what potential factors might lead to an unexpectedly high level of collisions by any species, and therefore appropriate mitigation measures can be prepared only if a cause, or causes, of ecologically significant impacts on the relevant species is known. Additionally, flexibility in mitigation shall be designed to encourage innovative and new technologies be implemented over the operational life of the wind farm where appropriate.

Broad categories of potential causes of heightened collision risk may include the following:

- Agricultural practices, such as feeding of grain to stock, burning stubble that attracts raptors, that may result in concentrations of birds in proximity of turbines.
- Control of pest animals and management of stock and large animal carcasses.
- Seasonal nesting or roosting in proximity of turbines.
- Periodic environmental conditions such as localised high densities of natural food sources or availability of surface water.

If a trigger level of collisions is detected and it can be attributed to a cause such as one of these, then an appropriate management action may be feasible. Shut down of turbines will be last resort, but may be used in the short-term if a particular turbine is involved and the cause is likely to resolve itself, for example once a nesting event finishes. If a cause is not readily apparent, then investigation of the reason(s) for the impact must be undertaken prior to proposal of a mitigation strategy. Advice from NSW DCCEEW will be sought with regard to design and implementation of any such investigations and of an ultimate mitigation strategy, if required. NSW DCCEEW will be notified within 10 working days of determination by Windlab or the contracted qualified ecologist that a trigger level or unacceptable impact for any at-risk species is detected.

There is a range of management options that could be considered depending on the species involved, whether the cause of the collision can be identified, and the likely duration of the heightened collision risk. To allow maximum flexibility of management responses, consistent with an adaptive management approach, a suite of potential mitigation and management options have been detailed below. The feasibility of each option would be considered in consultation with the project ecologist, Windlab, NSW DCCEEW and/or Cth DCCCEEW. Technological advances during the lifetime of the wind farm may also provide additional mitigation measures not listed below, and the BBAMP does not limit the consideration of such mitigation measures. Novel measures should be considered in response to specific requirements and based on the current technologies at the time of the impact.

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## 7.1 Mitigation and adaptive management measures

Mitigation and adaptive management options could include one or several of the following.

### 7.1.1 Increased monitoring and carcass searches

Increased monitoring (daily carcass searches) of relevant turbines would be implemented for a seven-day period following a Tier 1 alert to determine if the event was a one-off event, or a potential ongoing event.

Increased daily carcass searches for 14 days following discovery of a Tier 2 or Tier 3 trigger, would be implemented for a four-week period following a Tier 2 or Tier 3 alert to determine if the event was a one-off event, or a potential ongoing event. This would be undertaken by a suitably trained ecologist, environmental advisor and/or detector dog services. Additional search effort should occur across the wind farm, not just at the turbine relevant to a trigger, to determine if the event is likely to be a localised impact or more widespread.

Increased monitoring and carcass searches may also be appropriate as part of a testing and monitoring program in response to the implementation of any of the below management measures to determine their effectiveness in reducing collisions. The timing, frequency and duration of increased monitoring would be determined in response to the at-risk species and proposed mitigation measure.

### 7.1.2 Acoustic and ultrasonic deterrents

Methods intended to deter birds and bats from approaching wind turbines have been trialled overseas. Due to the experimental nature of these possible deterrent techniques, details of their implementation are difficult to prescribe. Particular technology and devices to be used would be assessed at the time of impact, and the appropriateness of current technology would be made in consultation with NSW DCCEEW and/or Cth DCCEEW. A testing, implementation and monitoring program for the use of acoustic and/or ultrasonic deterrents would be developed. This would include consideration of deterrents for a minimum seven-day period for automatic, reactive and temporary curtailment of turbines relating to a Tier 1 alert for medium to large threatened or at-risk bird species.

### 7.1.3 Transmission line warning markers

Transmission line warning markers allow birds to visualise transmission lines during flight. Installation of marker balls, flags or rotating markers would be considered along sections of the transmission lines where avian impact triggers are recorded.

### 7.1.4 Installation of additional mitigation units

The feasibility for installation of mitigation units will be investigated as part of the preventative mitigation measures in Section 5. If installed successfully at the site, additional units could be considered in areas determined to have a higher collision risk as a result of carcass searches to improve options for mitigation in response to the presence of species at-risk.

### 7.1.5 Altered land management practices

Land management practices could be modified to reduce attraction of species to the wind farm area. A review of land management practices in close proximity to wind turbines (within 200 meters) could include removing lambs and lambing ewes, raptor perch management, prompt carcass removal, reduction of grain stock feeding, exclude stubble burning that attracts raptors and relocation of farm dams/watering points. Consultation with and agreement from landowners would need to be sought.

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### 7.1.6 Modification of smart curtailment system

The triggers for the smart curtailment system would be developed based on pre-construction site-specific baseline data collection. If during operation, it is found that the prescribed triggers are not suitable for reducing incidence of collisions, these could be adjusted. A testing and monitoring program could be implemented to assess whether changes to the thresholds for bat activity, temperature and/or wind speed are a useful means of reducing collisions and subsequent impacts to fauna. This program would be specific to turbines where Tier 2 or Tier 3 alerts are recorded but would be designed to be scalable if required. The program would be prepared in consultation with NSW DCCEEW and/or Cth DCCEEW.

### 7.1.7 Temporary shutdown of turbines

Temporary wind turbine shutdowns would be utilised under the following circumstances:

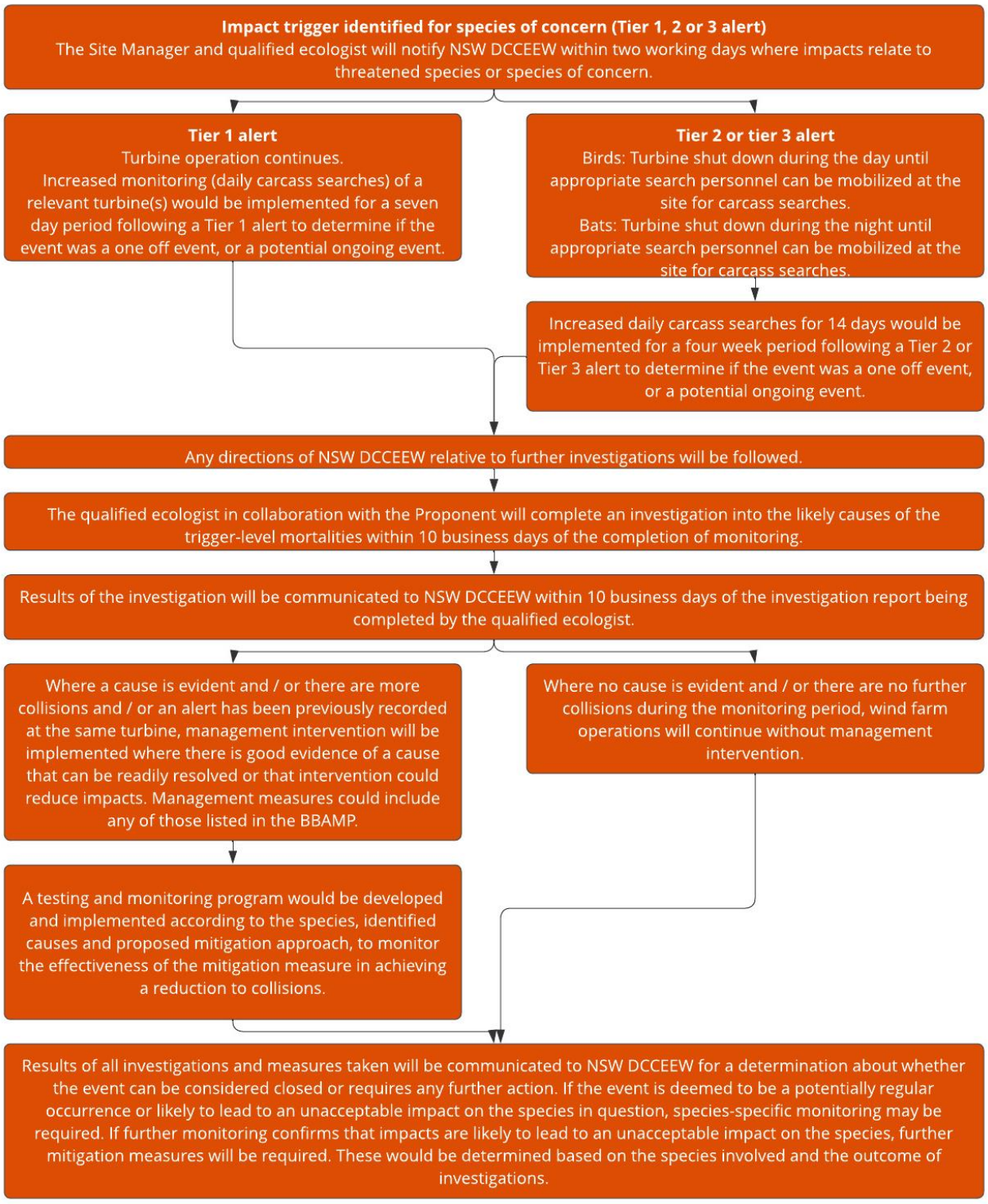
- Periods of low visibility (fog), if it were suspected that fog was the cause of documented collisions.
- Short-term seasonal shutdowns based on migratory periods, ephemeral wetland flood events, or nesting events (for example in the case of at-risk species or threatened species nesting within 200 m of a turbine, the nesting event will be allowed to occur, with increased monitoring and/or temporary curtailment).
- Following a Tier 2 or Tier 3 alert where there is a delay in getting the necessary personnel to site to undertake increased turbine monitoring.

Longer periods of turbine shutdown would be considered and implemented as a last resort option if implementation of the above or other mitigation measures do not result in a reduction to the occurrence of Tier 2 or Tier 3 impact triggers at a particular turbine such that there was a risk of unacceptable impact to a particular species considered likely.

## 7.2 Trigger Action Response Plan

The diagram below (Graph 2) sets out the adaptive response process to be implemented in the event that detected mortality exceeds the trigger levels in Section 4. The adaptive response process for responding to impact triggers must be adhered to for the operational life of the wind farm, unless otherwise determined through the BBAMP review process or other advice provided by NSW DCCEEW and/or Cth DCCEEW.

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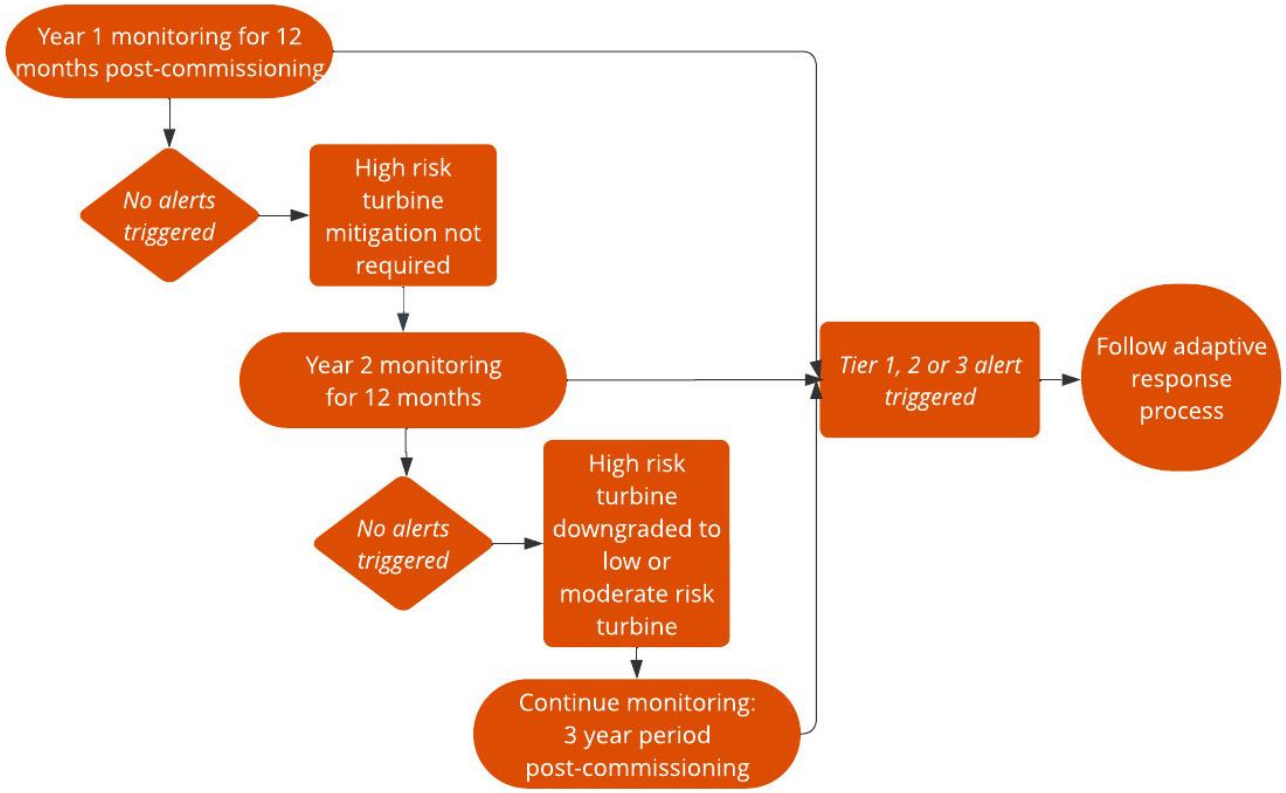



**Graph 2 Measures to be implemented in the event of reaching a trigger-level**

## 7.3 Adaptive management for decreasing curtailment

The BBAMP makes provisions for the turbine risk ratings determined during the turbine risk assessment (Section 3.4) to be reviewed, and the mitigation and monitoring requirements adjusted depending on the actual impacts recorded at each turbine. Graph 3 below provides a framework for adjusting the turbine risk ratings according to the alerts recorded during the first two years of monitoring described in Section 6.2.

The BBAMP makes provisions to downgrade the turbine risk rating, if sufficient evidence can be provided that it is safe to do so. Such evidence may include no tier alerts triggered at a given turbine, combined with a comparison to the results of a trial period of reduced curtailment.




**Graph 3 Framework for adjusting the turbine risk ratings according to the alerts recorded during monitoring (EXAMPLE ONLY – HOLD POINT)**

## 7.4 Residual prescribed impacts and compensatory measures

Following implementation of required mitigation, additional offset requirements for prescribed impacts may be required to offset residual impacts in accordance with the BAM (DPIE 2020). This may be achieved via the retiring of credits or payment to the NSW Biodiversity Conservation Trust (BCT). The amount of credits required to be offset would be calculated by the number of actual and modelled impacts, accounting for scavenger impacts, to individual species in a given year, multiplied by the biodiversity risk weighting (BRW) for the relevant species. This method is commensurate with the Equation 3 (Section 10.1.3) of the BAM (DPIE 2020) for calculating species credit requirements for flora species assessed by a count of the number of individuals, which is aligned with the calculation of offsets required for impacts to individual bird and bat strikes. This method also captures the relevance of a current threatened listing for a species, and is in accordance with the expectations of BAM (DPIE 2020) implementation for prescribed impacts (Section 8.6 of the BAM).

Where an unacceptable impact to a non-threatened 'at-risk' species be encountered or estimated, following mitigation, then a like for like risk weighting may be applied from a similar threatened species (i.e., Wedge-tailed Eagle to Little Eagle *Hieraaetus morphnoides*) following consultation with NSW DCCEEW. Any credit generation required to offset residual prescribed impacts would be calculated during the annual reporting, which will also demonstrate that credits required for the preceding 12 months have been retired under the NSW Biodiversity Offsets Scheme (BOS).

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# 8 Management actions

## 8.1 Summary of management actions

Management actions required under the BBAMP is summarised in Appendix 10.

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# Appendices

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# Appendix 1 Consolidated observation map

## Appendix 1.1. Consolidated bird observation map

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**Figure 3 Consolidated bird observation map**

Figure to include: – HOLD POINT

- Wind farm boundary
- Development footprint
- Turbine layout
- Hollow-bearing trees
- Stick nests
- Bird utilisation survey points
- Bird records

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# Appendix 1.2. Consolidated bat observation map

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**Figure 4 Consolidated bat observation map**

Figure to include: – HOLD POINT

- Wind farm boundary
- Development footprint
- Turbine layout
- Hollow-bearing trees
- Stick nests
- Bat utilisation survey points
- Bat records

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# Appendix 2 Baseline bird and bat survey methods, risk assessment and results

BBUS surveys were undertaken by Nature Advisory and reported in the *Junction Rivers Wind Farm Bird and Bat Baseline Report* (Nature Advisory 2023a). A summary of the methods and results is provided below.

## Appendix 2.1. Bird strike collision risk survey and diurnal bird survey

### Methods

The pre-construction survey method provides a standardised measure of bird activity. The method was designed to generate a sufficient quantum of utilisation data for a fully representative annual cycle for collision risk modelling. A representative sample of point counts were taken across the assessment area.

Bird utilisation surveys were undertaken consistent with the requirements for a Level One bird risk assessment in accordance with *Wind Farms and Birds - Interim Standards for Risk Assessment* (AusWEA 2005), which has also been adopted by the *Best Practice Guidelines for Wind Energy Developments in Australia* (Clean Energy Council 2018, AusWEA 2002).

Surveys were conducted over two years, with two surveys undertaken in each of four seasons (Nature Advisory 2023a):

- Summer:
  - Ten survey points between 23-28 February 2021.
  - Ten survey points between 15-19 February 2022.
- Autumn:
  - Ten survey points between 17-20 May 2021.
  - Ten survey points between 26-30 April 2022.
- Winter:
  - Ten survey points between 1-6 August 2021.
  - Ten survey points between 11-16 July 2022.
- Spring:
  - Ten survey points between 2-6 November 2021.
  - Ten survey points between 6-11 October 2022.

All survey locations were near proposed turbines as this provided the best access and visual for surveys (Figure 2). The majority of the utilisation survey points were located in open areas between stands of native vegetation. The method for the bird utilisation surveys undertaken in the wind farm is as follows:

- Observers walk to each fixed point. When reaching an observation point on the transect observers stop and allow time for birds to habituate to their presence. During this time, the area is scanned, during which all birds present are recorded incidentally. Scanning involves observing at a steady rate in a circle while remaining on the spot (over a 360-degree angle).

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- Once survey commences, observers record all birds as far as the eye can see over 15 minutes at each observation point (which does bias large birds over smaller ones, as the former are more conspicuous, however this can be accounted for in the analyses). Observations are to be made using the naked eye only. Binoculars can only be used to assist with the identification of a bird.
- As it is the number of movements of birds that is the important variable for modelling, all movements were noted even if it is the same individual. Only birds that were seen are to be recorded, although bird calls can be used to alert the observer to the presence of a bird and its location.
- The order in which points were sampled was randomised to ensure that transects are equally sampled over the various times of day.

The information collected included:

- Time of the observation.
- Point number.
- Species.
- Number.
- Height above ground:
  - Below rotor swept area height (less than 50 meters).
  - At rotor swept area height (51-300 meters).
  - Above rotor swept area height (greater than 301 meters).

Information not collected as part of previous surveys includes:

- Direction of flight.
- Distance from observer.
- Behaviour.

### Results

The raw data from all bird utilisation surveys, including survey location, species names, abundance and vertical distances are provided in the *Junction Rivers Wind Farm Bird and Bat Baseline Report* (Nature Advisory 2023a).

During the bird utilisation surveys, 82 bird species were recorded, including:

- A total of 62 species in 2021:
  - 51 species at impact sites.
  - 41 species at control sites.
- A total of 73 species in 2022:
  - 63 species at impact sites.
  - 50 species at control sites.

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From the 81 species recorded, four are listed as threatened under the BC act and/or EPBC Act, including:

- Southern Whiteface *Aphelocephala leucopsis* (Vulnerable, EPBC Act, Vulnerable, BC Act).
- Spotted Harrier *Circus assimilis* (Vulnerable, BC Act).
- White-fronted Chat *Epthianura albifrons* (Vulnerable, BC Act).
- Pink Cockatoo *Lophochroa leadbeateri* (Vulnerable, BC Act, Vulnerable EPBC Act).
- Regent Parrot (eastern subspecies) *Polytelis anthopeplus monarchoides* (Vulnerable, EPBC Act, Endangered, BC Act).

From the 82 total species recorded, 10 of these species were recorded flying at or above the maximum rotor swept height of 300 metres.

During the bird utilisation surveys at impact sites, 4999 bird movements (flights) were recorded comprising 82 different bird species. Of the 4999 flights recorded, 4684 (or 94%) were recorded at between 5 metres and 50 metres vertical distance (height), indicating that the majority of bird activity within the development footprint will not be at risk of blade strike.

The average flight heights shows that only ten species have been recorded flying within the rotor swept height (as outlined in Table A 1 below). This indicates that for most flights, there are only a small number of native birds that are considered at risk of collision with turbines.

**Table A 1 Bird species recorded flying at rotor swept height**

| Common name | Species name | Flight count at rotor swept height |
|---|---|---|
| **Australian Magpie** | *Cracticus tibicen* | 5 |
| **Australian Pelican** | *Pelecanus conspicillatus* | 1 |
| **Australian Pipit** | *Anthus novaeseelandiae* | 2 |
| **Australian Raven** | *Corvus coronoides* | 25 |
| **Brown Falcon** | *Falco berigora* | 1 |
| **Fairy Martin** | *Petrochelidon ariel* | 101 |
| **Galah** | *Eolophus roseicapilla* | 59 |
| **Little Raven** | *Corvus mellori* | 112 |
| **Wedge-tailed Eagle** | *Aquila audax* | 8 |
| **White-necked Heron** | *Ardea pacifica* | 1 |

## Limitations

It is important to note that the assessment of turbine collision risk relates to the probability that particular species may collide with turbines. It is not an indication of the likelihood that collisions might represent a significant impact on the population of any species.

In autumn and winter, some species of birds occur in flocks, hence generating larger counts, however, there may be lack of observations for several surveys if the flocks are elsewhere. Furthermore, migrant species are

generally not present in the region in autumn and winter and more likely to be present during spring and summer.

## Appendix 2.2. Microbat ultrasonic surveys and monitoring

### Methods

Nature Advisory completed two surveys in 2021 to characterise the microbat fauna using the wind farm. The survey effort was a broad analysis undertaken to determine the presence or absence of all possible species predicted to occur in the area, with a particular focus on potential threatened species. Survey timeframes and data analysed for the assessment is summarised Table A 2 below.

**Table A 2 Microbat utilisation survey effort**

| Season | Dates | No. nights | Detector nights | Recording hours |
|---|---|---|---|---|
| **Summer** | 22–27 February 2021 | 6 consecutive nights | 36 | 432 |
| **Autumn** | - | - | - | - |
| **Winter** | - | - | - | - |
| **Spring** | 2–30 November 2021 | 24–29 consecutive nights (location dependent) | 130 | 1560 |

Ultrasonic bat detectors (Song Meter detectors [SM4BAT]) were deployed at a total of six locations across the wind farm corridor for a total of up to 166 trap nights (Nature Advisory 2023a). Survey locations were chosen that were representative of the broad habitat types within the subject land and were located near proposed wind turbines. All microbat detectors are shown on Figure 2.

Song Meters were secured to trees or fence posts approximately 1.5–2.0 meters above ground and programmed to commence operation approximately 30 minutes before dusk, ceasing approximately 30 minutes after dawn (Nature Advisory 2023f).

All echolocation data captured during the survey periods were analysed by Rob Gration of EcoAerial Environmental Services using Kaleidoscope Pro analysis software by Wildlife Acoustics USA (Nature Advisory 2023f).

### Limitations

Natural and sampling variability in detected bat calls tends to be very high, with night-to-night differences due to minor changes in weather conditions alone being a substantial variable (Law et al. 2015). To reduce the influence of this, sampling was undertaken across multiple nights and multiple seasons. Survey was undertaken where possible, during weather conditions considered suitable for bats, to maximise accurate sampling of activity. Baseline data collection has also included the recording of environmental variables such as wind speed, time, month, temperature, and precipitation to facilitate the development of 'smart curtailment' strategies for the project (see Section 5.3.1). Further limitations identified by Nature Advisory are provided in the baseline report (Nature Advisory 2023a).

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## Results

Bat call activity was found to occur throughout the project area, with nine species identified to species level from data recorded across six acoustic detectors deployed during field surveys. The majority of the species recorded were not threatened species listed under the BC Act or the EPBC Act, with one Vulnerable species, Corben's Long-eared Bat *Nyctophilus corbeni* (Vulnerable, EPBC Act and BC Act) potentially detected via a species complex.

A total of nine confirmed species is considered to represent a high level of species diversity within the local microbat population. The species with the highest number of calls recorded across all sites as a whole is the Gould's Wattled Bat *Chalinolobus gouldii*, a common bat found throughout most of Australia, representing 91.7% of calls analysed. The next most common species include Little Mastiff-bat *Mormopterus planiceps* representing 80.6% of calls in summer 2021 and Free-tailed Bat complex representing 83.5% of calls in spring 2021.

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# Appendix 3 Qualitative assessment of turbine collision risk

## Appendix 3.1. Qualitative assessment of turbine collision risk for birds

**Table A 3 Qualitative assessment of turbine collision risk for birds (Nature Advisory 2023b)**

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Australasian Bittern** | *Botaurus poiciloptilus* | EN | EN | Species or species habitat may occur within search region | Australasian Bittern occurs in terrestrial wetlands, including a range of wetland types but prefers permanent water bodies with tall dense vegetation, particularly those dominated by sedges, rush, reeds or cutting grass (Marchant & Higgins 1990). There are no records for this species in the search region and suitable habitat is unlikely to occur in the study area and as such no collision or indirect risks. | Rare | Moderate | Negligible |
| **Australian Bustard** | *Ardeotis australis* | - | EN | Species or species habitat may occur in area | An arid and semi-arid grassland/savannah species and is nomadic or partially migratory (Menkhorst et al. 2021). It predominantly forages on the ground; however, it will fly off when disturbed. There are no records from the search region (DPIE 2021). There is potential for it to occur irregularly in habitats at BWF, but it is unlikely to fly at RSA height regularly given its preference for foraging on the ground. | Rare | Low | Negligible |
| **Barking Owl** | *Ninox connivens* | - | VU | Species or species habitat | There is some potential for the species to occur as there is suitable habitat and BWF falls within the species range (Menkhorst et | Rare | Moderate | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | may occur in area | al. 2017). Collision is likely to be very infrequent, if at all, due to the species' tendency to stick to treed habitats or to fly below turbine height over open habitats where it often obtains prey. | | | |
| **Black Falcon** | *Falco subniger* | - | VU | Recorded by Nature Advisory during 2022 | Mostly occurs in the western plains and in the drier lowland parts of NSW. There is one record in BioNet for the search region (DPIE 2021), so the species may occasionally reach the Balranald region and there is one record in the search region. Collision is likely to be very infrequent due to infrequent occurrence but in irruption years collision is almost certain given experience elsewhere in southern NSW. Consequences would be low due to the widespread distribution of the species (all of northern and eastern Australia; Menkhorst et al. 2017). | Unlikely | Moderate | Low |
| **Black Kite** | *Milvus migrans* | - | - | Recorded by Nature Advisory during 2022 | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. | Almost certain | Low | Low |
| **Black-breasted Buzzard** | *Hamirostra melanosternon* | - | VU | Species or species habitat identified as | The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north western NSW and north-eastern South Australia to the east coast at about | Rare | Moderate | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | potential to occur by Biosis | Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. Where it occupies a range of habitats, including grasslands and sparsely timbered woodlands especially along timbered watercourses which is the preferred breeding habitat (OEH 2022b). Just two records in the last 30 years to the east of the Darling River, the closest 70 km from the study area (OEH 2022b). With so few records from the region and no records in the study area or immediate surroundings this species is thought to unlikely occur in the study area. | | | |
| **Black-chinned Honeyeater (eastern subspecies)** | *Melithreptus gularis gularis* | - | VU | Species or species habitat may occur in area | This species is found mostly in Rough-barked eucalyptus dry forest and woodland, and in River Red Gum along watercourses in southern Australia (Menkhorst et al. 2017). There are no records from the region (DPIE 2021), and it is unlikely to fly at RSA height at BWF, so risk to this species is negligible. | Rare | Negligible | Negligible |
| **Black-eared Miner** | *Manorina melanotis* | EN | CE | Species or species habitat identified as potential to occur by Biosis | This species is restricted to large tracts of unfragmented mallee unburnt for at least 35–40 years (Menkhorst et al. 2017). There is no suitable habitat of this type within the study area or the region. The study area has highly to moderately fragmented patches of mallee and other woodland communities that we consider unsuitable for this species. The species was not observed during two years of survey at the study area. | Rare | Moderate | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Black-shouldered Kite** | *Elanus axillaris* | - | - | Recorded by Nature Advisory onsite | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. | Almost certain | Low | Low |
| **Black-tailed Godwit** | *Limosa limosa* | - | VU | Species or species habitat may occur in area | This species is a migratory shorebird that occurs along the coast and in a variety of inland wetlands (Marchant & Higgins 1993). In the last 30 years it has not been recorded in the vicinity of the study area (OEH 2022d), the nearest record is from the Deniliquin area 150 km to the east of the study area. Marginal habitat occurs within the study area. It would be exceedingly unlikely for this species to occur in the study area however because of its migratory nature individuals of this species could occur on site at any time during their residency in SE Australia. | Rare | Moderate | Negligible |
| **Brown Falcon** | *Falco berigora* | - | - | Recorded by Nature Advisory onsite | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of | Almost certain | Low | Low |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | operating wind turbines and occur regularly at other wind farms in NSW. | | | |
| **Brown Goshawk** | *Accipiter fasciatus* | - | - | Recorded by Nature Advisory onsite | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. | Almost certain | Low | Low |
| **Brown Treecreeper (eastern subspecies)** | *Climacteris picumnus victoriae* | VU | VU | Species or species habitat may occur in area | It occurs in woodlands dominated by eucalyptus, especially Stringybarks or other Rough-barked eucalypts, usually with open grassy understorey (Higgins et al. 2001). There is one record from within the search region (DPIE 2021). This species usually occurs in the lower canopy, low branches, trunks and ground and would not fly at RSA height. | Rare | Negligible | Negligible |
| **Bush Stone-curlew** | *Burhinus grallarius* | - | EN | Species or species habitat likely occur in area | A ground-dwelling grassy woodland species, rare in southern Australia, it is typically observed lying flat on the ground or walking (Menkhorst et al. 2017). There is one record from within the search region (DPIE 2021). Given this behaviour, interaction with turbines is expected to be very infrequent. | Rare | Low | Negligible |
| **Chestnut Quail-thrush** | *Cinclosoma castanotum* | - | VU | Species or species habitat | A ground-dwelling, mallee woodland species, it rarely moves more than several meters off the ground and remains within vegetation | Rare | Low | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | may occur in area | cover. For this reason, the risk of collision is negligible. | | | |
| **Curlew Sandpiper** | *Calidris ferruginea* | CE | EN | Species or species habitat may occur in area | This species is a migratory shorebird that occurs along the coast and in a variety of inland wetlands (Marchant & Higgins 1993). In the last 30 years it has not been recorded in the vicinity of the study area (OEH 2022c), the nearest record is from the Mildura area 140 km to the west of the study area. Marginal habitat occurs within the study area. Because of its migratory nature individuals of this species could occur on site at any time during their residency in SE Australia. | Rare | Moderate | Negligible |
| **Diamond Firetail** | *Stagonopleura guttata* | VU | VU | Species or species habitat likely occur in area | Found in woodlands, dry open forests and lightly timbered farmland where it feeds on native grasses (Higgins et al. 2006), it has been recorded regularly in farmland around wind turbines in southern NSW where it has never been observed flying at RSA height or colliding with turbines (Nature Advisory data). | Rare | Negligible | Negligible |
| **Dusky Woodswallow** | *Artamus cyanopterus cyanopterus* | - | VU | Recorded in BioNet search region | Occurs in dry open sclerophyll forests and woodlands, usually dominated by eucalypts. Often found on the edges or in clearings of forest and woodland and sometimes recorded in shrubland and heathland and other various modified landscapes (Higgins et al. 2006). This species may occasionally fly at RSA height but usually flies within the canopy. Any collision would likely have minimal population impact since this species | Likely | Negligible | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | is still moderately common across most of its range. | | | |
| **Flame Robin** | *Petroica phoenicea* | - | VU | Species or species habitat may occur in area | Breeds in forests in south-eastern Australia, usually in the hills or high-country. Migrates in autumn and winter to lower altitudes and more open habitat, such as farmlands, plains and some urban areas (Higgins and Peter 2002). There are no records from the BWF search region (DPIE 2021), and the site lies outside the usual range of this species. For this reason, it is likely to occur on the site very infrequently and impacts are therefore unlikely to be of consequence for this species' population. | Rare | Low | Negligible |
| **Fork-tailed Swift** | *Apus pacificus* | - | - | Recorded in BioNet search region | This species is aerial, occurring over inland plains, sometimes above foothills or in coastal areas, over cliffs and urban areas (Higgins 1999). It occurs over much of Australia and infrequently in the Berrigan region, often following weather fronts. it flies at turbine height. Collision is likely to be infrequent due to the irregularity of its occurrence – there is one records to date from the BWF search region (DPIE 2021). Small numbers possibly affected do not represent a significant proportion of the total population, estimated as at least in the tens of thousands (Department of the Environment 2015b). | Likely | Low | Low |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Gilbert's Whistler** | *Pachycephala inornata* | - | VU | Recorded in BioNet search region | Gilbert's Whistler inhabits dry eucalypt and mallee woodlands in southern Australia. It forages on the ground or in low foliage. As a sedentary species it does not move long distances or regularly across open country. There is one record of Gilbert's Whistler in the search region (DPIE 2021), indicating that it is not widespread or abundant in the region. The species is therefore unlikely to occur frequently on the BWF site and if it did it would not fly at turbine height. Consequently, the possibility of impacts on this species from the BWF are considered remote. | Rare | Low | Negligible |
| **Grey Falcon** | *Falco hypoleucos* | - | EN | Species or species habitat likely occur in area | Primarily inhabits open plains with treed watercourses in arid inland Australia, ambushing flocks of passerines coming to drink when not active aerial hunting (Menkhorst et al. 2017). It flies at RSA height while hunting. It is not recorded in search region (DPIE 2021). It is a rare raptor in the region, very unlikely to occur at BWF. | Rare | Moderate | Negligible |
| **Grey-crowned Babbler (eastern subspecies)** | *Pomatostomus temporalis temporalis* | - | VU | Recorded in BioNet search region | There are 15 records within the search region (DPIE 2021; Nature Advisory 2021). It inhabits open forests and woodlands and requires an open shrub layer with sparse ground cover and fallen timber and leaf-litter (Higgins and Peter 2002). It is a ground dwelling bird that lives in communal family groups and nests in small terminal branches at top or crowns of a wide variety of plants, usually small trees or saplings and also in tall | Rare | Low | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | shrubs. This species generally confines itself to areas of wooded country and is unlikely to fly at RSA height. Nature Advisory observations indicate that family parties of the species persist at operating wind farms. | | | |
| **Hooded Robin (south-eastern form)** | *Melanodryas cucullata cucullata* | EN | VU | Species or species habitat may occur in area | This species occurs mostly in lightly timbered habitats such as dry woodlands with an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter, with scattered dead and fallen timber for foraging perches (Higgins and Peter 2002). No records have been obtained from the BWF search region (DPIE 2021). As a perch and pounce forager from branches or logs/posts to the ground, this species is unlikely to fly at RSA height and so is unlikely to be impacted by operating wind turbines. | Rare | Low | Negligible |
| **Little Eagle** | *Hieraaetus morphnoides* | - | VU | Recorded in BioNet search region | The Little Eagle is distributed throughout the Australian mainland except in the most densely forested parts of the Great Dividing Range (Marchant and Higgins 1993). Turbine strikes of this raptor species could occur and the species has been recorded twice in the search region (DPIE 2021). It is expected that regular collision is unlikely in NSW given its very low population densities. In the 1990s, the Little Eagle was estimated globally as numbering tens of thousands to as many as 100 000 birds (Ferguson-Lees & Christie 2001), but in recent decades, it is believed to have undergone a moderate reduction in | Unlikely | Moderate | Low |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | population size in NSW (OEH species listing advice). | | | |
| **Pink Cockatoo** | *Lophochroa leadbeateri* | - | VU | Recorded by Nature Advisory and in BioNet search region | This species is uncommon in arid and semi-arid woodlands, mallee and mulga (Menkhorst et al. 2021). Some 38 records have been reported from the search region (DPIE 2021). It may fly at RSA height when dispersing, but it is mostly resident in a large home range. It was recorded on the BWF site during bird surveys (Nature Advisory 2023). When undertaking longer distance movements, it is possible that this cockatoo flies at turbine height so there is a likelihood that it could interact with turbines. | Unlikely | Moderate | Low |
| **Malleefowl** | *Leipoa ocellata* | VU | EN | Species or species habitat may occur in area | Malleefowl is a ground-dwelling mallee woodland species. It is a poor flyer and confines its activity to the ground. There is no record in the search region (DPIE 2021) and the site is just east of the current range of the species. For these reasons, it is unlikely to be affected by the BWF. | Rare | Low | Negligible |
| **Masked Owl** | *Tyto novaehollandiae* | - | VU | Species or species habitat may occur in area | Forest and woodland species, often observed in ecotones between forest and open country (Menkhorst et al. 2017). Predominantly a perch and pounce hunting species, feeding mostly on small to medium sized terrestrial mammals, therefor unlikely to fly at RSA height regularly. It is not expected to collide with wind turbines. | Unlikely | Low | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Nankeen Kestrel** | *Falco cenchroides* | - | - | Recorded by Nature Advisory onsite | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. | Almost certain | Low | Low |
| **Painted Honeyeater** | *Grantiella picta* | VU | VU | Species or species habitat likely occur in area | This species is strongly associated with mistletoe around the margins of open forests and woodlands; it occurs from the Gulf of Carpentaria to southern Victoria and eastern South Australia, mostly inland of the Great Divide (Higgins et al. 2001). There are no records from the BWF search region (DPIE 2021). This species usually flies within the tree canopy and would rarely visit the BWF site. | Unlikely | Negligible | Negligible |
| **Peregrine Falcon** | *Falco peregrinus* | - | - | Recorded by Nature Advisory onsite | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. | Almost certain | Low | Low |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Pied Honeyeater** | *Certhionyx variegatus* | - | VU | Species or species habitat likely occur in area | This species inhabits arid and semi-arid woodland and shrublands. It is highly mobile, and unpredictable in its movements across landscapes; however, it is associated with flowering shrubs, particularly Eremophila spp. Display flights during territorial establishment involve vertical flights (Menkhorst et al. 2021). There is potential for it to fly at RSA height during movement between feeding grounds, and during territorial display, however the BWF region is not a stronghold, so it I unlikely to visit the region regularly. | Rare | Low | Negligible |
| **Plains-wanderer** | *Pedionomus torquatus* | CE | EN | Species or species habitat may occur in area | This species is a ground-dwelling arid and semi-arid grassland adapted species, preferring sparsely vegetated inland plains (Menkhorst et al. 2017). It has not been recorded flying at RSA height. There is limited potential habitat within the wind farm study area and no records in the region, suggesting BWF is unlikely to support the species. | Rare | Low | Negligible |
| **Purple-crowned Lorikeet** | *Glossopsitta porphyrocephala* | - | VU | Species or species habitat likely occur in area | This is a dry eucalypt and mallee woodland species of southern Australia. There are not records in the search region (DPIE 2021) and a few records on the Victorian side of the Murray River nearby (ALA 2021). It flies rapidly at and above canopy height between patches of flowering eucalypts and may occasionally fly at turbine height. However, the lack of local records suggests that it is | Rare | Low | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | likely to occur infrequently and therefore turbine collision is likely to be rare. | | | |
| **Purple-gaped Honeyeater** | *Lichenostomus cratitius* | - | VU | Species or species habitat likely occur in area | This mallee woodland honeyeater occurs mostly to the west in Victoria and South Australia, with one record nearby in NSW (ALA 2021). Its occurrence on the BWF site is likely to be very infrequent. It tends to stick to cover and not fly above tree canopy height. Given these facts, it is highly unlikely to be affected by the BWF. | Rare | Low | Negligible |
| **Red-lored Whistler** | *Pachycephala rufogularis* | VU | CE | Species or species habitat identified as potential to occur by Biosis | This species occurs in dense Mallee-Broombush dominated woodland or cypress pine scrub (Menkhorst et al. 2017). In NSW only known to occur in and around Round Hill and Nombinnie Nature Reserves in central NSW (OEH 2022e). There is no suitable habitat in the study area or REGION and the known populations are 275km from the study area. It is therefore unlikely that this species will occur. | Rare | Low | Negligible |
| **Redthroat** | *Pyrrholaemus brunneus* | - | VU | Species or species habitat likely occur in area | This species inhabits low shrublands of plans, mostly north of the Murrumbidgee River. Remnant habitat on the site is unsuitable, although saltbush has been planted in the area. Given the lack of natural habitat and the fact that most regional records are north of the Murrumbidgee River (ALA 2021), the species is considered unlikely to occur on the BWF site. | Rare | Low | Negligible |
| **Regent Honeyeater** | *Anthochaera phrygia* | CE | CE | Species or species habitat | The species inhabits dry open forest and woodland, particularly more fertile patches | Rare | Moderate | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | likely occur in area | of Box- Ironbark woodland, on the inland slopes of the Great Dividing Range (Menkhorst et al. 1999). and along rivers with Casuarina cunninghamiana infested by mistletoe Amyema cambagei and wet forests of coastal Australia (Higgins et al. 2001). Regent Honeyeater occurs well south and east of the site. Only three records in the last 30 years, within 150 km of the study area, one in 1997 from Barham approximately 110km from the study area and two from Deniliquin, 1992 & 2006, approximately 150km from the study area. Thus, the location of these records and the lack of suitable habitat in the study area or immediate surroundings, it is considered unlikely this species will occur on the BWF. | | | |
| **Regent Parrot (eastern subspecies)** | *Polytelis anthopeplus monarchoides* | VU | EN | Recorded by Nature Advisory and in BioNet search region | This species breeds in riverside forests of River Red Gum and forages widely in mallee and agricultural landscapes (Menkhorst et al. 2017). Corridors of tree cover are required for commuting between breeding and feeding areas. As this species was recorded on the BWF site during bird surveys, it is likely that these individuals are resident in the study area. Regent Parrot was not observed at the proposed RSA height (>50m above ground). This species forages primarily in mallee, in low growing vegetation (maximum canopy height in the study area is approximately 8 meters). When commuting, it flies at or just above the canopy, not at height. It is therefore unlikely | Unlikely | Moderate | Low |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | that this species will fly at RSA height. This species is subject to a separate investigation by Nature Advisory to more fully determine the utilisation this species within the study area and with be the subject of separate reporting. | | | |
| **Rufous Fieldwren** | *Calamanthus campestris* | - | VU | Species or species habitat likely occur in area | This is a shrub-dwelling species. Remnant habitat on the site is unsuitable, although saltbush has been planted in the area. Given the lack of natural habitat and the fact that most regional records are west of the Murray River (ALA 2021), the species is considered unlikely to occur on the BWF site. | Rare | Negligible | Negligible |
| **Scarlet Robin** | *Petroica boodang* | - | VU | Species or species habitat likely occur in area | The Scarlet Robin lives in open forests and woodlands in Australia. During winter, it visits more open habitats, such as grasslands, and can be seen in farmland and urban parks and gardens at this time. This species forages on the ground or in the low branches of trees so would not fly at RSA heights. Nature Advisory has observed this species remaining on wind farm sites after turbines commence operation. | Rare | Negligible | Negligible |
| **Speckled Warbler** | *Chthonicola sagittata* | - | VU | Species or species habitat likely occur in area | This species is a ground-dwelling insectivore, found in dry forests and open woodlands. It forages on the ground or in low shrubs, rarely from low in trees, only flying into trees or shrubs to avoid predators or when disturbed (Menkhorst et al. 2017). It is very unlikely to fly at turbine height. | Rare | Negligible | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Spotted Harrier** | *Circus assimilis* | - | VU | Recorded by Nature Advisory onsite | This species prefers open woodlands that do not obstruct low flight, and natural and exotic grasslands in arid and semi-arid areas (Higgins & Davies 1996). Suitable habitat for the species exists and there are two records of it in the search region (DPIE 2021). Collision with turbines is unlikely or very infrequent. Risks to this species are therefore negligible. | Unlikely | Low | Negligible |
| **Square-tailed Kite** | *Lophoictinia isura* | - | VU | Species or species habitat likely occur in area | This species forages over open forest, woodland, heath and mallee. Square-tailed Kite migrates seasonally, heading south during the warmer months, avoiding the northern wet, and is likely to fly high during migration (Menkhorst et al. 2017). It has the potential to occur irregularly in the region, however there are no records of this species in the search region (DPIE 2021) or from the BWF and habitat is marginally suitable. Therefore, the species would only occur very infrequently. | Unlikely | Low | Negligible |
| **Striated Grasswren** | *Amytornis striatus* | - | - | Species or species habitat identified as potential to occur by Biosis | This species is widely distributed through the arid and semi-arid regions of mainland Australia, confined to areas with well-developed Porcupine Grass (Triodia irritans), usually in association with mallee eucalypts and sandy soils (OEH 2022a). No suitable habitat of this type is available in the study area or in the immediate area of the study area and no records of this species occur within 110km of the study area. Bearing this in mind and the poor dispersal ability of this | Rare | Low | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | species it is considered unlikely to occur in the study area. The species is also not considered to be a collision risk or subject to barrier effects from constructed turbines. | | | |
| **Superb Parrot** | *Polytelis swainsonii* | VU | VU | Species or species habitat may occur in area | The Superb Parrot occupies open woodlands of the inland slopes and southern Riverina of New South Wales and north-central Victoria. Breeding occurs in large eucalypts with hollows in the Riverina and south-west slopes regions; a proportion of the population moves north in autumn winter (Higgins 1999; OEH 2021). Although listed under EPBC and BC Acts, Garnett et al. 2010 did not consider the species threatened citing new information that the population is over 10,000 birds and not declining. It has the potential to occur very irregularly in the region given the lack or nearby records (DPIE 2021; ALA 2021) and the species would only occur very infrequently on the BWF, if at all. | Rare | Moderate | Negligible |
| **Swift Parrot** | *Lathamus discolor* | CE | EN | Species or species habitat may occur in area | In NSW this species is a non-breeding autumn-winter visitor from its breeding grounds in Tasmania. It prefers a narrow range of eucalypts including Boxes, Ironbark's, Blakely's Red-gum, Swamp Mahogany, Blackbutt, Red Bloodwood and Spotted Gum (Higgins 1999; OEH 2021). It spends winter mostly inland of the Great Dividing Range, but some years reaches the coast (Higgins 1999; Kennedy and Tzaros 2005). There are no records from BWF or the surrounding region (DPIE 2021), so it is likely | Rare | Moderate | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | to occur only rarely, if at all. Most records in this part of its range come from River Red Gum woodlands associated with major watercourses, habitat that does not occur on the BWF site. | | | |
| **Turquoise Parrot** | *Neophema pulchella* | - | VU | Species or species habitat may occur in area | This parrot occurs in eucalypt woodlands and open forests, with ground cover of grasses and sometimes low, understorey of shrubs; usually in native grassy forests and woodlands composed of mixed assemblages of native pine and a variety of eucalyptus. It also occurs in savannah woodlands and riparian woodlands (Higgins 1999). It was not recorded at BWF or in the study region (DPIE 2021) and there are few records nearby (ALA 2021). Therefore, it is unlikely to occur regularly on the site and impacts on it are unlikely. | Rare | Moderate | Negligible |
| **Varied Sittella** | *Daphoenositta chrysoptera* | - | VU | Recorded in BioNet search region | The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Its range in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over recent decades (OEH 2021). It inhabits eucalypt forests and woodlands flying at canopy level. The Varied Sittella forages in groups, flying into the tree canopy and working down the branches and trunks, probing through the bark in search of insects | Rare | Negligible | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | (Pizzey & Knight 2003). This species is unlikely to fly at RSA height. | | | |
| **Wedge-tailed Eagle** | *Aquila audax* | - | - | Recorded by Nature Advisory onsite | The Wedge-tailed Eagle is the species most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Several birds of this species have been struck at other wind farms in NSW. Disturbance is not an issue, with the eagle breeding successfully as close as 200 meters from operating wind turbines. | Almost certain | Moderate | Low |
| **Whistling Kite** | *Haliastur sphenurus* | - | - | Recorded by Nature Advisory onsite | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. | Almost certain | Low | Low |
| **White-bellied Sea-Eagle** | *Haliaeetus leucogaster* | - | VU | Species or species habitat identified as potential to occur by Biosis | The White-bellied Sea-eagle has been recorded regularly at the Yanga Lakes 10km north of the study area. There is no suitable habitat within the study area, however White-bellied Sea-eagle could potentially soar over the study area while travelling between suitable wetland habitat. The low density of WBSE in the area suggests the potential of a collision with a wind turbine to be low. Disturbance to this species is not considered to be an issue since they have | Unlikely | Moderate | Low |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | not been observed using the study area for foraging, resting or breeding. | | | |
| **White-fronted Chat** | *Epthianura albifrons* | - | VU | Recorded in BioNet search region | This species inhabits open country, grasslands and low shrublands especially open wetlands and low fringing vegetation across southern Australia including southern NSW (Higgins et al. 2006; OEH 2021). The species has been recorded at several other wind farms in NSW, Victoria and South Australia by Nature Advisory, indicating a tolerance of operating wind turbines. It is unlikely to be affected by turbine collision as it rarely flies high enough, being a ground-feeding bird. | Rare | Negligible | Negligible |
| **Yellow Wagtail** | *Motacilla flava* | - | - | Species or species habitat may occur in area | Outside this species known range and distribution. Known from predominantly coastal regions in northern Australia, this migratory species has not been recorded further south than Newcastle in NSW, although range expansion is suggested (Menkhorst et al. 2017). Given the lack of records (DPIE 2021), unsuitable habitat and known distribution (OEH 2021), it is very unlikely this species will occur at BWF, and it is unlikely to interact with turbines. | Rare | Negligible | Negligible |

## Appendix 3.2. Qualitative assessment of turbine collision risk for bats

### Table A 4 Qualitative assessment of turbine collision risk for bats (Nature Advisory 2023b)

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| **Corben's Long-eared Bat** | *Nyctophilus corbeni* | VU | VU | Species or species habitat may occur in area | The study area falls within the known distribution of the species (OEH 2022). The species inhabits a variety of vegetation types including mallee, Belah and Cypress Pine communities. Nature Advisory has identified suitable habitat on the study area for this species. It has however, not been formally identified through acoustic surveys conducted at the study area. The Long-eared Bats as a group are unlikely to fly at turbine height and therefore unlikely to collide with turbines. | Unlikely | Low | Negligible |
| **Gould's Wattled Bat** | *Chalinolobus gouldii* | - | - | Species or species habitat may occur in area; known to be at risk | Widely distributed, common species. Flies at RSA height. Known to be at risk from wind farms (Nature Advisory unpublished data). | Almost certain | Low | Low |
| **Inland Forest Bat** | *Vespadelus baverstocki* | - | VU | Species or species habitat may occur in area | A dry woodland species not known from the region. Most records are north of the Murrumbidgee River (ALA 2021). It is a canopy and sub-canopy foraging bat that is unlikely to fly regularly at turbine height and therefore unlikely to collide with turbines. | Unlikely | Low | Negligible |
| **Little Pied Bat** | *Chalinolobus picatus* | - | VU | Species or species habitat may occur in area | An arid woodland species not known from the region. Most records are north of the Murrumbidgee River (ALA 2021). It is a canopy and sub-canopy foraging bat that is | Unlikely | Low | Negligible |

| Common name | Scientific name | Status | | Reasoning | Habitat values and behavioural considerations | Indirect impact – collision risk | | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC | BC | | | Likelihood | Consequence | Risk |
| | | | | | unlikely to fly regularly at turbine height and therefore unlikely to collide with turbines. | | | |
| **Southern Myotis** | *Myotis macropus* | - | VU | Foraging, feeding or related behaviour may occur within area | A dry woodland species not known from the region. Most records are north of the Murrumbidgee River (ALA 2021). It is a canopy and sub-canopy foraging bat that is unlikely to fly regularly at turbine height and therefore unlikely to collide with turbines. | Unlikely | Low | Negligible |
| **White-striped Freetail-bat** | *Austronomus australis* | - | - | Species or species habitat may occur in area; known to be at risk | Widely distributed common species. Flies at RSA height. Known to collide regularly with wind turbines (Nature Advisory data). | Almost certain | Low | Low |
| **Yellow-bellied Sheathtail-bat** | *Saccolaimus flaviventris* | - | VU | Widely distributed species. Known to be at risk from wind farms. | Highly mobile and high flying. Although there are no nearby records (DPIE 2021; ALA 2021), the site lies within its broader range. The species is known to have collided in small numbers with wind turbines. | Likely | Low | Low |

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# Appendix 4 Qualitative risk assessment for turbines prior to implementation of safeguards

**Table A 5 Qualitative risk assessment for turbines prior to implementation of safeguards**

| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| 1 | Unlikely | Moderate | Moderate |
| 2 | Unlikely | Moderate | Moderate |
| 3 | Unlikely | Moderate | Moderate |
| 4 | Unlikely | Moderate | Moderate |
| 5 | Rare | Moderate | Low |
| 6 | Rare | Moderate | Low |
| 7 | Possible | Moderate | Moderate |
| 8 | Unlikely | Moderate | Moderate |
| 9 | Unlikely | Moderate | Moderate |
| 10 | Possible | Moderate | Moderate |
| 11 | Possible | Moderate | Moderate |
| 12 | Unlikely | Moderate | Moderate |
| 13 | Unlikely | Moderate | Moderate |
| 14 | Rare | Moderate | Low |
| 15 | Rare | Moderate | Low |
| 16 | Rare | Moderate | Low |
| 17 | Rare | Moderate | Low |
| 18 | Probable | Moderate | High* |
| 19 | Unlikely | Moderate | Moderate* |
| 20 | Rare | Moderate | Low |
| 21 | Rare | Moderate | Low |
| 22 | Rare | Moderate | Low |
| 23 | Rare | Moderate | Low |
| 24 | Possible | Moderate | Moderate |
| 25 | Unlikely | Moderate | Moderate |
| 26 | Possible | Moderate | Moderate |

| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| **27** | Unlikely | Moderate | Moderate |
| **28** | Unlikely | Moderate | Moderate* |
| **29** | Possible | Moderate | Moderate* |
| **30** | Probable | Moderate | High* |
| **31** | Rare | Moderate | Low |
| **32** | Rare | Moderate | Low |
| **33** | Rare | Moderate | Low |
| **34** | Rare | Moderate | Low |
| **35** | Unlikely | Moderate | Moderate |
| **36** | Rare | Moderate | Low |
| **37** | Rare | Moderate | Low |
| **38** | Rare | Moderate | Low |
| **39** | Rare | Moderate | Low |
| **40** | Unlikely | Moderate | Moderate |
| **41** | Possible | Moderate | Moderate |
| **42** | Possible | Moderate | Moderate |
| **43** | Unlikely | Moderate | Moderate |
| **44** | Rare | Moderate | Low |
| **45** | Possible | Moderate | Moderate |
| **46** | Possible | Moderate | Moderate |
| **47** | Rare | Moderate | Low |
| **48** | Possible | Moderate | Moderate |
| **49** | Unlikely | Moderate | Moderate |
| **50** | Rare | Moderate | Low |
| **51** | Rare | Moderate | Low |
| **52** | Rare | Moderate | Low |
| **53** | Rare | Moderate | Low |
| **54** | Rare | Moderate | Low |
| **55** | Rare | Moderate | Low |
| **56** | Rare | Moderate | Low |
| **57** | Possible | Moderate | Moderate |

| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| **58** | Possible | Moderate | Moderate |
| **59** | Possible | Moderate | Moderate |
| **60** | Possible | Moderate | Moderate |
| **61** | Possible | Moderate | Moderate |
| **62** | Probable | Moderate | High |
| **63** | Rare | Moderate | Low |
| **64** | Unlikely | Moderate | Moderate |
| **65** | Probable | Moderate | High |
| **66** | Probable | Moderate | High |
| **67** | Probable | Moderate | High |
| **68** | Probable | Moderate | High |
| **69** | Possible | Moderate | Moderate |
| **70** | Possible | Moderate | Moderate |
| **71** | Rare | Moderate | Low |
| **72** | Possible | Moderate | Moderate |
| **73** | Unlikely | Moderate | Moderate |
| **74** | Possible | Moderate | Moderate |
| **75** | Rare | Moderate | Low |
| **76** | Rare | Moderate | Low |
| **77** | Rare | Moderate | Low |
| **78** | Possible | Moderate | Moderate |
| **79** | Rare | Moderate | Low |
| **80** | Unlikely | Moderate | Moderate |
| **81** | Rare | Moderate | Low |
| **82** | Rare | Moderate | Low |
| **83** | Possible | Moderate | Moderate |
| **84** | Possible | Moderate | Moderate |
| **85** | Possible | Moderate | Moderate |
| **86** | Possible | Moderate | Moderate |
| **87** | Unlikely | Moderate | Moderate |
| **88** | Rare | Moderate | Low |

| WTG # | Turbine strike likelihood | Maximum consequence | Turbine risk |
|---|---|---|---|
| **89** | Unlikely | Moderate | Moderate |
| **90** | Possible | Moderate | Moderate |
| **91** | Possible | Moderate | Moderate |
| **92** | Unlikely | Moderate | Moderate |
| **93** | Unlikely | Moderate | Moderate |
| **94** | Possible | Moderate | Moderate |
| **95** | Unlikely | Moderate | Moderate |
| **96** | Probable | Moderate | High |

*** Turbine risk rating relates to flood years, when larger numbers of waterbird species/individuals are present in the region.**

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# Appendix 5 Turbine mortality survey data sheet

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## Turbine mortality survey data sheet

| **Survey details:** | | | |
|---|---|---|---|
| Date: | | Observers: | |
| Start time: | | Finish time: | |
| Turbine ID: | | | |
| **Survey methodology (please tick):** | | | |
| ***Dog ID*** | | | |
| ***Human observers*** | | | |
| ***Incidental*** (Any bird or bat turbine mortality observed outside a routine survey) | | | |
| Ground visibility (circle): *High* *Moderate* *Poor* | | | |
| Was entire search area covered?<br>*Yes / No* | NOTE: If not, estimate area covered as a percentage (%) of total search area: | | |
| Survey limitations (e.g., long grass, any areas that were inaccessible/not surveyed and why): | | | |
| **Weather details (please circle):** | | | |
| Temperature: | | | |
| Precipitation: *Fine* *Showers* *Rain* | | | |
| Wind strength: *Calm* *Breeze* *Moderate* *Strong* | | | |
| Wind direction: | Cloud cover (%): | | |
| **Turbine bird and bat mortality record:** | | | |
| Dead/injured bird or bat recorded?<br>*Yes / No* | If yes, record total number: | Bird and Bat carcass / injury datasheet completed?<br>*Yes / No* | Photographs taken?<br>*Yes / No* |
| **Additional notes:** | | | |
| | | | |

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# Appendix 6 Dead or injured bird/bat data sheet

This datasheet must be completed for every dead / injured bird or bat found during high- and general-intensity turbine mortality surveys. This datasheet should also be completed for any dead /injured bird or bar recorded incidentally (i.e., not during routine surveys).

Each dead bird or bat (including feather spots) must be removed upon discovery and placed into a clearly labelled plastic bag with the date, time, location (GPS coordinates) and turbine number, as required for species identification.

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## Dead or injured bird/bat – data sheet

| **Date and location:** | | | | |
|---|---|---|---|---|
| Date: | | | Observer/s: | |
| Time animal was found: | | | | |
| Turbine ID: | | | Easting/Northing of carcass: | |
| **Detection:** | | | | |
| Survey method (circle): | *Dog search* | *Human search intensity* | *Incidental* | NOTE: turbine survey datasheet must also be completed. |
| Distance of carcass / injured animal from observer when first detected: | | | | |
| Describe ground visibility within a 1 m radius of where carcass / injured animal was found: | | | | |
| Carcass / injured animal photographed? *Yes / No* | | | Photo and camera details (e.g., camera number, photo numbers, location of saved photos): | |
| **Weather details at time of detection (please circle):** | | | | |
| Temperature: | | | | |
| Precipitation: | *Fine* | *Showers* | *Rain* | |
| Wind strength: | *Calm* | *Breeze* | *Moderate* | *Strong* |
| Wind direction: | | | Cloud cover (%): | |
| **Carcass / injured animal information and condition:** | | | | |
| Species (if unknown closest taxonomic group, e.g., raptor, bat): | | | | |
| Age (circle): | *Unknown* | *Adult* | *Juvenile* | |
| Sex (circle): | *Unknown* | *Male* | *Female* | |
| Condition (circle): | *Dead (carcass)* | *Injured but alive* | *Feather spot (≥ 10 feathers)* | |
| Degree of decay (circle): | *Fresh* | *More than a week old* | *Very old or highly decayed* | |
| Describe location and type of any injuries evident: | | | | |
| Describe evidence of scavenging, if any: | | | | |
| **Notes / additional information:** | | | | |
| | | | | |

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# Appendix 7 Approval to use proxy carcasses

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# Appendix 8 Carcass persistence trial data sheet

This carcass deployment sheet must be completed for each turbine used in the scavenger trial.

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## Carcass persistence trial – carcass deployment data sheet

| **Survey and turbine details:** | | | | | |
|---|---|---|---|---|---|
| Date: | | | Observers: | | |
| Time: | | | | | |
| Turbine ID: | | | | | |
| Ground visibility (circle): *High* *Moderate* *Poor* | | | | | |
| Description of ground visibility (e.g., grass height, rock cover): | | | | | |
| **Carcass deployment record:** | | | | | |
| Carcass type | Unique carcass identifier: | Direction from turbine base: | Distance from turbine base: | Easting / northing: | Notes: |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |
| **Additional notes:** | | | | | |
| | | | | | |

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# Appendix 9 Searcher efficiency trial data sheet

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## Searcher efficiency trial – carcass data sheet

| **Survey details:** | | | | | |
|---|---|---|---|---|---|
| Date: | | | Observers: | | |
| Time commenced: | | | Time completed: | | |
| Turbine ID: | | | | | |
| Ground visibility (circle): *High* *Moderate* *Poor* | | | | | |
| Description of ground visibility (e.g., grass height, rock cover): | | | | | |
| **Carcass deployment record:** | | | | | |
| Carcass type (Species, size class) | Unique carcass identifier: | Direction from turbine base: | Distance from turbine base: | Easting / northing: | Notes: |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |
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| | | | | | |
| **Additional notes:** | | | | | |
| | | | | | |

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# Appendix 10 Management actions

**Table A 6 Summary of management actions and performance criteria – HOLD POINT**

| No. | Action | Objective | Measure | Reporting | Adaptive management | Responsibility | Timing/ frequency |
|---|---|---|---|---|---|---|---|
| **Minimising raptor perch sites (Section 5.4)** | | | | | | | |
| | | | | | | | |
| **Pest animal control (Section 5.5)** | | | | | | | |
| | | | | | | | |
| **Large animal carcass removal requirements (Section 5.6)** | | | | | | | |
| | | | | | | | |
| **Ongoing operational monitoring (Section 6.1)** | | | | | | | |
| | | | | | | | |
| **Monitoring of turbine collisions (Section 6.2)** | | | | | | | |
| | | | | | | | |
| **Carcass persistence trials (Section 6.2.6)** | | | | | | | |
| | | | | | | | |
| **Searcher efficiency trials (Section 6.2.7)** | | | | | | | |
| | | | | | | | |
| **Requirements for incidental discovery of carcasses (Section 6.2.8)** | | | | | | | |
| | | | | | | | |
| **Injured birds and bats (Section 6.3)** | | | | | | | |
| | | | | | | | |

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| No. | Action | Objective | Measure | Reporting | Adaptive management | Responsibility | Timing/ frequency |
|---|---|---|---|---|---|---|---|
| **Analysis of results (Section 6.4)** | | | | | | | |
| | | | | | | | |
| **Reporting (Section 6.5)** | | | | | | | |
| | | | | | | | |

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# Appendix 9. Nature Advisory Bird and Bat Assessments

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22nd February 2024

Lisa Caruso
Project Development Manager
Windlab
Level 4
60 Marcus Clarke Street
Canberra City 2601 Australia

**Attention: Lisa Caruso, Project Development Manager**
By email — lisa.caruso@windlab.com Mobile: +61 410 178 350

Dear Lisa,

**RE: JUNCTION RIVERS WIND PROJECT**
**SUMMER BIRD UTILISATION SURVEYS**
**NATURE ADVISORY PROJECT NO. 20195.3**

Nature Advisory Pty Ltd was engaged to carry out seasonal bird utilisation surveys (BUS) as the first stage of pre-construction bird and bat monitoring at the Junction Rivers Wind Project, South-western NSW. These surveys were conducted between the 14th and 19th February 2022 by an experienced Nature Advisory zoologist, Phil Allen.

Survey points at the project site were selected according to whether they were located on elevated areas of the landscape, were representative of the landscape and proposed turbine locations, and offered a minimum 270-degree viewing out to 200 m. Ten points (eight impact points and two reference points) were surveyed eight times, for fifteen minutes using the fixed-point bird count method. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (Nature Advisory Pty Ltd, unpublished data), and falls within the "*Survey guidelines for Australia's threatened birds*" (DAWE 2017). This showed that 82 to 100 percent (average 88 percent) of species seen in one hour of surveying were seen in the initial 15 minutes of observation. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area during the survey.

Each of the points was surveyed eight times (8 replicates), twice each at each of four different times of day: early morning (8 to 10:30am), late morning (10:30am to 13:00 pm), early afternoon (13:30 to 15:00pm) and late afternoon (15:00 to 17:30pm). This ensured even coverage of bird activity at each survey location throughout the day, over the duration of the survey.

Flight height is presented as below, at or above rotor swept area height (RSA height):

- A = Below RSA (< 50 metres above ground)
- B = At RSA (50 – 300 metres above ground)
- C = Above RSA (> 300 metres above ground).

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (threatened species, raptors, waterbirds) were made whilst travelling throughout the proposed wind farm site. Emphasis was placed on observing birds that were moving through the site at RSA height, threatened species, and species of concern including raptors and waterbirds.

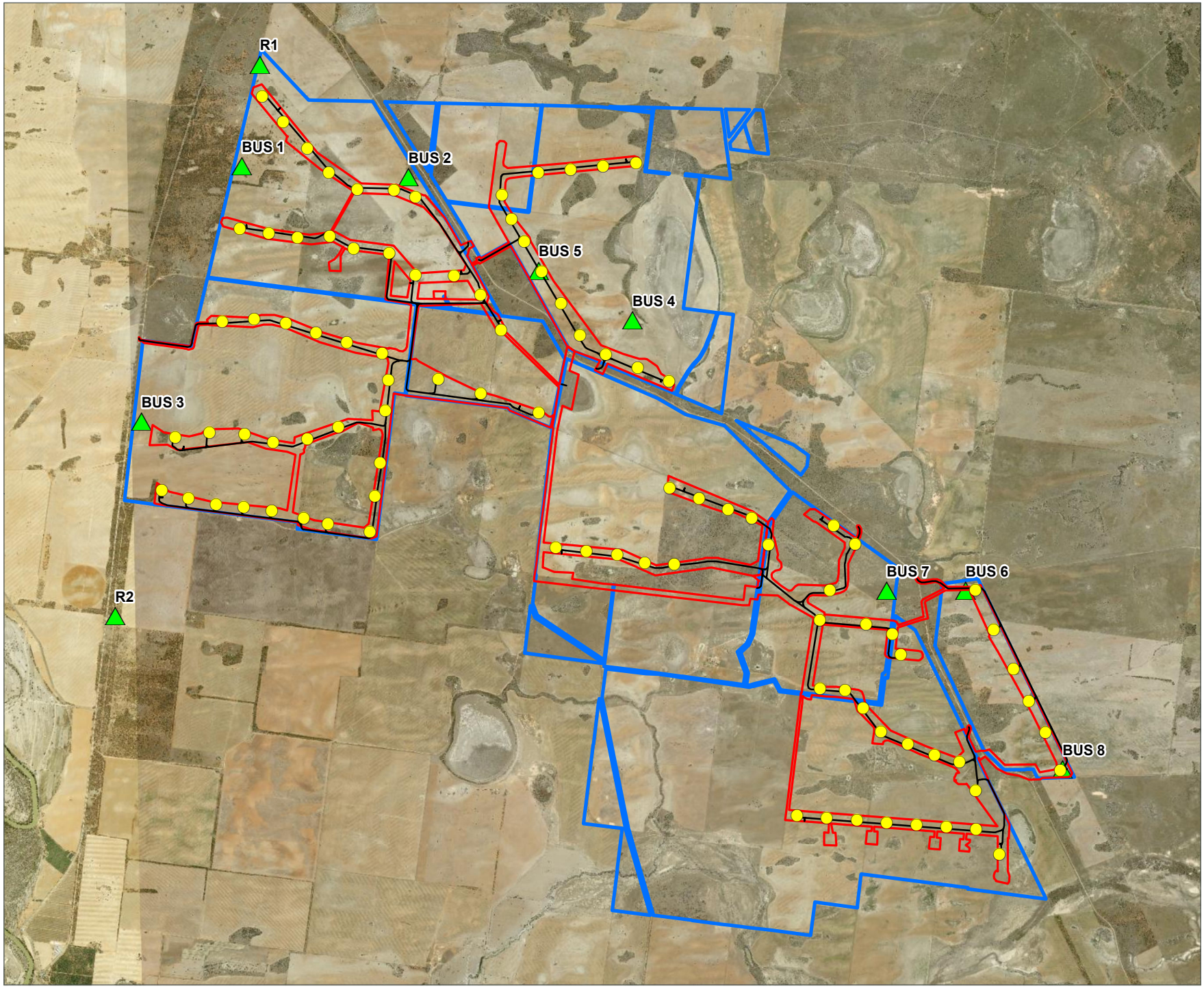



**Figure 1:** Junction Rivers **Wind** Project **BUS points**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

Wind Farm Boundary
Development corridor
Turbine
Access tracks
BUS point

N

Metres
0 1,400

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

## Summer

A total of 935 individual birds were observed during the formal summer surveys, representing 43 species at Junction Rivers Wind Project. (Appendix 1). The majority of these bird species are common native species, found in arid and semi-arid modified woodland and shrubland, shrubland and agricultural landscapes of inland NSW. A total of 45 observations were made of Major Mitchell's Cockatoo during the survey. The species has previously been recorded from the site. The White-fronted Chat was recorded eight times during the survey.

The ten most abundant birds observed during the survey are included in Table 1 below. These species constitute 71.55% of the total observations during the survey. A full list of species observed during the survey can be found in Appendix 1.

Table 1: Ten most abundant species during summer BUS 2022

| Species | Count | % total obs |
|---|---|---|
| Fairy Martin | 115 | 12.30 |
| Little Raven | 88 | 9.41 |
| Australian Magpie | 83 | 8.88 |
| Galah | 77 | 8.24 |
| Yellow-throated Miner | 74 | 7.91 |
| Blue Bonnet | 59 | 6.31 |
| Noisy Miner | 52 | 5.56 |
| Major Mitchell's Cockatoo* | 45 | 4.81 |
| Apostlebird | 44 | 4.71 |
| White-winged Chough | 32 | 3.42 |
| Total | 669 | 71.55 |

*Listed as Vulnerable under the BC Act. NSW

14 threatened bird species have the potential to occur within the windfarm footprint (DAWE 2021; Bionet 2021), as follows:

- Australian Bustard (Endangered BC Act) (Potential to occur)
- Black Falcon (Vulnerable BC Act) (Potential to occur)
- Bush Stone-curlew (Endangered BC Act) (Potential to occur)
- Dusky Woodswallow (Vulnerable BC Act) (Potential to occur)
- Grey Falcon (Vulnerable EPBC Act) (Potential to occur)
- Grey-crowned Babbler (Vulnerable BC Act) (Potential to occur)
- Little Eagle (Vulnerable BC Act) (Potential to occur)
- Major Mitchell's Cockatoo (Vulnerable BC Act) (Confirmed on site)
- Painted Honeyeater (Vulnerable BC Act and EPBC Act) (Potential to occur)
- Pied Honeyeater (Vulnerable BC Act) (Potential to occur)
- Regent Parrot (Endangered BC Act; Vulnerable EPBC Act) (Confirmed on site)
- Spotted Harrier (Vulnerable BC Act) (Confirmed with 500m of the WF boundary)
- Square-tailed Kite (Vulnerable BC Act) (Potential to occur)
- White-fronted Chat (Vulnerable BC Act) (Confirmed on site)

## Threatened species

Of threatened species with potential to occur within the region, five raptors, are the most likely to fly at RSA height.

The Major Mitchell's Cockatoo and White-fronted Chat were recorded during the summer BUS. During formal surveys Major Mitchell's Cockatoo was recorded at two locations: R1 and B6, Additional incidental observations were made at two other locations with the wind farm site. The White-fronted Chat was recorded at one location: B4.

*Major Mitchell's Cockatoo*

Major Mitchell's Cockatoo is listed as Vulnerable under the BC Act of New South Wales. This species is uncommon and patchily distributed across arid and semi-arid inland woodland and treeless habitats (Menkhorst *et al.* 2017). This species feeds on a wide variety of seeds of plants in the Chenopodaceae, Fabaceae, Cupressaceae and Cucurbitaceae family. Established pairs and small family groups tend to be resident with large home ranges (Menkhorst *et al.* 2017). This species was recorded during formal BUS, and it is likely that these individuals are resident in the study site. Major Mitchell's Cockatoo was not observed at the proposed RSA (>50m above ground). This species has been observed feeding on the ground and in low growing vegetation at various locations. Further assessment of this species on the project site during future BUS surveys with further inform how the species is moving around the site and potential level of risk posed to the species.

*White-fronted Chat*

White-fronted Chat is listed as Vulnerable under the BC Act of New South Wales. This species is found in small groups near damp salt-pan samphire flats in inland habitats (Menkhorst *et al.* 2017). This species feeds on insects, spiders, acacia seeds and nectar. This species has been recorded across multiple seasons and is most likely resident within the region and will occupy the site during much of the year. White-fronted Chat was not observed at the proposed RSA (>50m above ground), and as this species forages primarily on or close to ground level and inhabits low-growing vegetation (maximum canopy height in the study area is approximately eight metres). Due to the general behaviour of this species, it presents a low level of collision risk.

*Raptors*

Impacts on Wedge-tailed Eagle and other common raptors are expected to occur, with experience at other wind farms indicating that small numbers of these species will collide with turbines each year (Nature Advisory, unpubl. data). Impacts on listed threatened species may occur. However, additional bird utilisation surveys will be required to determine the use of the windfarm by these listed species.

Table 2: Raptor species observed during summer BUS 2022

| Species | BUS records | Incidental observation | Total observations |
|---|---|---|---|
| Brown Falcon | 2 | 2 | 4 |
| Nankeen Kestrel | 6 | 6 | 12 |
| Wedge-tailed Eagle | 5 | 3 | 8 |
| Total | 13 | 11 | 24 |

*Waterbirds*

Two species of waterbird were recorded during the survey. A single record of a White-necked Heron at B6 and a record of 30 Great Cormorants at R1. Both species were observed flying at RSA height. Observations of waterbird species and numbers will continue to be recorded during future BUS surveys and this will inform the spatial distribution and numbers of these, and other waterbird species associated with the site. This will determine the level of risk associated with waterbird species.

## Additional species considered:

*White-throated Needletail*

This species breeds in north-east Asia and migrates to Australia where it occurs from October to April and feeds on aerial insects. This species utilises habitat along the Great Dividing Range and along the eastern coast. It is a highly mobile species covering large distances in short periods. The species may be an infrequent visitor to the site during optimal weather conditions. The Junction Rivers Wind Project is likely be on the edge of the range for this species.

## Conclusions and recommendations

A total of 43 bird species were recorded during formal BUS of the Summer survey effort in February 2022. The majority of these bird species are common native species, found in arid and semi-arid landscapes of inland NSW. Two species listed as vulnerable in NSW were recorded, both species had been represented at the site previously.

Continued studies are recommended to determine the potential presence/absence of threatened bird species, to monitor the presence and activity of recorded threatened bird species, and to monitor seasonal variances over a full year within the study area.

Yours sincerely,



**Bernard O'Callaghan**
**Senior Ecologist and Project Manager**
**Nature Advisory**

(03) 9815 2111 OR 0437 711 328

## References


Department of Agriculture, Water and Environment (DAWE) 2017, *Environment Protection and Biodiversity Conservation Act 1999, Survey guidelines for Australia's threatened birds*. Department of Environment and Energy, Canberra, viewed 23 September 2020, <https://www.environment.gov.au/system/files/resources/ 107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds-april-2017.pdf >.

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## Appendix 1: Summer species list 2022 BUS

| Common Name | Scientific Name | Count | EPC Act | BC Act |
|---|---|---|---|---|
| Apostlebird | | 44 | | |
| Australasian Pipit | | 22 | | |
| Australian Magpie | | 83 | | |
| Australian Raven | | 29 | | |
| Mallee Ringneck | | 2 | | |
| Black-faced Cuckoo-shrike | | 4 | | |
| Black-faced Woodswallow | | 6 | | |
| Blue Bonnet | | 59 | | |
| Brown Falcon | | 2 | | |
| Chestnut-crowned Babbler | | 6 | | |
| Chestnut-rumped Thornbill | | 23 | | |
| Common Starling | | 1 | | |
| Crested Pigeon | | 15 | | |
| Fairy Martin | | 115 | | |
| Galah | | 77 | | |
| Golden Whistler | | 2 | | |
| Great Cormorant | | 30 | | |
| Grey Butcherbird | | 22 | | |
| Grey Shrike-thrush | | 6 | | |
| Ground Cuckoo-shrike | | 18 | | |
| Little Raven | | 88 | | |
| Magpie-lark | | 9 | | |
| Major Mitchell's Cockatoo | | 45 | | V |
| Masked Woodswallow | | 12 | | |
| Nankeen Kestrel | | 8 | | |
| Noisy Miner | | 52 | | |
| Red-rumped Parrot | | 3 | | |
| Silvereye | | 4 | | |
| Singing Honeyeater | | 5 | | |
| Spiney-cheeked Honeyeater | | 1 | | |
| Splendid Fairy-wren | | 3 | | |
| Striated Pardalote | | 1 | | |
| Superb Fairy-wren | | 1 | | |
| Wedge-tailed Eagle | | 5 | | |
| Weebill | | 9 | | |
| White-fronted Chat | | 8 | | V |
| White-necked Heron | | 1 | | |
| White-winged Chough | | 32 | | |
| Willie Wagtail | | 3 | | |
| Yellow-faced Honeyeater | | 1 | | |
| Yellow-rumped Thornbill | | 4 | | |
| Yellow-throated Miner | | 74 | | |

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22nd February 2024

Lisa Caruso
Project Development Manager
Windlab
Level 4
60 Marcus Clarke Street
Canberra City 2601 Australia

**Attention: Lisa Caruso, Project Development Manager**
By email — lisa.caruso@windlab.com Mobile: +61 410 178 350

Dear Lisa,

**RE: JUNCTION RIVERS WIND PROJECT**
**AUTUMN BIRD UTILISATION SURVEYS**
**NATURE ADVISORY PROJECT NO. 20195.3**

Nature Advisory Pty Ltd was engaged to carry out seasonal bird utilisation surveys (BUS) as the first stage of pre-construction bird and bat monitoring at Junction Rivers Wind Project, south-western New South Wales (NSW). These surveys were conducted between the 26thth of April and the 3rd of May 2022 by an experienced Nature Advisory zoologist, Philip Allen.

Survey points in the project site were selected according to whether they were located on elevated areas of the landscape, were representative of the landscape and proposed turbine locations, and offered a minimum 270-degree viewing out to 200 m. Ten points (eight impact points and two reference points) were surveyed eight times, for fifteen minutes using the fixed-point bird count method. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (Nature Advisory Pty Ltd, unpublished data), and falls within the "*Survey guidelines for Australia's threatened birds*" (DAWE 2017). This showed that 82 to 100 percent (average 88 percent) of species seen in one hour of surveying were seen in the initial 15 minutes of observation. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area during the survey.

Each of the points was surveyed eight times (8 replicates), twice each at each of four different times of day: early morning (8:00am to 10:30am), late morning (10:30am to 13:00 pm), early afternoon (13:30 to 15:00pm) and late afternoon (15:00 to 17:30pm). This ensured even coverage of bird activity at each survey location throughout the day, over the duration of the survey.

Flight height is presented as below, at or above rotor swept area height (RSA height):

- A = Below RSA (< 50 metres above ground)
- B = At RSA (50 – 300 metres above ground)
- C = Above RSA (> 300 metres above ground).

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (threatened species, raptors, waterbirds) were made whilst travelling throughout the proposed wind farm site. Emphasis was placed on observing birds that were moving through the site at RSA height, threatened species, and species of concern including raptors and waterbirds.

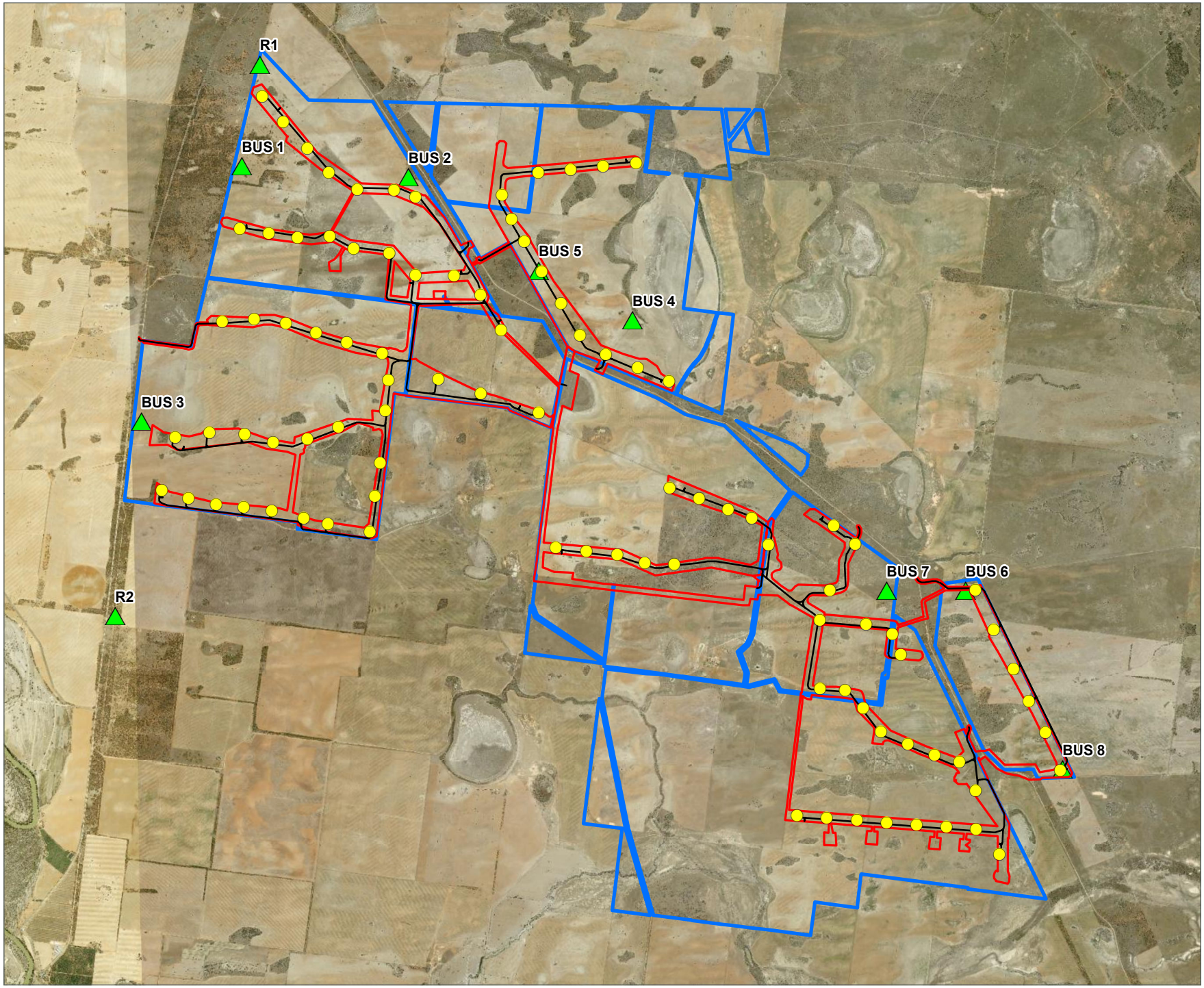



**Figure 1:** Junction Rivers **Wind** Project **BUS points**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

Wind Farm Boundary
Development corridor
Turbine
Access tracks
BUS point

N

Metres
0 1,400

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## Results

### Autumn

A total of 1485 individual birds were observed during the formal autumn surveys, representing 43 species and one genus (*Corvid* spp.) at Junction Rivers Wind Project. (Appendix 1). The majority of these bird species are common native species, found in arid and semi-arid modified woodland and shrubland, shrubland and agricultural landscapes of inland NSW. A total of 18 observations were made of Major Mitchell's Cockatoo - 16 during the formal surveys, and another two as incidental observations. A total of 67 observations were made of Regent Parrot- 40 during the formal surveys, and another 27 as incidental observations. Both species have previously been recorded at the site.

The 10 most abundant bird species observed during the survey are included in Table 1 below. These species constitute 76.95% of total observations during the survey. A full list of species observed during the survey can be found in Appendix 1.

Table 1: Ten most abundant species during autumn BUS 2022

| Species | Count | % total obs |
|---|---|---|
| Australian Magpie | 183 | 12.33 |
| Yellow-throated Miner | 163 | 10.98 |
| Blue Bonnet | 153 | 10.31 |
| Australian Raven | 153 | 10.31 |
| Little Raven | 109 | 7.35 |
| Red-rumped Parrot | 105 | 7.08 |
| Galah | 101 | 6.81 |
| Chestnut-rumped Thornbill | 70 | 4.72 |
| Crested Pigeon | 59 | 3.98 |
| Magpie Lark | 50 | 3.37 |
| Total | 1142 | 76.95 |

14 threatened bird species have the potential to occur within the windfarm footprint (DAWE 2022; Bionet 2022), as follows:

- Australian Bustard (Endangered BC Act) (Potential to occur)
- Black Falcon (Vulnerable BC Act) (Potential to occur)
- Bush Stone-curlew (Endangered BC Act) (Potential to occur)
- Dusky Woodswallow (Vulnerable BC Act) (Potential to occur)
- Grey Falcon (Vulnerable EPBC Act) (Potential to occur)
- Grey-crowned Babbler (Vulnerable BC Act) (Potential to occur)
- Little Eagle (Vulnerable BC Act) (Potential to occur)
- **Major Mitchell's Cockatoo (Vulnerable BC Act) (Confirmed on site)**

- Painted Honeyeater (Vulnerable BC Act and EPBC Act) (Potential to occur)
- Pied Honeyeater (Vulnerable BC Act) (Potential to occur)
- **Regent Parrot (Endangered BC Act; Vulnerable EPBC Act) (Confirmed on site)**
- Spotted Harrier (Vulnerable BC Act) (Confirmed with 500m of the WF boundary)
- Square-tailed Kite (Vulnerable BC Act) (Potential to occur)
- White-fronted Chat (Vulnerable BC Act) (Confirmed on site)

## Threatened species

Of the threatened species with potential to occur within the region, five raptors, are the most likely to fly at RSA height.

The Major Mitchell's Cockatoo and Regent Parrot were recorded during the autumn BUS. During formal surveys Major Mitchell's Cockatoo was recorded at R2. The Regent Parrot was recorded at R1.

*Major Mitchell's Cockatoo*

Major Mitchell's Cockatoo is listed as Vulnerable under the BC Act of New South Wales. This species is uncommon and patchily distributed across arid and semi-arid inland woodland and treeless habitats (Menkhorst *et al.* 2017). This species feeds on a wide variety of seeds of plants in the Chenopodaceae, Fabaceae, Cupressaceae and Cucurbitaceae family. Established pairs and small family groups tend to be resident with large home ranges (Menkhorst *et al.* 2017). This species was recorded during formal BUS, and it is likely that these individuals are resident in the study site. Major Mitchell's Cockatoo was not observed at the proposed RSA (>50m above ground). This species has been observed feeding on the ground and in low growing vegetation at various locations. Further assessment of this species on the project site during future BUS surveys will further inform how the species is moving around the site and potential level of risk posed to the species.

*Regent Parrot*

The Regent Parrot is listed as Vulnerable under the EPBC Act in Australia, and as Endangered under the BC Act of NSW. This species occurs as two isolated sub-species in Australia, with the *Polytelis anthopeplus monarchoides* variant being present at the Junction Rivers Wind Project site (Menkhorst *et al.* 2017). This species feeds on grass/cereal seeds, small pest invertebrates such as psyllids (and their larvae), as well as buds and flowers. This species was recorded during formal BUS, however it is unlikely that it is a resident in the study site. This species is considered both resident and nomadic, with the population distribution likely governed by access to water. The Regent Parrot was not observed at the proposed RSA (>50m above ground). Regent Parrots when flying over open landscapes, such as cropped areas of this study site, can fly as low as one or two metres of the ground, especially when flying between patches of remnant vegetation. In the Autumn BUS they were observed flying at four metres above the ground, moving between patches of mallee. In this instance, they flew across the open fields from the north of R1, with a south-west heading towards vegetation west of R1. They were also observed resting in the canopy of mallee at the north-western boundary of the wind farm footprint. Further assessment of this species on the project site during future BUS surveys will further inform how the species is moving around the site and potential level of risk posed to the species.

*Raptors*

Impacts on Wedge-tailed Eagle and other common raptors are expected to occur. Our experience at other wind farms indicates that small numbers of these species will collide with turbines each year (Nature Advisory, unpubl. data). Impacts on listed threatened species may occur. However, additional bird utilisation surveys will be required to determine the use of the windfarm by these listed species. Raptor species observed during the autumn BUS are illustrated in Table 2 below.

Table 2: Raptor species observed during autumn BUS 2022

| Species | BUS records | Incidental observation | Total observations |
|---|---|---|---|
| Nankeen Kestrel | 8 | 0 | 8 |
| Black Kite | 7 | 1 | 8 |
| Wedge-tailed Eagle | 5 | 6 | 11 |
| Brown Falcon | 3 | 2 | 5 |
| Whistling Kite | 1 | 6 | 7 |
| Peregrine Falcon | 1 | 0 | 1 |
| Total | 25 | 14 | 40 |

*Waterbirds*

Two species of waterbird were recorded as incidental observations. Three records of the Australian Pelican – one near R2 and the other two near BUS point 5. Straw-necked Ibis were also observed near BUS point 5. Both species were observed flying at RSA height. Observations of waterbird species and numbers will continue to be recorded during future BUS surveys and this will inform the spatial distribution and numbers of these, and other waterbird species associated with the site. This will determine the level of risk associated with waterbird species.

## Additional species considered:

*White-throated Needletail*

This species breeds in north-east Asia and migrates to Australia where it occurs from October to April and feeds on aerial insects. This species utilises habitat along the Great Dividing Range and along the eastern coast. It is a highly mobile species covering large distances in short periods. The species may be an infrequent visitor to the site during optimal weather conditions. The Junction Rivers Wind Project is likely be on the edge of the range for this species.

## Conclusions and recommendations

A total of 43 bird species and one genus were recorded during formal BUS during the autumn survey effort in April/May 2022. The majority of these bird species are common native species, found in arid and semi-arid landscapes of inland NSW. Two species listed as vulnerable in NSW were recorded, both species had been represented at the site previously.

Continued studies are recommended to determine the potential presence/absence of threatened bird species, to monitor the presence and activity of recorded threatened bird species, and to monitor seasonal variances over a full year within the study area.

Yours sincerely,



Bernard O'Callaghan

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## References


Department of Agriculture, Water and Environment (DAWE) 2017, *Environment Protection and Biodiversity Conservation Act 1999, Survey guidelines for Australia's threatened birds*. Department of Environment and Energy, Canberra, viewed 23 September 2020, <https://www.environment.gov.au/system/files/resources/ 107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds-april-2017.pdf >.

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Department of Agriculture, Water and Environment (DAWE) 2021, *Environment Protection and Biodiversity Conservation Act 1999, Protected Matters Search Tool*. Department of Environment and Energy, Canberra, viewed 3rd March 2021, <http://www.environment.gov.au >

## Appendix 1: Autumn species list 2022 BUS

| Common Name | Scientific Name | Count | Formal (F), Incidental (I) | EPBC Act | BC Act |
|---|---|---|---|---|---|
| Apostlebird | *Struthidea cinerea* | 22 | F | | |
| Australasian Pipit | *Anthus novaeseelandiae* | 4 | F | | |
| Australian Magpie | *Cracticus tibicen* | 183 | F | | |
| Australian Pelican | *Pelecanus conspicillatus* | 3 | F, I | | |
| Australian Raven | *Corvus coronoides* | 153 | F | | |
| Banded Lapwing | *Vanellus tricolor* | 2 | F | | |
| Black Kite | *Milvus migrans* | 8 | F, I | | |
| Black-faced Cuckoo-shrike | *Coracina novaehollandiae* | 30 | F | | |
| Blue Bonnet | *Northiella haematogaster* | 153 | F | | |
| Blue-faced Honeyeater | *Entomyzon cyanotis* | 1 | F | | |
| Brown Falcon | *Falco berigora* | 6 | F, I | | |
| Chestnut-rumped Thornbill | *Acanthiza uropygialis* | 70 | F | | |
| Common Bronzewing | *Phaps chalcoptera* | 1 | F | | |
| Crested Pigeon | *Ocyphaps lophotes* | 59 | F | | |
| Eastern Rosella | *Platycercus eximius* | 4 | F | | |
| Galah | *Eolophus roseicapilla* | 101 | F | | |
| Grey Butcherbird | *Cracticus torquatus* | 38 | F | | |
| Grey Shrike-thrush | *Colluricincla harmonica* | 2 | F | | |
| Ground Cuckoo-shrike | *Coracina novaehollandiae* | 7 | F | | |
| Little Raven | *Corvus mellori* | 109 | F | | |
| Magpie-lark | *Grallina cyanoleuca* | 50 | F | | |
| Major Mitchell's Cockatoo | *Lophochroa leadbeateri* | 18 | F, I | | V* |
| Mallee Ringneck | *Barnardius zonarius barnardi* | 9 | F | | |
| Musk Lorikeet | *Glossopsitta concinna* | 2 | F | | |
| Nankeen Kestrel | *Falco cenchroides* | 10 | F, I | | |
| Noisy Miner | *Manorina melanocephala* | 24 | F | | |
| Peregrine Falcon | *Falco peregrinus* | 1 | F | | |
| Pied Butcherbird | *Cracticus nigrogularis* | 26 | F | | |
| Raven Sp. | *Corvus Sp.* | 21 | F | | |
| Red-rumped Parrot | *Psephotus haematonotus* | 105 | F | | |
| Regent Parrot | *Polytelis anthopeplus* | 67 | F, I | V* | En^ |
| Singing Honeyeater | *Lichenostomus virescens* | 13 | F | | |
| Spiney-cheeked Honeyeater | *Acanthagenys rufogularis* | 6 | F | | |
| Wedge-tailed Eagle | *Aquila audax* | 5 | F, I | | |
| Welcome Swallow | *Hirundo neoxena* | 2 | F | | |
| Whistling Kite | *Haliastur sphenurus* | 7 | F, I | | |
| White-plumed Honeyeater | *Ptilotula penicillata* | 8 | F | | |
| White-winged Chough | *Corcorax melanorhamphos* | 8 | F | | |
| Willie Wagtail | *Rhipidura leucophrys* | 7 | F | | |

| Common Name | Scientific Name | Count | Formal (F), Incidental (I) | EPBC Act | BC Act |
|---|---|---|---|---|---|
| Yellow-faced Honeyeater | *Lichenostomus chrysops* | 3 | F | | |
| Yellow-rumped Thornbill | *Acanthiza chrysorrhoa* | 11 | F | | |
| Yellow-throated Miner | *Manorina flavigula* | 163 | F | | |

*Listed as Vulnerable

^Listed as Endangered

22nd February 2024

Windlab Pty Ltd
Level 4, 60 Marcus Clarke Street
Canberra City 2601

**Attention: Lisa Caruso, Project Development Manager**
By email — lisa.caruso@windlab.com Mobile: +61 410 178 350

Dear Lisa,

**RE: JUNCTION RIVERS WIND PROJECT**
**WINTER 2022 BIRD UTILISATION SURVEYS**
**NATURE ADVISORY PROJECT NO. 20195.3**

Nature Advisory Pty Ltd was engaged to carry out seasonal bird utilisation surveys (BUS) as the first stage of pre-construction bird and bat monitoring at Junction Rivers Wind Project, south-western New South Wales (NSW). These winter surveys were conducted between the 11th -15th June 2022 by an experienced Nature Advisory zoologist, Clinton Schipper.

The survey consisted of eight survey points at eight impact sites (located near proposed turbine locations), and two reference points, at sites representative of the landscape on the proposed wind farm. Each survey point offered a minimum of a 270-degree view out to 200 metres.

Each survey point was surveyed for fifteen minutes, eight times, at four different times of day: early morning (7:30am to 10:00am), late morning (10:00am to 12:30pm), early afternoon (12:30pm to 15:00pm) and late afternoon (15:00pm to 17:30pm). This ensured even coverage of bird activity at each site throughout the day, over the duration of the survey.

The fixed-point bird count method was used. The adequacy of this method using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (Nature Advisory Pty Ltd, unpublished data), and falls within the "*Survey guidelines for Australia's threatened birds*" (DAWE 2017). The earlier study showed that 82 to 100 percent (average 88 percent) of species seen in one hour of surveying were seen in the initial 15 minutes of observation. Based on this result, 15 minutes is considered adequate to generate representative data on the bird species in the area during the survey. During each survey the bird species, number of each species, flight height and distance from observer (up to 200m) is recorded.

In addition to birds recorded during fixed-point counts, incidental observations of birds were made whilst travelling throughout the proposed wind farm site. When threatened species, or species of concern including raptors and waterbirds were observed, the location, height and direction these birds were flying was recorded.

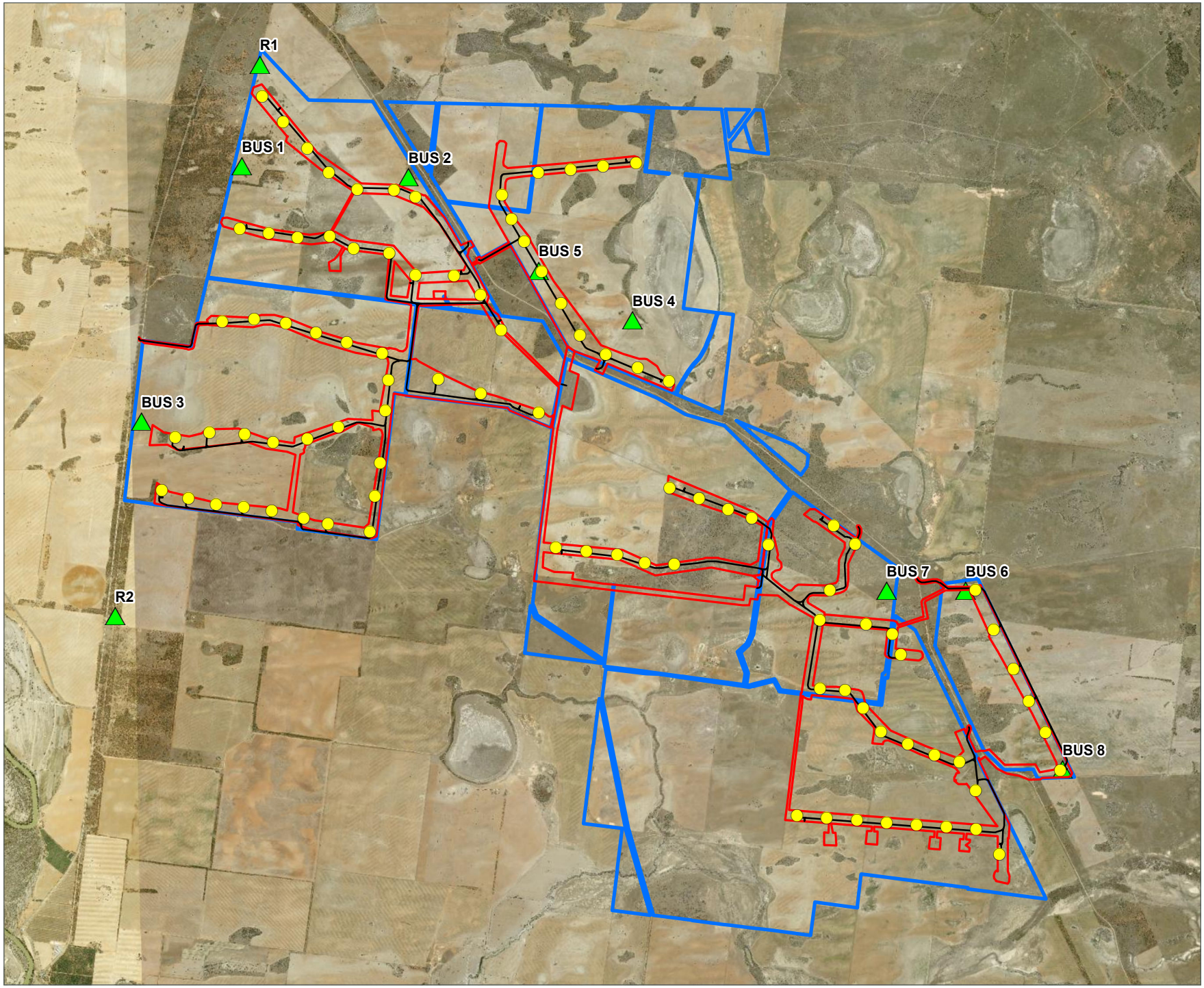



**Figure 1:** Junction Rivers **Wind** Project **BUS points**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

Wind Farm Boundary
Development corridor
Turbine
Access tracks
BUS point

N

Metres
0 1,400

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## Results

### Winter

A total of 769 individual birds were observed during the formal winter surveys, representing 34 species at Junction Rivers Wind Project. (Appendix 1). The majority of these bird species are common native species, found in arid and semi-arid modified woodland and shrubland, shrubland and agricultural landscapes of inland NSW. Again, Major Mitchell's Cockatoo (Vulnerable, BC Act NSW) were recorded during point count surveys, Black Falcon (Vulnerable, BC Act NSW) and Regent Parrot (Vulnerable EPBC Act) were recorded incidentally while travelling between survey points.

The 10 most abundant bird species observed during the survey are included in Table 1 below. These species constitute 79.58% of total observations during the survey. A full list of species observed during the survey can be found in Appendix 1.

Table 1 Ten most abundant species during autumn BUS 2022

| Species | Count | % total obs |
|---|---|---|
| Blue Bonnet | 171 | 22.24 |
| Noisy Miner | 126 | 16.38 |
| Australian Magpie | 102 | 13.26 |
| Galah | 45 | 5.85 |
| Yellow-throated Miner | 39 | 5.07 |
| Crested Pigeon | 37 | 4.81 |
| Red-rumped Parrot | 34 | 4.42 |
| Chestnut-crowned Babbler | 22 | 2.86 |
| Spiny-cheeked Honeyeater | 19 | 2.47 |
| Australian Raven | 17 | 2.21 |
| Total | 612 | 79.58 |

14 threatened bird species have the potential to occur within the windfarm footprint (DAWE 2022; Bionet 2022), as follows:

- Australian Bustard (Endangered BC Act) (Potential to occur)
- **Black Falcon (Vulnerable BC Act) (Confirmed on site)**
- Bush Stone-curlew (Endangered BC Act) (Potential to occur)
- Dusky Woodswallow (Vulnerable BC Act) (Potential to occur)
- Grey Falcon (Vulnerable EPBC Act) (Potential to occur)
- Grey-crowned Babbler (Vulnerable BC Act) (Potential to occur)

- Little Eagle (Vulnerable BC Act) (Potential to occur)
- **Major Mitchell's Cockatoo (Vulnerable BC Act) (Confirmed on site)**
- Painted Honeyeater (Vulnerable BC Act and EPBC Act) (Potential to occur)
- Pied Honeyeater (Vulnerable BC Act) (Potential to occur)
- **Regent Parrot (Endangered BC Act; Vulnerable EPBC Act) (Confirmed on site)**
- **Spotted Harrier (Vulnerable BC Act) (Confirmed on site**)
- Square-tailed Kite (Vulnerable BC Act) (Potential to occur)
- **White-fronted Chat (Vulnerable BC Act) (Confirmed on site)**

### Threatened species

Of the threatened species with potential to occur within the region, five raptors, are the most likely to fly at RSA height.

Black Falcon, Major Mitchell's Cockatoo, Regent Parrot and Spotted Harrier were recorded during the winter BUS. During formal surveys Major Mitchell's Cockatoo was recorded at R2. A Black Falcon was observed to the east of survey point R1. Flying at less than five metres above the ground flying from the west to the east. It was observed landing and drinking at a water pan, before flying off in the direction from which it came, again flying less than 10 metres above the ground. The Regent Parrot was recorded incidentally, observed flying over or through the canopy of the woodland corridor between the western boundary of the study area and Yanga Way. All birds were observed flying below 10 metres above the ground.

*Major Mitchell's Cockatoo*

Major Mitchell's Cockatoo is listed as Vulnerable under the BC Act of New South Wales. This species is uncommon and patchily distributed across arid and semi-arid inland woodland and treeless habitats (Menkhorst *et al.* 2017). This species feeds on a wide variety of seeds of plants in the Chenopodaceae, Fabaceae, Cupressaceae and Cucurbitaceae family. Established pairs and small family groups tend to be resident with large home ranges (Menkhorst *et al.* 2017). This species was recorded during formal BUS, and it is likely that these individuals are resident in the study site. Major Mitchell's Cockatoo was not observed at the proposed RSA (>50m above ground). This species has been observed feeding on the ground and in low growing vegetation at various locations. Further assessment of this species on the project site during future BUS surveys will further inform how the species is moving around the site and potential level of risk posed to the species.

*Regent Parrot*

The Regent Parrot is listed as Vulnerable under the EPBC Act in Australia, and as Endangered under the BC Act of NSW. This species occurs as two isolated sub-species in Australia, with the *Polytelis anthopeplus monarchoides* variant being present at the Junction Rivers Wind Project (Menkhorst *et al.* 2017). This species feeds on grass/cereal seeds, small pest invertebrates such as psyllids (and their larvae), as well as buds and flowers. This species was recorded on six occasions during winter survey as incidental and formal observations. The details are included in Table 2 below. The observations were largely of birds travelling along the vegetated corridor along the western boundary of the study site and Yanga Way. Across the broad distribution of the species it is considered both resident and nomadic, with the population distribution likely governed by access to water. The Regent Parrot was not observed at the minimum proposed RSA height (≥50 metres above ground). Regent Parrots when flying over open landscapes, such as cropped areas of this study site, can fly as low as one or two metres of the ground, especially when flying between patches of remnant vegetation. When observed these birds were observed flying just above canopy height or through the canopy. Further assessment of this species on the project

site is recommended to fully understand the extent to which the species is utilising the site and the potential level of risk to this species, posed by operating turbines.

Table 2 Observational records of Superb Parrot during winter BUS

| Number of birds | Formal (BUS) | Incidental | Flight height range (m) | Notes |
|---|---|---|---|---|
| 9 | | ✓ | 0-10 | Flock flying just above tree height north – northwest |
| 19 | | ✓ | 10-20 | Three flocks travelling north -northwest away from observer |
| 10 | | ✓ | 0-10 | Flying southeast away from observer |
| 3 | | ✓ | 0-10 | Flying south at tree level |
| 1 | ✓ | | 0-10 | Heard while performing R1 point count |
| 1 | ✓ | | 0-10 | Heard while performing point count |

*Raptors*

*Black Falcon*

Black Falcon is listed as Vulnerable under the BC Act NSW. Black Falcons are partly migratory, partly dispersive, with migratory movements heavily reliant on seasonal conditions and availability of food. They are attracted to plagues of locusts and food abundances, but apparently not attracted to plagues of mice (Marchant and Higgins 1993). They are found along tree-lined watercourses and in isolated woodlands, open country including farmland, cropping land and terrestrial wetlands of tropical and temperate Australia, with a stronghold in arid and semi-arid zones, generally below 500 metres above sea level (Marchant and Higgins 1993, Debus et al 2017).

Nature Advisory has recorded collisions between Black Falcon and operating turbines at two other wind farms over the last 15 years (Nature Advisory, unpubl. data). This indicates that the species is at risk of collision with turbines within its range but that this is not a common occurrence.

*Spotted Harrier*

Spotted Harrier is listed as Vulnerable under the BC Act NSW. Spotted Harrier are known to occur throughout NSW, inhabiting areas of medium to open woodland and grasslands (Marchant & Higgins 1993). A Spotted Harrier was observed over the study site while travelling between BUS points it was observed flying below the proposed RSA height. Like most raptors this species has the potential to fly at RSA height and collide with turbines.

*Other Raptors*

Five non-listed raptor species were observed during the winter BUS, namely Brown Falcon, Black-shouldered Kite, Nankeen Kestrel, Wedge-tailed Eagle and Whistling Kite. Impacts on Wedge-tailed Eagle and other common raptors are expected to occur. Our experience at other wind farms indicates that small numbers of these species will collide with turbines each year (Nature Advisory, unpubl. data). Impacts on listed threatened species may occur. However, additional bird utilisation surveys will be required to determine the use of the windfarm by these listed species.

*Waterbirds*

Four species of waterbird were recorded as incidental observations. One Australian Pelican was observed between BUS point one and R1. White-faced Heron, Grey Teal and Pacific Black Duck were observed along Balranald Road near BUS point four. The Australian Pelican was observed flying at RSA height, while the other species were observed on the ground. Observations of waterbird species and numbers will continue to be recorded during future BUS surveys and this will inform the spatial distribution and numbers of these, and other waterbird species associated with the site. This will determine the level of risk associated with waterbird species.

## Additional species considered:

*White-throated Needletail*

This species breeds in north-east Asia and migrates to Australia where it occurs from October to April and feeds on aerial insects. This species utilises habitat along the Great Dividing Range and along the eastern coast. It is a highly mobile species covering large distances in short periods. The species may be an infrequent visitor to the site during optimal weather conditions. The Junction Rivers Wind Project is likely be on the edge of the range for this species.

## Conclusions and recommendations

A total of 50 bird species were recorded during the winter BUS surveyed in July 2022. Thirty-four during BUS point counts and a further 16 incidentally in the study site. The majority of these bird species are common native species, found in arid and semi-arid landscapes of inland NSW. One EPBC Act listed species and three species listed as vulnerable in NSW were recorded, during winter BUS. Three species had been represented at the site previously while the Black Falcon is new for the site.

Continued studies are recommended to determine the potential presence/absence of threatened bird species, to monitor the presence and activity of recorded threatened bird species, and to monitor seasonal variances over a full year within the study area.

Yours sincerely,



**Bernard O'Callaghan**
**Senior Ecologist and Project Manager**
**Nature Advisory**

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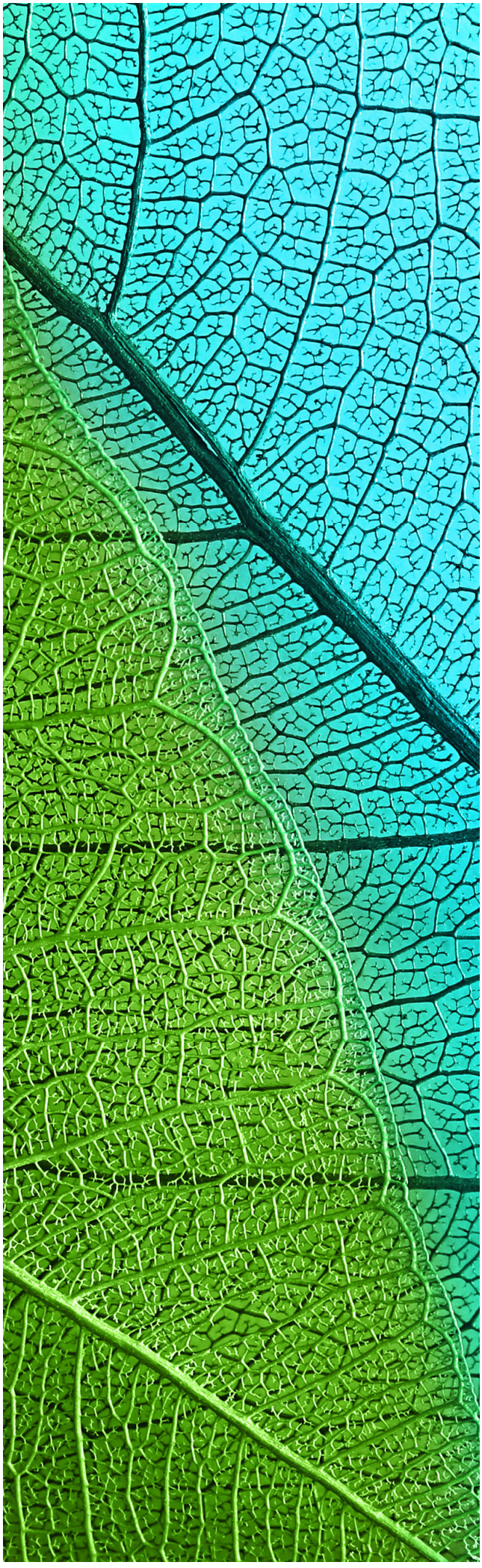
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## Appendix 1: Autumn species list 2022 BUS

| Common Name | Scientific Name | EPBC Act | BC Act |
|---|---|---|---|
| Apostlebird | *Struthidea cinerea* | | |
| Australian Magpie | *Gymnorhina tibicen* | | |
| Australian Pelican | Pelicanus conspicillatus | | |
| Australian Pipit | *Anthus novaeseelandiae* | | |
| Australian Raven | *Corvus coronoides* | | |
| Australian Wood Duck | *Tadorna tadornoides* | | |
| Black Falcon | *Falco subniger* | | V |
| Black-faced Cuckooshrike | Coracina lineata | | |
| Bluebonnet | *Northiella haematogaster* | | |
| Blue-faced Honeyeater | *Entomyzon cyanotis* | | |
| Brown Falcon | *Falco berigora* | | |
| Brown Songlark | *Cincloramphus cruralis* | | |
| Chestnut-crowned Babbler | *Pomatostomus temporalis* | | |
| Chestnut-rumped Thornbill | *Acanthiza uropygialis* | | |
| Common Starling | *Sturnus vulgaris* | | |
| Crested Pigeon | *Ocyphaps lophotes* | | |
| Eastern Rosella | *Platycercus eximius* | | |
| Emu | *Dromaius novaehollandiae* | | |
| Galah | *Eolophus roseicapilla* | | |
| Grey Butcherbird | *Cracticus torquatus* | | |
| Grey Fantail | *Rhipidura albiscapa* | | |
| Grey Teal | *Anas gracilis* | | |
| Ground Cuckooshrike | *Coracina maxima* | | |
| Laughing Kookaburra | *Dacelo novaeguineae* | | |
| Magpie-lark | *Grallina cyanoleuca* | | |
| Major Mitchell's Cockatoo | *Lophochroa leadbeateri* | | V |
| Mallee Ringneck | *Barnardius zonarius barnardi* | | |
| Nankeen Kestrel | *Falco cenchroides* | | |
| Noisy Miner | *Manorina melanocephala* | | |
| Painted Buttonquail | *Turnix varius* | | |
| Pied Butcherbird | *Cracticus nigrogularis* | | |
| Red Wattlebird | *Anthochaera carunculata* | | |
| Red-rumped Parrot | *Psephotus haematonotus* | | |
| Regent Parrot | *Polytelis anthopeplus* | V | En |
| Singing Honeyeater | *Gavicalis virescens* | | |
| Southern Whiteface | *Aphelocephala leucopsis* | | |
| Spiny-cheeked Honeyeater | *Acanthagenys rufogularis* | | |
| Spotted Harrier | *Circus assimilis* | | V |
| Striated Pardalote | *Pardalotus striatus* | | |
| Wedge-tailed Eagle | *Aquila audax* | | |

| Common Name | Scientific Name | EPBC Act | BC Act |
|---|---|---|---|
| Weebill | *Smicrornis brevirostris* | | |
| Welcome Swallow | *Hirundo neoxena* | | |
| Whistling Kite | *Haliastur sphenurus* | | |
| White-faced Heron | *Egretta novaehollandiae* | | |
| White-plumed Honeyeater | *Ptilotula penicillata* | | |
| White-winged Chough | *Corcorax melanorhamphos* | | |
| White-winged Fairywren | *Malurus leucopterus* | | |
| Willie Wagtail | *Rhipidura phasiana* | | |
| Yellow-rumped Thornbill | *Acanthiza chrysorrhoa* | | |
| Yellow-throated Miner | *Manorina flavigula* | | |

*V = Vulnerable, En = Endangered



# Junction Rivers Wind Project

## Bird Utilisation Survey – Year One

**Prepared for NGH Consulting**

Updated February 2024
Report No. 20195.04 (1.1)

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# 1. Introduction

NGH Consulting engaged Nature Advisory Pty Ltd to provide baseline data on the pre-construction utilisation by birds of the proposed Junction Rivers Wind Project site.

The bird utilisation survey (BUS) was undertaken consistent with the requirements for a "Level One" bird risk assessment in accordance with Best Practice Guidelines for Wind Energy Developments in Australia issued by the Clean Energy Council (2018).

Four pre-construction bird utilisation surveys were undertaken by experienced zoologists in 2021; one in each season to account for seasonal differences in bird activity and presence of species (due to migration). The dates and surveyors are detailed below.

- Summer: 22/02/2021 – 28/02/2021 (Eamon O'Meara)
- Autumn: 17/05/2021 – 21/05/2021 (Eamon O'Meara)
- Winter: 1/08/2021 – 9/8/2021 (Gavin Thomas)
- Spring: 2/11/2021 – 6/11/2021 (Eamon O'Meara)

This report is divided into the following sections:

**Section 2** describes the methods used for the bird utilisation survey

**Section 3** presents the assessment results

**Section 4** provides conclusions

This investigation was undertaken by a team from Nature Advisory comprising Eamon O'Meara (Zoologist), Gavin Thomas (Zoologist), Emma Loboda (GIS Analyst), Bernard O'Callaghan (Director) and Brett Lane (Principal Consultant).

# 2. Methods

## 2.1. Fixed-point bird count

The fixed-point bird count method involved an observer stationed at a survey point for 15 minutes. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm site (nature Advisory data). This showed that 82 to 100 percent (average 88 percent) of species seen in one hour of surveying were seen in the initial 15 minutes of observation. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area during the survey.

During this period, all bird species and numbers of individual birds observed within 200 metres were recorded. The species, the number of birds and the height of the bird when first observed were documented. For species of concern (threatened species, waterbirds and raptors), the minimum and maximum heights were recorded.

Flight height is presented as below, at or above rotor swept area height (RSA height):

- **A =** Below RSA (< 50 metres above ground)
- **B =** At RSA (50 – 300 metres above ground)
- **C =** Above RSA (> 300 metres above ground)

Table 1 indicates when each point was counted on each survey day. This schedule ensured that all points were visited equally at different times of day to allow for time-of-day differences in bird movements and activity. Every survey point (impact and reference) was visited eight times over each seasonal survey period (Figure 1).

**Table 1: Times when points were counted for each fixed-point bird count survey day**

| Time | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 |
|---|---|---|---|---|---|---|
| 8:00 - 8:30 | Travel to site | 7 | 1 | 2 | 5 | Travel From site |
| 8:30 - 9:00 | | 8 | R1 | 4 | 6 | |
| 9:00 - 9:30 | | 1 | R2 | 5 | 7 | |
| 9:30 - 10:00 | | R1 | 3 | 6 | 8 | |
| 10:00 - 10:30 | | 3 | 2 | 8 | R1 | |
| 10:30 - 11:00 | | R2 | 4 | 7 | 1 | |
| 11:00 - 11:30 | | 2 | 5 | 3 | R2 | |
| 11:30 - 12:30 | | 4 | 6 | R2 | 3 | |
| 12:30 - 13:00 | | 5 | 7 | 1 | 2 | |
| 13:00 -13:30 | | 6 | 8 | R1 | 4 | |
| 13:30 - 14:00 | | 7 | 1 | 2 | 5 | |
| 14:00 - 14:30 | | 8 | R1 | 4 | 6 | |

| Time | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 |
|---|---|---|---|---|---|---|
| 14:30 - 15:00 | | R2 | 3 | 5 | 7 | |
| 15:00 - 15:30 | | 3 | R2 | 6 | 8 | |
| 15:30 - 16:00 | | 1 | 2 | 7 | R1 | |
| 16:00 - 16:30 | | R1 | 4 | 8 | 1 | |
| 16:30 – 17:00 | Deploy Songmeters | 2 | 5 | 1 | 3 | |
| 17:00 – 17:30 | | 4 | 6 | R1 | R2 | |
| 17:30 – 18:00 | | 5 | 7 | R2 | 2 | |
| 18:00 – 18:30 | | 6 | 8 | 3 | 4 | |

**Note:** See Figure 1 for survey point locations. The prefix 'R' refers to reference points.

## 2.2. Locations of survey points

Over the four survey periods, ten fixed survey points were established; eight impact points and two reference points. Impact points were located near proposed turbine locations and reference points were located at least 500 metres away from proposed turbines and from impact points in areas of similar habitat.

The survey points were distributed as evenly as possible (subject to access constraints) across the wind farm to maximise coverage in areas where wind turbines are likely to be sited (Figure 1). Impact points were positioned as far as possible on elevated ground, allowing a clear view in all directions. Table 2 below provides a description of the habitats associated with each impact and reference point.

**Table 2: Habitat associated with each survey point**

| Site | Description | Lat | Long |
|---|---|---|---|
| 1 | Crop paddock on small rise/dune 180 from western fence line and Mallee scrub | -34.803521 | 143.5302 |
| 2 | Casuarina woodland adjacent to crop paddock | -34.805993 | 143.5669 |
| 3 | Crop paddock on rise/dune 160m from western fence line and Mallee scrub | -34.849708 | 143.5071 |
| 4 | Crop paddock adjacent to Mulga/casuarina scrub | -34.823316 | 143.5953 |
| 5 | Crop paddock adjacent to dry lakebed (tree lined) (landholder of 30 years has never seen lake hold water) | -34.832609 | 143.6159 |
| 6 | Dune, grass covered, under telephone line, scattered acacias and casuarinas | -34.882554 | 143.6713 |
| 7 | Rehabilitated saltbush and tumbleweed dune adjacent to Mallee scrub | -34.882726 | 143.6887 |
| 8 | Rehabilitated saltbush and casuarina sand dune country | -34.915506 | 143.7096 |
| R1 | Fence line, crop paddock and casuarina/Mallee woodland remnant near HV powerline. Water trough x 2 | -34.785023 | 143.5344 |
| R2 | Mallee scrub and open crop paddock | -34.885065 | 143.5006 |

## 2.3. Incidental observations

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (threatened species, raptors, waterbirds) were made whilst travelling throughout the wind farm site. Notes are also made on woodland birds observed in remnant woodlands and any early morning and evening roosting movements. Emphasis was placed on observing birds that were moving through the site at RSA height.

## 2.4. Data preparation and statistical analysis

Data was collected during four seasonal BUS studies during the pre-construction phase, from summer to spring 2021. Observations were recorded in the pre-defined filed observation forms. Raw data were then entered into spreadsheet file and tables and graphs were extracted. Graphs were generated in Microsoft Excel.

First, the suitability of the survey method was checked using a cumulative species number graph (see results below). To investigate the variations of species diversity and abundance between impact and reference sites, species diversity and abundance was compared between points and between impact and reference points.

## 2.5. Limitations

The bird utilisation survey was undertaken once in each of the four seasons in 2021.

In autumn and winter, birds such as starlings, cockatoos, ravens, or magpies usually occur in flocks generating larger counts. However, there may be a lack of observations for several surveys if the flocks are in a different area. Furthermore, most migrant species are not present in the region at that time.

For these reasons, and the reasons explained in section 3.1, the utilisation rates and species abundances recorded during the current survey are considered to be representative of the site. They are also considered to provide a good basis on which to assess the bird risks associated with the proposed Junction Rivers Wind Project.

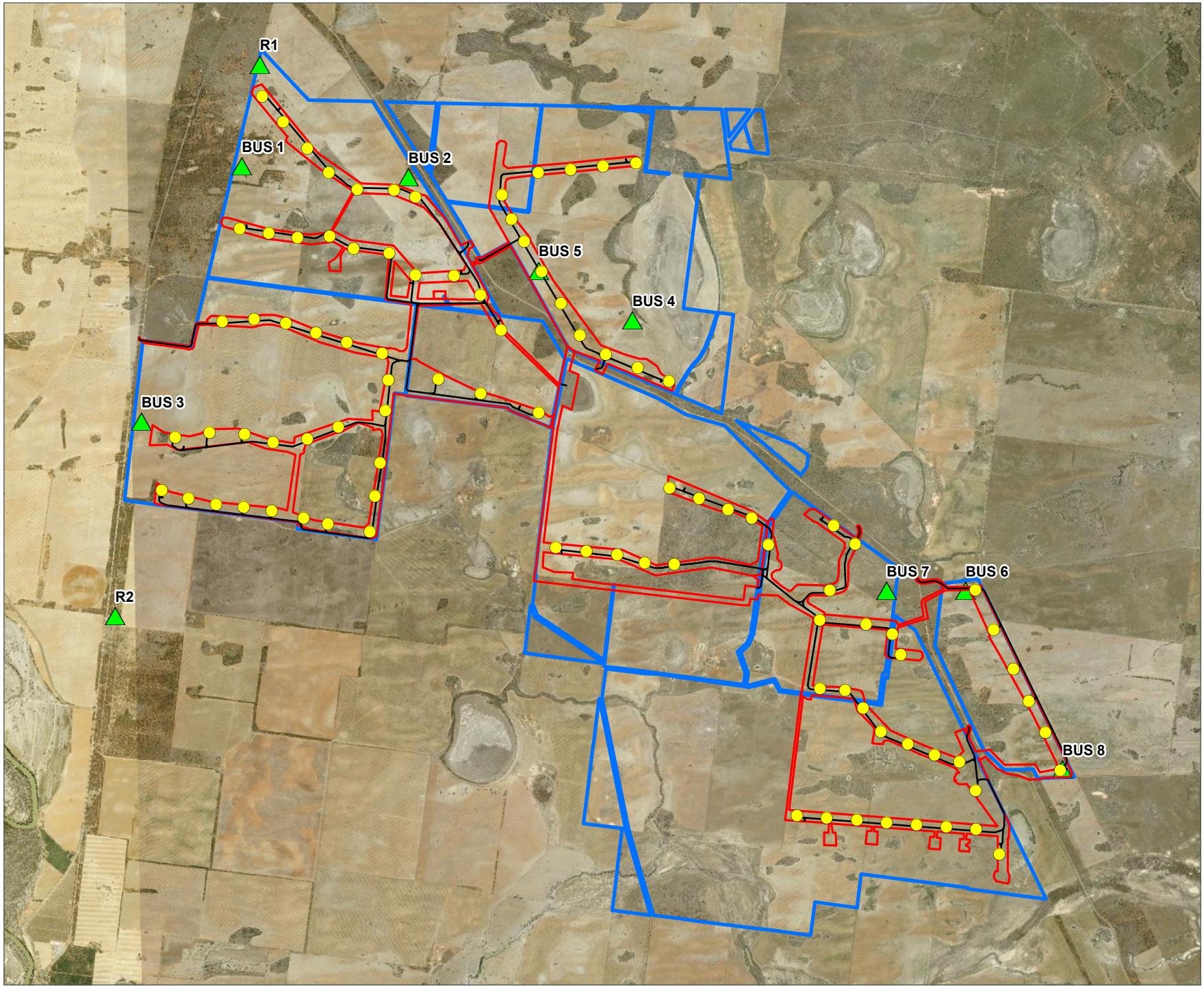



**Figure 1:** Junction Rivers **Wind** Project **BUS points**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

Wind Farm Boundary
Development corridor
Turbine
Access tracks
BUS point

N

Metres
0 1,400

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# 3. Results

## 3.1. Survey suitability

The cumulative number of species observed from the consecutive fixed-point bird counts conducted at the observation points during the 2021 survey period has been plotted in (Figure 2). The data indicated that during summer and autumn 2021 surveys, the number of species recorded levelled out after about 42 and 38 counts respectively. In winter this levelled out after 54 counts, and in spring at 55 counts, with two additional species towards the latter end of the survey effort This supports the adequacy of using eight replicate counts to generate representative data on the bird species in the area during the relevant time of year.

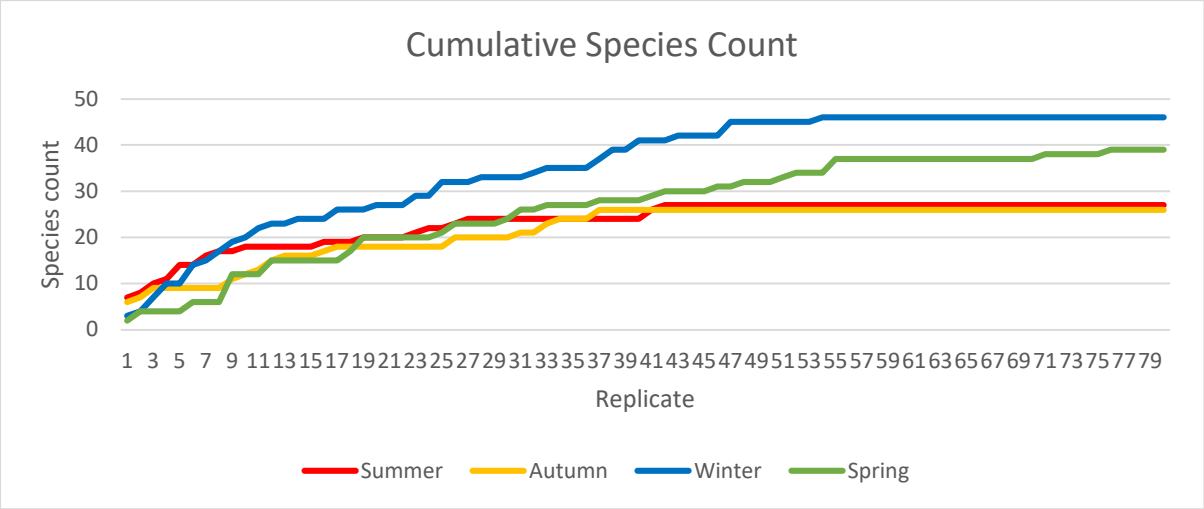



Figure 2: The cumulative count of bird species recorded during formal BUS at Junction Rivers Wind Project 2021.

## 3.2. Species composition

A total of 63 bird species were recorded during the combined four seasonal surveys over one year of observations (Table 4). Some 52 species were recorded at the impact survey points and 42 at the reference survey points (Table 4). Species recorded were predominantly farmland and bushland species with some records of raptors and waterbirds. Total utilisation (cumulative counts) of each species recorded at each site is presented in Table 4.

Species diversity varied between each season. Diversity was highest in winter and spring and lowest in summer and autumn. Species composition (diversity) differs between months due to seasonal changes in presence and abundance, activity, changes in foraging behaviour and seasonal distribution of birds among various habitats.

The five most common species at the impact and reference survey points are presented in Table 3 below.

Table 3: The five most common bird species recorded at BUS points at Junction Rivers Wind Project

| Impact survey points | Reference survey points |
|---|---|
| Eastern Blue Bonnet | Eastern Blue Bonnet |
| Australian Magpie | Apostlebird |
| Galah | Crested Pigeon |
| Yellow-throated Miner | Galah |
| Chestnut-crowned Babbler | Yellow-throated Miner |

These five species comprised 58.23% of all birds recorded at the impact survey points and 53.54% at the reference survey points. The total number of birds observed at impact points during the surveys varied between 78 at survey point 4, to 477 at survey point 2, while birds observed at the reference points varied from 638 at survey point R1 to 675 at survey point R2.

Bird diversity at the reference points ranged from 23 to 37 species, and the seven impact points from 13 to 31 species. Abundance also averaged higher at the reference points.

Table 4: Number and height distribution of bird species at survey points during combined four seasons surveys at Junction Rivers Wind Project site

| Site | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | R1 | | R2 | | Total | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | |
| Apostlebird | 7 | | | | | | | | | | | | 78 | | 7 | | 143 | | 16 | | 251 | | 251 |
| Australasian Pipit | | | | | 1 | | 2 | 2 | 4 | | | | 2 | | | | | | | | 9 | 2 | 11 |
| Australian Magpie | 25 | | 31 | 17 | 28 | | 33 | | 23 | | 50 | | 39 | 5 | 65 | | 24 | | 35 | | 353 | 22 | 375 |
| Australian Raven | 17 | | 2 | | 3 | | | | 10 | | 54 | | 11 | | 11 | | 6 | | 7 | | 121 | | 121 |
| Banded Lapwing | 6 | | | | | | | | | | | | | | 2 | | | | | | 8 | | 8 |
| Black Kite | | | | | | | 1 | | | | | | | | | | | | | | 1 | | 1 |
| Black-faced Cuckoo-shrike | | | 1 | | 1 | | | | 7 | | 3 | | 2 | | 2 | | 3 | | 4 | | 23 | | 23 |
| Black-shouldered Kite | | | | | | | 1 | | | | | | | | | | | | | | 1 | | 1 |
| Blue Bonnet | 25 | | 144 | | 33 | | 9 | | 54 | | 47 | | 101 | | 114 | | 70 | | 104 | | 701 | | 701 |
| Brown Falcon | | | | | | | | | 2 | | | | | | | 2 | | | | | 2 | 2 | 4 |
| Brown Goshawk | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 |
| Brown Songlark | | | | | | | | | | | 1 | | 10 | | 12 | | | | | | 23 | | 23 |
| Brown-headed Honeyeater | | | | | | | | | | | | | 4 | | | | | | | | 4 | | 4 |
| Chestnut-crowned Babbler | | | 74 | | | | | | | | 63 | | 20 | | 7 | | | | 40 | | 204 | | 204 |
| Chestnut-rumped Thornbill | | | | | | | | | | | | | | | | | | | 47 | | 47 | | 47 |
| Common Bronzewing | | | | | | | | | | | | | | | | | | | 2 | | 2 | | 2 |
| Common Starling | | | | | | | | | | | | | | | 17 | | 1 | | | | 18 | | 18 |
| Corvid spp. | | | 7 | | 1 | | | | | | 5 | | | | 1 | | | | 1 | | 15 | | 15 |
| Crested Pigeon | 5 | | 18 | | 20 | | 2 | | 5 | | 3 | | 31 | | 11 | | 70 | | 86 | | 251 | | 251 |
| Eastern Rosella | | | 2 | | 2 | | | | | | | | 2 | | | | | | 6 | | 12 | | 12 |
| Emu | | | | | | | | | | | | | | | | | | | 4 | | 4 | | 4 |
| Fairy Martin | | | | | | | | 1 | | | | | | | | | | | | | | 1 | 1 |
| Galah | 15 | | 75 | | 10 | | 13 | | 19 | 2 | 20 | 31 | 4 | | 10 | 26 | 98 | | 12 | | 276 | 59 | 335 |
| Golden Whistler | 1 | | | | | | | | | | | | | | | | | | | | 1 | | 1 |
| Great Cormorant | | 13 | | | | | | | | | | | | | | | | | | | | 13 | 13 |
| Grey Butcherbird | 6 | | | | | | | | | | 1 | | 2 | | 2 | | | | 8 | | 19 | | 19 |
| Grey Shrike-thrush | | | | | | | | | | | | | | | | | | | 2 | | 2 | | 2 |
| Little Raven | 59 | 35 | 9 | | 7 | | 5 | | 2 | | 13 | | | | 16 | | 72 | | 7 | | 190 | | 225 |
| Little Wattlebird | | | | | | | | | | | | | | | | | | | 4 | | 4 | | 4 |
| Magpie-lark | 15 | | 6 | | | | | | 2 | | | | 3 | | 51 | | 13 | | 2 | | 92 | | 92 |
| Major Mitchell's Cockatoo | | | | | 5 | | | | | | 7 | | 6 | | 2 | | 5 | | 4 | | 29 | | 29 |
| Mallee Ringneck | | | 6 | | 6 | | 2 | | | | | | 8 | | | | 6 | | 4 | | 32 | | 32 |
| Mistletoebird | 1 | | | | | | | | | | | | 1 | | | | | | | | 2 | | 2 |
| Nankeen Kestrel | | | | | | | | | 2 | | | | 3 | | 1 | | 1 | | 2 | | 9 | | 9 |
| Noisy Miner | 3 | | 5 | | 1 | | | | 3 | | 6 | | 21 | | 6 | | | | 2 | | 47 | | 47 |
| Pied Butcherbird | | | 2 | | 2 | | 5 | | 5 | | 7 | | 7 | | 4 | | 7 | | 4 | | 43 | | 43 |
| Rainbow Bee-eater | | | | | | | | | | | 2 | | 6 | | | | | | 13 | | 21 | | 21 |
| Red Wattlebird | | | | | | | | | | | | | | | | | | | 2 | | 2 | | 2 |
| Red-rumped Parrot | | | 18 | | | | | | | | 7 | | 25 | | | | 35 | | | | 85 | | 85 |
| Regent Parrot | | | | | 2 | | | | | | | | | | | | 37 | | | | 39 | | 39 |
| Restless Flycatcher | | | | | | | | | | | | | | | | | | | 11 | | 11 | | 11 |
| Singing Honeyeater | 1 | | | | 1 | | 1 | | | | | | 8 | | 14 | | 1 | | 5 | | 31 | | 31 |
| Southern Whiteface | | | | | | | | | | | 2 | | | | 3 | | | | | | 5 | | 5 |
| Spiny-cheeked Honeyeater | 2 | | | | 3 | | | | | | | | | | 6 | | 2 | | 44 | | 57 | | 57 |

| Site | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | R1 | | R2 | | Total | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | |
| Spotted Harrier | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 |
| Straw-necked Ibis | | | | | | | | | | | | | 1 | | 2 | | | | | | 3 | | 3 |
| Striated Pardalote | 3 | | | | | | | | | | | | | | | | 1 | | 13 | | 17 | | 17 |
| Sulphur-crested Cockatoo | | | | | | | | | | | | | | | | | | | 1 | | 1 | | 1 |
| Wedge-tailed Eagle | | | | | | | | 1 | | 1 | 2 | | | | 3 | | | | | 1 | 5 | 3 | 8 |
| Weebill | 6 | | | | | | | | | | | | | | 2 | | | | | | 8 | | 8 |
| Welcome Swallow | 2 | | | | 2 | | | | | | | | 1 | | | | | | | | 5 | | 5 |
| Whistling Kite | | | 2 | | 1 | | | | | | | | | | | | | | | | 3 | | 3 |
| White-browed Woodswallow | | | 5 | | | | | | | | | | | | | | | | 94 | | 99 | | 99 |
| White-fronted Chat | | | | | | | | | | | | | 1 | | 2 | | | | | | 3 | | 3 |
| White-necked Heron | | | | | | | | | | | | | | | 1 | | | | | | 1 | | 1 |
| White-plumed Honeyeater | | | | | | | | | | | | | | | | | | | 7 | | 7 | | 7 |
| White-winged Chough | 23 | | | | | | | | | | 15 | | 30 | | | | 9 | | | | 77 | | 77 |
| White-winged Fairywren | | | | | | | | | | | 5 | | | | | | | | | | 5 | | 5 |
| Willie Wagtail | 1 | | | | 1 | | | | | | 1 | | 2 | | 10 | | 4 | | | | 19 | | 19 |
| Yellow-faced Honeyeater | | | | | 2 | | | | | | | | | | | | | | | | 2 | | 2 |
| Yellow-plumed Honeyeater | 2 | | | | | | | | | | | | | | | | | | | | 2 | | 2 |
| Yellow-rumped Thornbill | | | | | | | | | | | | | | | 12 | | | | 5 | | 17 | | 17 |
| Yellow-throated Miner | 43 | | 53 | | 10 | | | | 22 | | 9 | | 23 | | 29 | | 30 | | 74 | | 293 | | 293 |
| **Grand Total** | **316** | **48** | **460** | **17** | **142** | **0** | **74** | **4** | **162** | **3** | **354** | **31** | **457** | **5** | **427** | **28** | **638** | **0** | **675** | **1** | **3616** | **137** | **3753** |

**Notes:** R = Reference; A = Below RSA height; B = At RSA height. No birds were recorded above RSA height.

## 3.3. Flight Heights

Bird heights were classified as below (< 50 metres), at (50–300 metres), and above (> 300 metres) RSA height. Detailed results of the number of birds recorded at the different flight heights are presented in Table 5.

Most birds were recorded below RSA height, at both impact sites and reference sites (Table 5): 94.4% and 99.9% respectively.

Table 5: Summary of birds recorded at the three flight heights

| Flight Height | Impact survey points | | Reference survey points | |
|---|---|---|---|---|
| | Number of birds | Percentage of all birds | Number of birds | Percentage of all birds |
| A (below RSA) | 2304 | 61.4% | 1312 | 34.97% |
| B (at RSA) | 136 | 3.6% | 1 | 0.03% |
| C (above RSA) | 0 | 0.0% | 0 | 0.0% |
| **Total birds recorded** | **2440** | **65.0%** | **1313** | **35.0%** |

The five most abundant species flying at RSA are detailed below in Table 6.

Table 6: The five most abundant species flying at RSA height at Junction Rivers Wind Project

| Impact survey points | Reference survey points |
|---|---|
| Galah | Wedge-tailed Eagle |
| Little Raven | - |
| Australian Magpie | - |
| Great Cormorant | - |
| Wedge-tailed Eagle | - |

These accounted for 3.6% of the total birds observed at impact survey points. One Wedge-tailed Eagle was observed flying at RSA height at reference survey point R2, accounting for 0.08% of the total birds observed at reference sites.

## 3.4. Threatened Species

Most birds found to utilise the proposed wind farm site were common birds. Of the species recorded during the bird utilisation surveys, one species listed as Vulnerable under the *EPBC Act 1999* was found, and one listed as Endangered and three listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act). These are considered further below.

*Regent Parrot*

Regent Parrot is listed as Vulnerable under the EPBC Act and Endangered under the BC Act of New South Wales. This species breeds in riverside forests of River Red Gum and forages widely in mallee and agricultural landscapes (Menkhorst et al. 2017). Corridors of tree cover are required for commuting between breeding and feeding areas. As this species was recorded during formal BUS, it is likely that these individuals are resident in the study area. Regent Parrot was not observed at the proposed RSA height (>50m above ground). This species forages primarily in mallee, in low growing vegetation (maximum canopy height in the study area is approximately 8 metres). When commuting, it flies at or just above the canopy, not at height. It is therefore highly unlikely that this species will fly at RSA height.

*Major Mitchell's Cockatoo*

Major Mitchell's Cockatoo is listed as Vulnerable under the BC Act of New South Wales. This species is uncommon and patchily distributed across arid and semi-arid inland woodland and treeless habitats (Menkhorst et al. 2017). It feeds on a wide variety of seeds of native saltbush, Acacias and cypress pines, and exotic melons. Established pairs and small family groups tend to be resident with large home ranges (Menkhorst et al. 2017). As this species was recorded during formal BUS, it is likely that these individuals are resident in the study area. Major Mitchell's Cockatoo was not observed at the proposed RSA height (>50m above ground). This species forages primarily on the ground, and in low growing vegetation (maximum canopy height in the study area is approximately 8 metres) so it is unlikely it will fly at the proposed RSA height.

*Spotted Harrier*

Spotted Harrier is listed as Vulnerable under the BC Act of New South Wales. This species is widespread in open and sparsely wooded habitats, especially grasslands and crops in arid and semi-arid regions. It is a mobile species, mostly seen flying low and slowly, foraging for ground birds and mammals (Menkhorst et al. 2017). As this species was recorded during formal BUS, it is likely that it is a regular visitor to the study area. Spotted Harrier was not observed at the proposed RSA height (>50m above ground). This species forages primarily for ground birds and mammals, flying low over grassland and crops. It is unlikely this species will fly regularly at the proposed RSA height.

*White-fronted Chat*

White-fronted Chat is listed as Vulnerable under the BC Act of New South Wales. This species is found in small groups near damp salt-pan samphire flats in inland habitats (Menkhorst et al. 2017). This species feeds on insects, spiders, acacia seeds and nectar. As it was recorded during the formal winter BUS, it is likely an occasional visitor to the study area. White-fronted Chat was not observed at the proposed RSA height (>50m above ground). It forages primarily on or close to ground level and inhabits low-growing vegetation (maximum canopy height in the study area is approximately 8 metres), it is highly unlikely that this species will fly at the proposed RSA height. It has been observed feeding on the ground near operating wind turbines at wind farms elsewhere in NSW (Nature Advisory data), indicating limited potential for indirect impacts.

## 3.5. Raptors

Eight raptor species were recorded during the 2021 BUS at impact sites, comprising a total of 24 observations in total (Table 7), indicating comparatively low activity levels. The presence of these raptors varied between the seasons. Two additional species, Brown Goshawk and Spotted Harrier, were recorded at reference sites.

Nankeen Kestrel was the most abundant raptor species at Junction Rivers Wind Project during the first year of BUS. It was seen regularly throughout the study area across all seasons. Kestrels are at risk of collision with operating turbines based on experience at other wind farms. As they are relatively common, impacts on their population from the occasional collision are minimal.

The Wedge-tailed Eagle was observed eight times at Junction Rivers Wind Project, representing a comparatively ow utilisation rate of 0.008 birds per hectare per hour. It is possible that up to three resident pairs of eagles include the site in their home ranges. Fifty percent of Wedge-tailed Eagle flights were observed at RSA height (impact and reference points combined). The Wedge-tailed Eagle is the most vulnerable species to collision with operating turbines because of their soaring habits while foraging.

The number of raptors was low in relation to the total number of birds recorded during the surveys, with raptors forming approximately 4% of birds seen at RSA height (Table 7). Based on the low utilisation rate by raptors at the impact points, risks to them are likely to be low.

### 3.6. Waterbirds

Four waterbird/shorebird species, the Banded Lapwing, Great Cormorant, Straw-necked Ibis and White-necked Heron were recorded during the surveys at impact sites, comprising 25 observations in total (0.6% of all birds).

These species are common farmland waterbirds found in most habitat types and agricultural landscapes throughout eastern and southern Australia. Flocks of some species were observed at impacts survey points across the wind farm site. All Great Cormorant (13 individuals in a single flock) were observed flying at RSA height.

The proposed Junction Rivers Wind Project site contained few dams and a no naturally occurring wetlands known to hold water. None of the waterbirds observed at Junction Rivers Wind Project were threatened species, either under Commonwealth or state conservation legislation.

Table 7: Raptor and Waterbird species recorded at impact survey points during four seasons surveys at Junction Rivers Wind Project

| | Summer 2021 | | Autumn 2021 | | Winter 2021 | | Spring 2021 | | Grand Total | Total at RSA | Total raptor flights (%) | Flights at RSA (%) | Flights recorded at RSA compared with all bird flights at RSA (%) | Flights recorded at RSA compared with all bird flights observed (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Raptors | A | B | A | B | A | B | A | B | | | | | | |
| Black Kite | 1 | - | - | - | - | - | 1 | - | 2 | - | 7.41 | 0 | 0 | 0 |
| Black-shouldered Kite | - | - | - | - | 1 | - | - | - | 1 | - | 3.7 | 0 | 0 | 0 |
| Brown Falcon | 2 | - | - | - | - | - | - | 2 | 4 | 2 | 14.81 | 50.00 | 1.46 | 0.05 |
| Brown Goshawk | - | - | - | - | 1 | - | - | - | 1 | - | 3.7 | 0 | 0 | 0 |
| Nankeen Kestrel | 4 | - | - | - | 2 | - | 3 | - | 9 | - | 33.33 | 0 | 0 | 0 |
| Spotted Harrier | - | - | - | - | 1 | - | - | - | 1 | - | 3.7 | 0 | 0 | 0 |
| Wedge-tailed Eagle | - | 1 | 4 | - | - | 2 | - | - | 6 | 3 | 25.93 | 50.00 | 2.19 | 0.08 |
| Whistling Kite | - | - | 2 | - | - | - | - | - | 2 | - | 7.41 | 0 | 0 | 0 |
| **Totals** | **8** | **0** | **6** | **0** | **7** | **0** | **7** | **0** | **27** | **5** | **100.0** | | **3.65** | **0.13** |
| | Summer 2021 | | Autumn 2021 | | Winter 2021 | | Spring 2021 | | Grand Total | Total at RSA | Total waterbird flights (%) | Flights at RSA (%) | Flights recorded at RSA compared with all bird flights at RSA (%) | Flights recorded at RSA compared with all bird flights observed (%) |
| Waterbirds | A | B | A | B | A | B | A | B | | | | | | |
| Banded Lapwing | - | - | - | - | 8 | - | - | - | 8 | 0 | 32 | 0 | 0 | 0 |
| Great Cormorant | - | 13 | - | - | - | - | - | - | 0 | 13 | 52 | 100 | 9.49 | 0.35 |
| Straw-necked Ibis | - | - | - | - | - | - | 3 | - | 3 | 0 | 12 | 0 | 0 | 0 |
| White-necked Heron | - | - | - | - | - | - | 1 | - | 1 | 0 | 4 | 0 | 0 | 0 |
| **Totals** | **0** | **13** | **0** | **0** | **8** | **0** | **4** | **0** | **12** | **13** | **100** | | **9.49** | **0.35** |

**A**=below rotor swept area (RSA) height (<50 m); **B=** at RSA height (50-300 m). No flights were recorded above RSA height of >300m.

# 4. Conclusions

The conclusions from the year of bird utilisation surveys of the Junction Rivers Wind Project are presented below.

- The study area largely consists of land cleared for agriculture supporting a low diversity and abundance of common, predominantly farmland birds. Some woodland birds inhabit the smaller remnant natural areas of Mulga and Mallee.
- Only a small proportion of all flights (3.65%) were at RSA height. The most common species flying at this height were Galah, Little Raven, Australian Magpie, Great Cormorant and Wedge-tailed Eagle.
- The utilisation rates of Wedge-tailed Eagle at the site was low (mean 0.008 bird/ha/hour in winter 2021), with spatial distribution indicating up to three pairs may use the site occasionally as part of their home ranges.
- The study area supports very few other raptors or waterbirds, groups considered vulnerable to collision with operating wind turbines
- The abundance of birds recorded was at a high in spring (1224), dropping to 972 in winter, 964 in summer, and 793 in autumn. This is likely attributed to a good winter breeding season and natural resource flushes.
- The diversity of birds changed seasonally, increasing with regional rainfall, with common farmland birds dominating the species list. 27 species were recorded in summer, 26 species in autumn, 46 species in winter, and 39 species in spring.
- The cumulative count of birds recorded flying at RSA heights varied from 68 in autumn to 15 in summer, with 18 birds recorded flying at RSA in spring and 36 birds in winter. The highest single count of birds flying at RSA was a flock of 35 Little Raven in autumn. Australian Magpie, Galah, Great Cormorant, Australasian Pipit and Fairy Martin were other birds flying at RSA heights. Raptors were not common at RSA, except for the Wedge-tailed Eagle which was seen flying at RSA heights four times, and Brown Falcon observed at RSA height twice.
- The utilisation rate of the Wedge-tailed Eagle averaged at 0.008 eagles per hectare per hour. The utilisation rate of the Nankeen Kestrel averaged 0.009 kestrels per hectare per hour. These are comparatively low rates, with Nature Advisory data indicating Wedge-tailed Eagle rates in eastern Australia can vary from 0.001 to 0.44 birds per hectare per hour. The utilisation rate of other raptors and waterbirds was found to be very low.
- Waterbirds were found to be largely traversing the landscape between waterbodies, across the study area and were in low abundance. Three species of common farmland waterbirds were observed: Banded Lapwing, Straw-necked Ibis and White-necked Heron. In addition, a flock of 13 Great Cormorant were observed flying at RSA over the site, possibly commuting between the Billabong Creek and the Murrumbidgee River, a distance of about 30 kilometres
- Four species of threatened birds were recorded utilising the study area:
    - Major Mitchell's Cockatoo
    - Regent Parrot
    - Spotted Harrier, and
    - White-fronted Chat

None of these behaves in a manner that puts them at risk of collision with wind turbines with a proposed lower RSA height of 50 metres above the ground.

- An additional four seasonal surveys for another year would be required to provide a baseline of bird activity that addresses the baseline monitoring requirements of the Commonwealth under any EPBC Act approval, should this be relevant.

# 5. References

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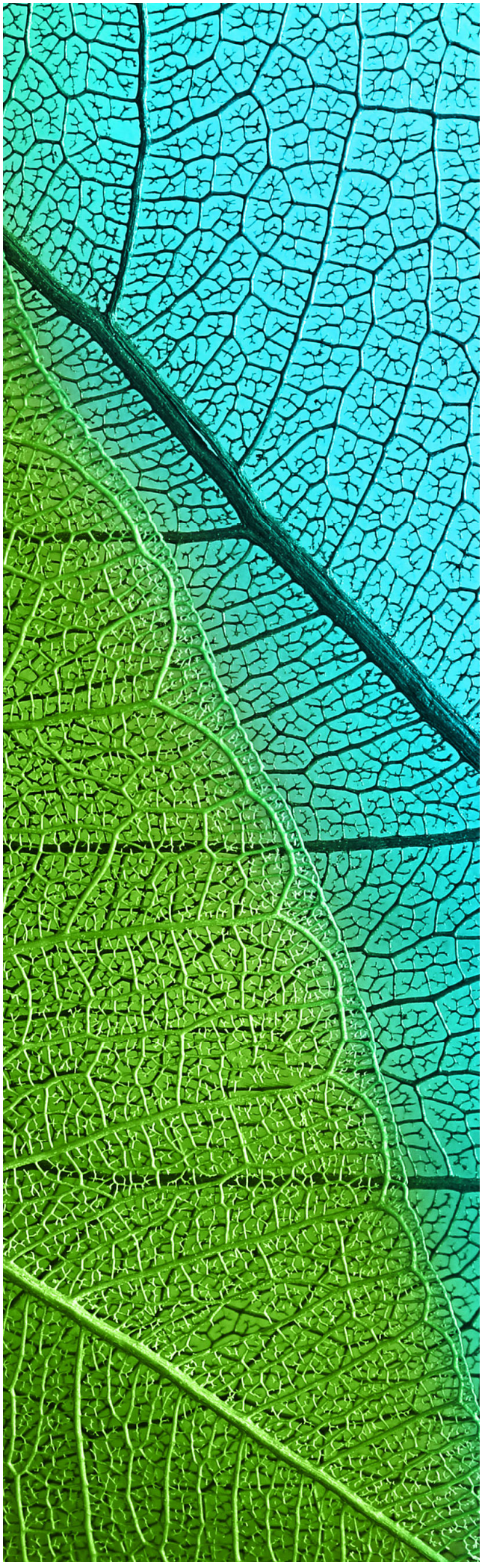
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# Junction Rivers Wind Project

## Bat Utilisation Survey

**Prepared for NGH Consulting**

February 2024
Report No. 20195.3 (1.1)

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# 1. Introduction

NGH Consulting engaged Nature Advisory Pty Ltd to undertake bat utilisation surveys of the proposed Junction Rivers Wind Project, located approximately 15 km south-east of Balranald, NSW. This assessment is part of a series of investigations that aim to satisfy the requirements of a development application in accordance with schedule 2 of the *Environmental Planning and Assessment Regulation Act 2000*.

Bat Utilisation Surveys were undertaken to collect information on bat species, including any threatened species using the site, and the activity levels of these species. Surveys were undertaken using SongMeter® detectors (SM4BAT ZC; Wildlife Acoustics) distributed across habitat types at the proposed Junction Rivers Wind Project site.

The bat utilisation surveys were undertaken in accordance with *Survey Guidelines for Australia's threatened bats* (DEWHA 2010), and consistent with methods adopted at many windfarms in eastern Australia over the last 20 years that have satisfied the information requirements of decision-makers and regulators.

Two detailed bat surveys have been undertaken at the proposed Junction Rivers Wind Project, the first in Summer (22–27 / 02 / 2021) over six days, and the second in spring (2–30 /11 / 2021) over 29 days.

This report is divided into the following sections:

Section 2 describes the methods used for the bat utilisation survey

Section 3 presents the assessment results

This investigation was undertaken by a team from Nature Advisory comprising Eamon O'Meara (Zoologist), Gavin Thomas (Zoologist), Emma Loboda (GIS Analyst), Bernard O'Callaghan (Director) and Brett Lane (Principal Consultant).

# 2. Methods

Automated bat detectors (Songmeters) recorded the species-specific echolocation calls of free-flying bats at survey sites that were representative of the habitat types of the wind farm site and located near proposed wind turbine locations (Figure 1). Songmeters were secured to trees or fence posts approximately 1.5 - 2 metres above ground. The detectors were programmed to commence operation approximately 30 minutes before dusk, and to cease approximately 30 minutes after dawn.

Each Song meter unit used an 64GB SDHC card that recorded bat echolocation calls, along with the date and time of each call.

Calls from the units were downloaded and sent to Rob Gration (EcoAerial Environmental Services, Newport VIC) for identification. The files from the recording sites were viewed in Kaleidoscope Pro analysis software (Wildlife Acoustics, USA), which provides a sonogram display of frequency versus time. Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded across Australia. Identification is largely based on changes to frequency patterns over time, with such changes being characteristic of individual species for most genera. Only those recordings that contained at least two definite and discrete calls were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently.

In both of the surveys, a broad analysis was undertaking looking at the presence and absence of all possible species know to inhabit the area. Particular focus was placed on threatened species that may occur.

## 2.1. Timing of the surveys

**Summer 2021:** Six Song meters were deployed at six sites over six consecutive nights from 22nd to the 27th February, 2021, totalling 36 bat detector-nights or 432 bat recording hours

**Summer 2021:** Six Song meters were deployed at six sites over 24–29 consecutive nights, depending on the site, from 2nd to the 30th November, 2021, totalling 130 bat detector-nights or 1560 bat recording hours

## 2.2. Locations of survey points

The location and characteristics of the recording sites are described in Table 1 below and their locations are shown in Figure 1.

Table 1: Habitat associated with each survey point

| Site | Description | Lat | Long |
|---|---|---|---|
| 1 | Crop paddock on small rise/dune 180 metres from western fence line and Mallee scrub | -34.803521 | 143.5302 |
| 2 | Casuarina woodland adjacent to crop paddock | -34.805993 | 143.5669 |
| 3 | Crop paddock adjacent to a patch of remnant vegetation | -34.849708 | 143.5071 |
| 4 | Crop paddock adjacent to Mulga/casuarina scrub | -34.823316 | 143.5953 |
| 5 | Dune, grass covered, under telephone line, scattered acacias and casuarinas | -34.882554 | 143.6713 |
| 6 | Rehabilitated saltbush and casuarina sand dune country | -34.915506 | 143.7096 |

## 2.3. Limitations

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific. Calls that could not be identified definitively were allocated to species complexes.

A further limitation in the use of this technique is that it is not possible to census bat numbers. For example, 10 calls of a particular species may be recorded but it is not known if this represents ten or one individual of that species flying past the bat recorder 10 times. Therefore, it is not possible to determine utilisation rates.

Occasionally recording devices such as those used in the survey experience technical difficulties, which are not uncommon. As a result, short periods of time may not be recorded and total hours of recordings vary between the different recorders. Weather conditions including severe storms during the recording period may at time interfere with the recording process.

The bat detectors used during this survey sample a limited airspace to a distance of approximately 20 - 30 metres.

Finally, bat activity levels may vary in response to weather variables such as air temperature, relative humidity, barometric pressure, wind speed, direction and gusts, rain and moonlight. Typically, bats are found to be less active during the following circumstances:

- During periods of full moon, and when the moon is high in the sky;
- At higher wind speeds a decrease in activity may be observed at wind speeds over 10 metres per second; and
- During moderate to heavy rainfall.

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific; however, not all species can be consistently or reliably identified using this technique. If a call is not able to be identified to the species level and it may belong to any of two or three species of bats it is assigned to a “species call complex”. Some examples of a species call complex are:

- Long-eared Bats (*Nyctophilus* spp.) calls are difficult to distinguish to species level, and hence are grouped under their generic name. The species that are likely to occur at the wind farm site are *Nyctophilus geoffroyi* and *N. gouldi*. These species are not listed as threatened; and
- Calls of species of Forest Bats (*Vespadelus* spp.) can be difficult to differentiate and, therefore, some of their calls have been combined into the species complex for the purposes of analysis.
- Similarly, calls of Broad-nosed Bats (*Scoterepens* spp.) can be difficult to differentiate, therefore some of their calls have been combined into species complex.

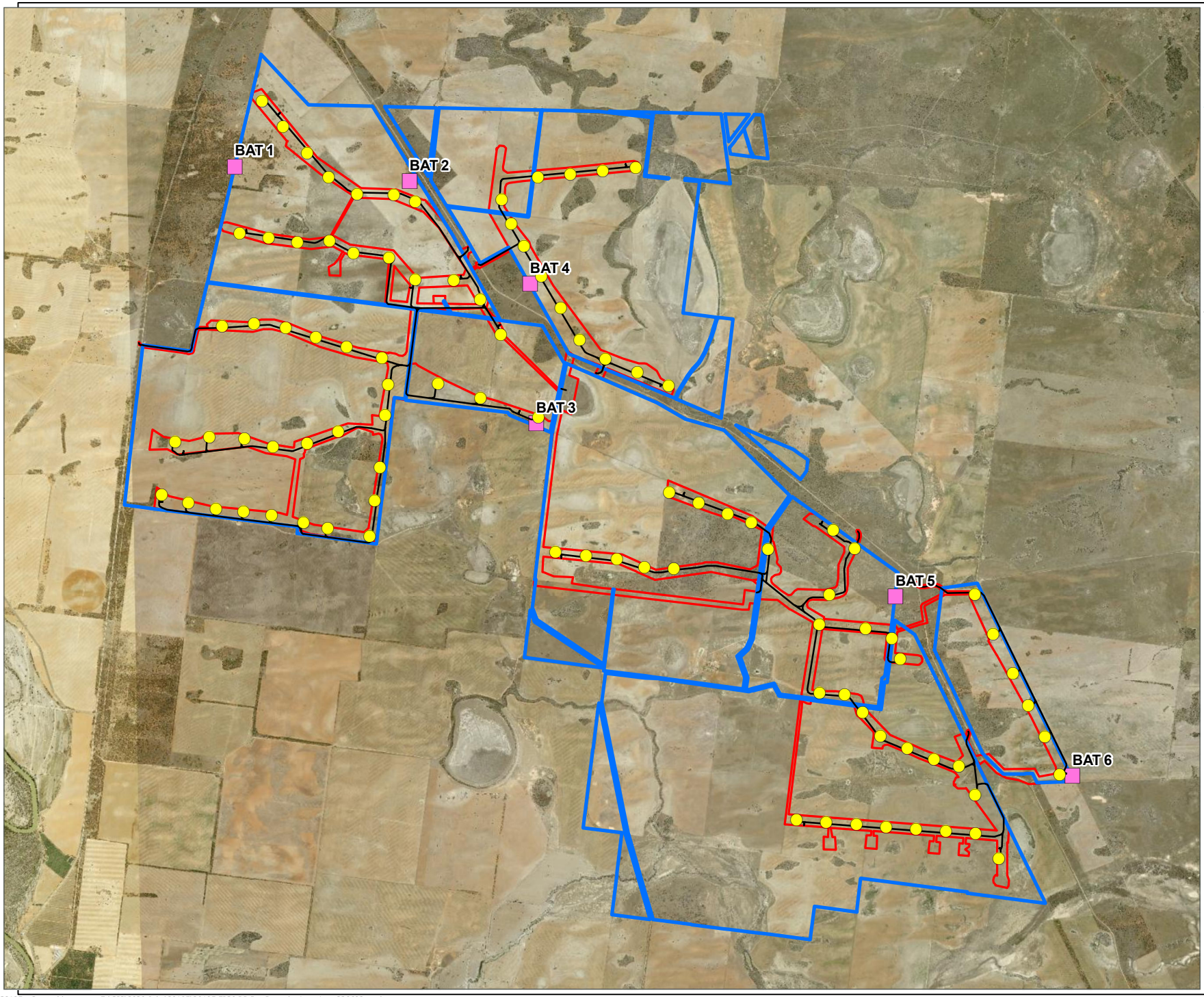



**Figure 1:** Junction Rivers **Wind** Project
**Bat recorder locations**

**Project :** Junction Rivers Wind Project
**Date :** Windlab Pty Ltd
**Client :** 22/0/2024

- Wind Farm Boundary
- Development corridor
- Turbine
- Access tracks
- Bat recorder location

N

Metres
0 1,400

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# 3. Results

Across the two survey periods (summer and spring 2021), nine species of bats were positively identified to occur on the wind farm site. Seven species were confirmed to occur on the site during the summer 2021 survey and nine species during the spring 2021 survey. All of the recorded bats were common, secure and widespread that occur in farmland and woodland habitats throughout eastern and south-eastern Australia (Table 2). No threatened bat species was recorded during both of summer and spring surveys.

In addition to above, three species complexes were also recorded during both of the summer and spring surveys. Species complexes were from non-threatened species (Table 2).

Bat call images (sonograms) are shown in Appendix 1 for further confirmation of the identity of bats.

Table 2: Bat diversity at Junction Rivers Wind Project during summer and spring 2021*

| Common name | Scientific name | cons. Status | Summer 21 | Spring 21 |
|---|---|---|---|---|
| Gould's Wattled Bat | *Chalinolobus gouldi* | common, secure | All sites | 1, 2, 3, 5, 5 |
| Chocolate Wattled Bat | *Chalinolobus morio* | common, secure | 1, 2, 3, 5, 6 | 1, 2, 3, 5, 6 |
| Inland Free-tailed Bat | *Ozimops petersi* | common, secure | 6 | 1, 5, 6 |
| Southern Free-tailed bat | *Ozimops planiceps* | common, secure | All sites | 1, 2, 5, 6 |
| Inland Broadnosed Bat | *Scoterepens balstoni* | common, secure | 2, 3, 5, 6 | 1, 2, 5, 7 |
| White-striped Freetail Bat | *Austrnomous australis* | common, secure | 4 | 1, 2, 5, 6 |
| Large Forest bat | *Vespadelus darlingtoni* | common, secure | | 1 |
| Little Forest Bat | *Vespadelus vulturnus* | common, secure | All sites | 1, 2, 3, 5, 6 |
| Southern Forest Bat | *Vespadelus regulus* | common, secure | | 1, 2 |
| Species complexes | | | | |
| Free-tailed Bat | *Ozimops planiceps & petersi* | | 2, 3, 4, 5, 6 | 1, 2, 3, 5, 6 |
| Long-eared Bat | *Nyctophilus sp* | | 2, 3, 4, 5, 6 | 1, 2 |
| Forest Bat sp | *Vespadelus regulus / V. vulturnus/V. regulus* | | 2, 3, 5, 6 | 1, 2, 3, 5, 6 |

* Note: No bats were recorded at Site No. 4 during spring 21 season.

## 3.1. Bat Activity

A large number of calls was recorded across the sites during both of the summer and spring 2021 surveys (Table 3). Bats were common across the wind farm site, with no particular pattern detectable among the various sites or between the two seasons. Overall, there were more calls recorded from the common bats in spring (19259 calls) than in summer (3562 calls). The number of calls recorded seems to be the product of season, site habitat structure and prevailing weather conditions at time of recording, however, site 2, located within a casuarina woodland recorded most of the bat calls.

Table 3: Total bat calls across summer and spring surveys

| Season | No. of bat calls at sites | | | | | | Total calls |
|---|---|---|---|---|---|---|---|
| | Site 1 | Site 2 | site 3 | site 4 | site 5 | site 6 | |
| Summer 21 | 265 | 1525 | 631 | 272 | 588 | 281 | 3562 |
| % Calls | 7.4 | 42.8 | 17.7 | 7.6 | 16.5 | 7.9 | 100.0 |
| Spring 21 | 6471 | 8345 | 431 | 0 | 1258 | 2754 | 19259 |
| % Calls | 33.6 | 43.3 | 2.2 | 0.0 | 6.5 | 14.3 | 100.0 |

## 3.2. Relative abundance of bats

The relative abundance (or activity) of bats is usually measured as number of calls per recording night, but such measure was not possible due to the very large number of calls recorded from the common species which require a long time and efforts separating the individual species calls from each other. Instead, the percentage occurrence over the recording nights was used as measure for the purpose of evaluating bat relative abundance (activity) over the wind farm study site.

### *3.2.1. Summer 2021*

Records of bats during summer were made from six sites over six nights. Seven species of common and secure bats were positively identified and three species complexes (Table 2).

The percentage occurrence was used as measure for the purpose of evaluating bat relative abundance (activity) over the wind farm study site. This was then measured in terms of percentage of detector nights each species was recorded across the six recoding sites. These are shown in Table 4 and depicted graphically in Figure 2. The most common species were as follows:

- Gould's wattled Bat 91.7%
- Southern Free-tailed Bat 80.6%
- Free-tailed Bat Complex 58.3%
- Little Forest bat 47.2%
- Chocolate Wattled Bat 44.4%

With all other species being detected from an average of 2.8% (rare species) to 41.7% (moderately abundant) of the six nights of recordings during the survey period.

### *3.2.2. Spring 2021*

Records of bats during spring were made from six sites (same sites as those from summer survey), over a number of nights varying from 24 to 29. Nine species of common and secure bats were positively identified and three species complexes (Table 2).

As in the summer survey, the percentage occurrence was used as measure for the purpose of evaluating bat relative abundance (activity) over the wind farm study site. the percentage of detector nights each species was recorded across the six recoding sites are shown in Table 5 and depicted graphically in Figure 2. The most common species were as follows:

- Gould's wattled Bat 90.4%
- Free-tailed Bat Complex 83.5
- Southern Free-tailed Bat 78.1%
- Chocolate wattled Bat 72.9%
- Southern Forest Bat 67.3%

With all other species being detected from an average of 3.4% (rare species) to 66.8% (moderately abundant) of the recording nights during the survey period.

The dominant bat species were almost the same at both seasons, with the highest counts for Gould's Wattled Bat and Free-tailed Bats. Similarly, activity was also similar across the six recording sites, with the dominant species recorded at each of these sites, indicating the homogenous nature of habitats across the study sites.

### 3.2.3. Bat species of concern

Bats that are most likely to fly at RSA heights and exposed to collision with operating turbines, appear to be active across the proposed wind farm site. These bats include Gould's Wattled Bat, Southern Free-tailed Bat, and Free-tailed Bat complex. The high call frequency and high proportion of nights in which records were made in both seasons indicate that these species are likely to be regularly utilising the site for foraging and roosting.

The species listed above were found to be common and dominant species in both summer and spring surveys (Table 4 and 5). On the other hand, the most known bat species, namely the White-striped Freetail Bat, usually found to fly at RSA heights in many other similar wind farms (Nature Advisory; Unpubl. Data), was uncommon at proposed Junction Rivers Wind Project site. It was not recorded during the summer survey, and its frequency of occurrence in spring was much lower than the other bats (table 4 and 5).

Bats of concern due to their potential for flights at RSA height, including the Gould's Wattled Bat and the Southern Free-tailed Bat, were common on the wind farm site. However, the newer turbine models with their minimum blade height above ground extends above 50-70 metres will reduce the potential impact on this species (Nature Advisory; Unpubl. Data).

Table 4: Percentage (%) of detector nights each species was recorded across the six survey sites over six nights of recording during summer 2021

| Recording sites/ No. nights of recording | Species of bats recorded at the six sites over six nights | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GWB | CWB | InFB | SFB | InBnB | WsFB | LiFB | FtBC | LeBC | FBC |
| site 1 / 6 | 66.7 | 33.3 | | 16.7 | | | 50.0 | | | |
| site 2 / 6 | 100.0 | 66.7 | | 100.0 | 16.7 | | 83.3 | 33.3 | 66.7 | 16.7 |
| site 3 / 6 | 100.0 | 66.7 | | 100.0 | 66.7 | | 66.7 | 33.3 | 66.7 | 16.7 |
| site 4 / 6 | 100.0 | | | 100.0 | | 16.7 | 33.3 | 83.3 | 33.3 | |
| site 5 / 6 | 100.0 | 66.7 | | 100.0 | 33.3 | | 50.0 | 100.0 | 50.0 | 33.3 |
| site 6 / 6 | 83.3 | 33.3 | 16.7 | 66.7 | 16.7 | | | 100.0 | 33.3 | 16.7 |
| Average | 91.7 | 44.4 | 2.8 | 80.6 | 22.2 | 2.8 | 47.2 | 58.3 | 41.7 | 13.9 |

**Notes**: CWB, Chocolate Wattled Bat – GWB, Gould's Wattled Bat – InFB, Inland Free-tailed Bat – SFB, Southern Free-tailed Bat - WsFB, White-striped Freetail Bat - LiFB, Little Forest Bat – FtBC, Free-tailed Bat Complex – LeBC, Long-eared Bat Complex – FBC, Forest Bat Complex.

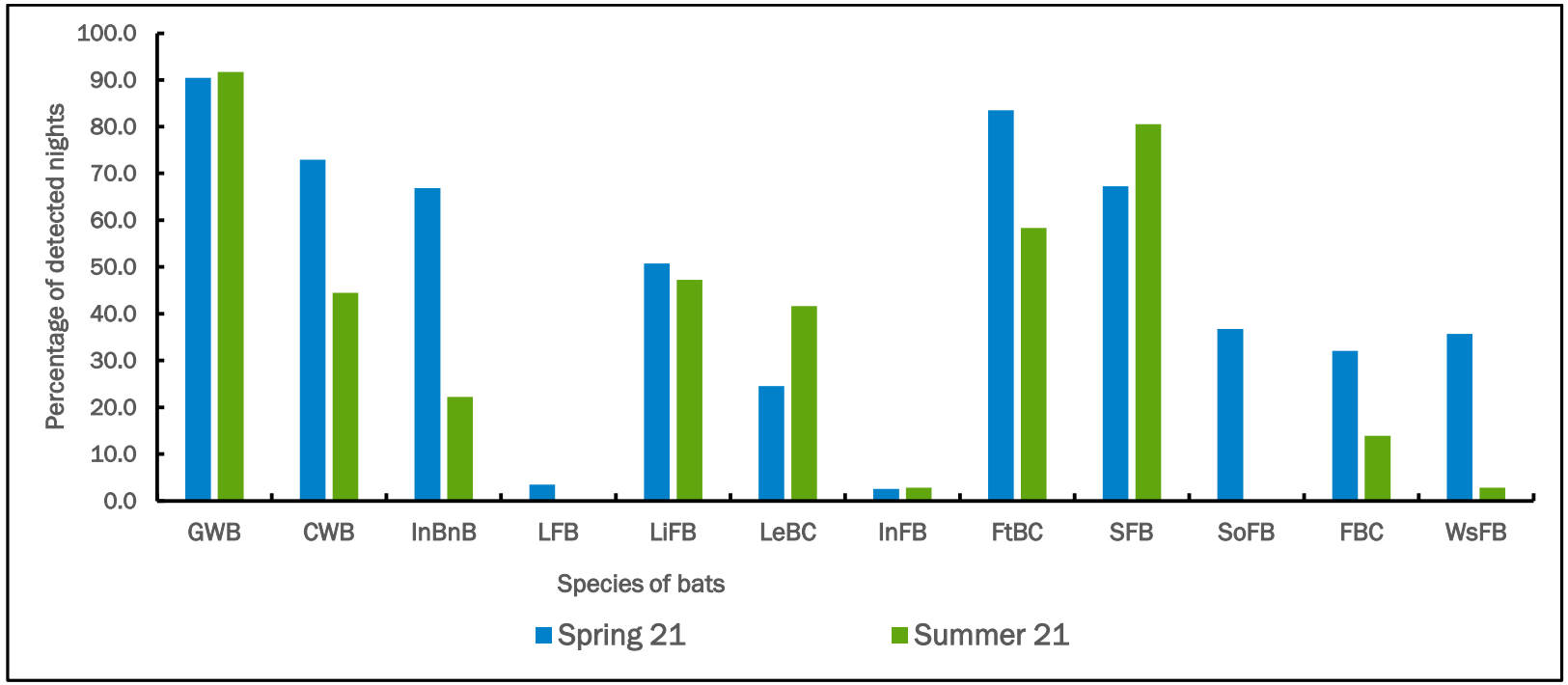
Table 5:Percentage (%) of detector nights each species was recorded across the six survey sites during spring 2021

| Recording sites/ No. nights of recording | Species of bats recorded at the six sites | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GWB | CWB | InBnB | LFB | LiFB | LeBC | InFB | FtBC | SFB | SoFB | FBC | WsFB |
| site1 / 29 | 89.7 | 89.7 | 58.6 | 17.2 | 48.3 | 3.4 | 0.0 | 96.6 | 93.1 | 86.2 | 69.0 | 41.4 |
| site2 / 28 | 96.4 | 92.9 | 89.3 | 0.0 | 85.7 | 64.3 | 0.0 | 100.0 | 82.1 | 89.3 | 32.1 | 60.7 |
| site3 / 24 | 91.7 | 33.3 | 91.7 | 0.0 | 20.8 | 0.0 | 0.0 | 20.8 | 0.0 | 8.3 | 4.2 | 0.0 |
| site5 / 25 | 87.0 | 69.6 | 69.6 | 0.0 | 73.9 | 21.7 | 8.7 | 100.0 | 65.2 | 0.0 | 21.7 | 34.8 |
| site6 / 24 | 87.5 | 79.2 | 25.0 | 0.0 | 25.0 | 33.3 | 4.2 | 100.0 | 95.8 | 0.0 | 33.3 | 41.7 |
| Average | 90.4 | 72.9 | 66.8 | 3.4 | 50.7 | 24.6 | 2.6 | 83.5 | 67.3 | 36.8 | 32.1 | 35.7 |

**Note1**: Notes: CWB, Chocolate Wattled Bat – GWB, Gould's wattled Bat – InBnB, Inland Broad-nosed Bat – LFB, Large Forest Bat – LiFB, Little Forest bat – LeBC, Long-eared Bat Complex – InFB, Inland Freetail Bat – FtBC, Free-tailed Bat Complex - SFB, Southern Free-tailed Bat – SoFB, Southern Forest Bat – FBC, Forest Bat Complex – WsFB, White-striped Freetail Bat.

**Note 2**: No bats were recorded at site No. 4, and therefore not included in table.

Figure 2: Percentage (%) of detector nights each species was recorded across the summer and spring 2021 surveys. Number of nights of recordings and species abbreviations as in Table 4 and 5.



# 4. Conclusions and Recommendations

Bat activity at the Junction Rivers Wind Project site compares well with other wind farm sites in similar, largely agricultural settings (Nature Advisory; unpubl. data). Survey effort and findings from this survey are summarised below.

- Two surveys were undertaken; first in summer 2021 (22–27/02/2021); and second in spring (2–30/11/2021);
- Bat call recording was made using SongMeter detectors distributed across all habitat types on the proposed wind farm site. Bat recordings were undertaken at six sites (locations) during the both of the summer and spring surveys;
- A total of 36 detector-nights, totalling 432 bat-hours and 130 detector-nights totalling 1560 bat-hours of recordings were made during Summer and spring surveys, respectively;
- Seven species of bats were recorded during summer survey and nine species during spring surveys in addition to three species complexes in both seasons;
- All species of bat recorded were common, secure and widespread bat species that occur in farmland and other habitats throughout eastern and south-eastern Australia. No listed species were recorded;
- The three most common species on the wind farm during both seasons of the survey, in order of activity levels were: Gould's Wattled Bat; Southern Free-tailed Bat and Free-tailed Bat Complex.
- The White-striped Freetail Bat, a species of special interest was not common at the wind farm site, and recorded only in spring survey.

## 4.1. Recommendations:

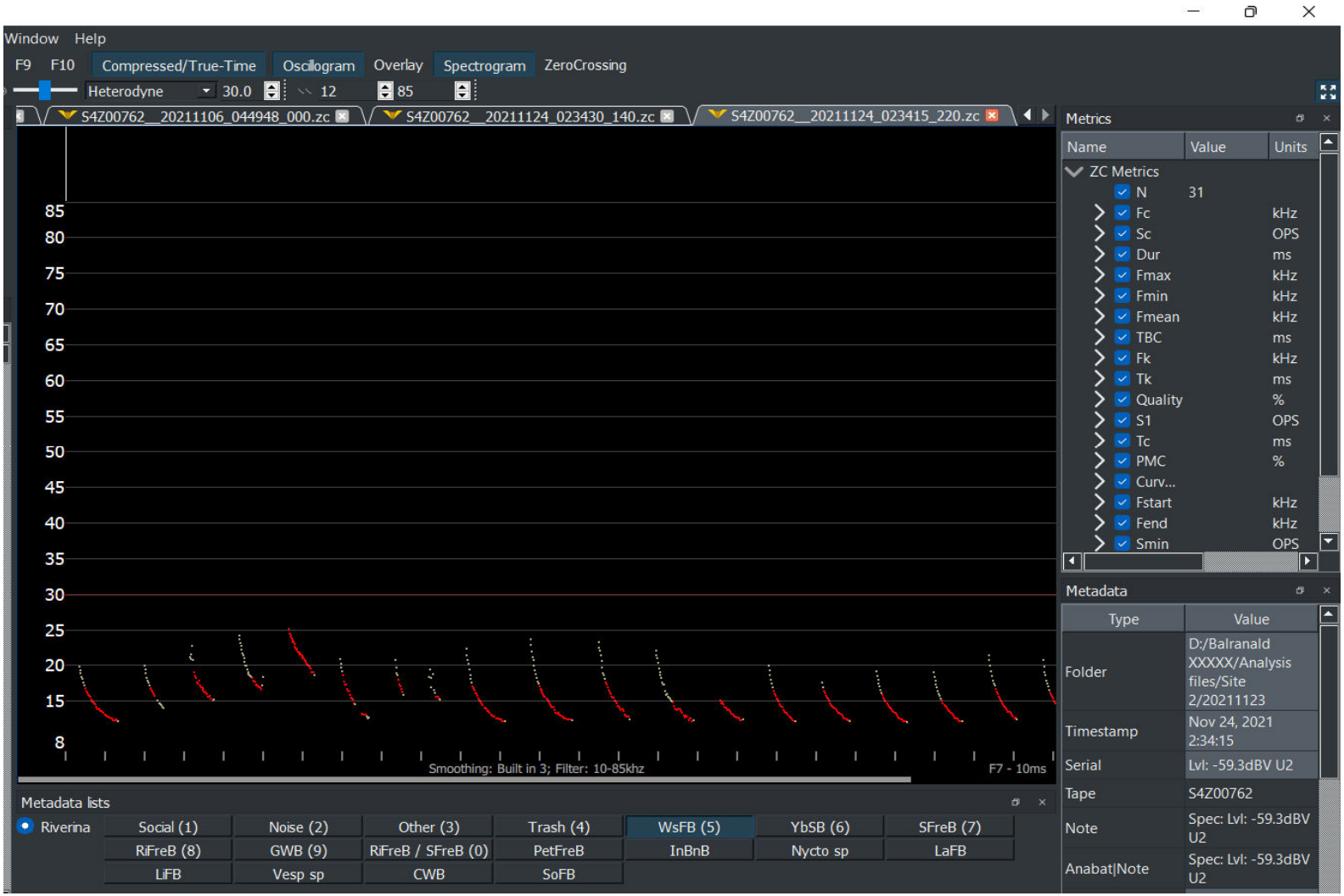
The following is recommended for Junction Rivers Wind Project.

- Based on the results summarised above, a buffer zone of approximately 100 metres is suggested to further reduce potential impacts on bats around the native remnant of woodlands.
- New models of turbines, including those with the height of the lowest tip of blades between 50-70 are noted as likely to have lesser impacts on bats when compared to more commonly used lower turbine RSAs more common in Australia. As the wind farm is in the design stage the proponents are encouraged to ensure the minimum RSA is not lower than 50 metres above the ground. In addition, the proponent is encouraged to create a higher minimum RSA to an operationally suitable level as this will reduce impacts on higher flying species of bats.

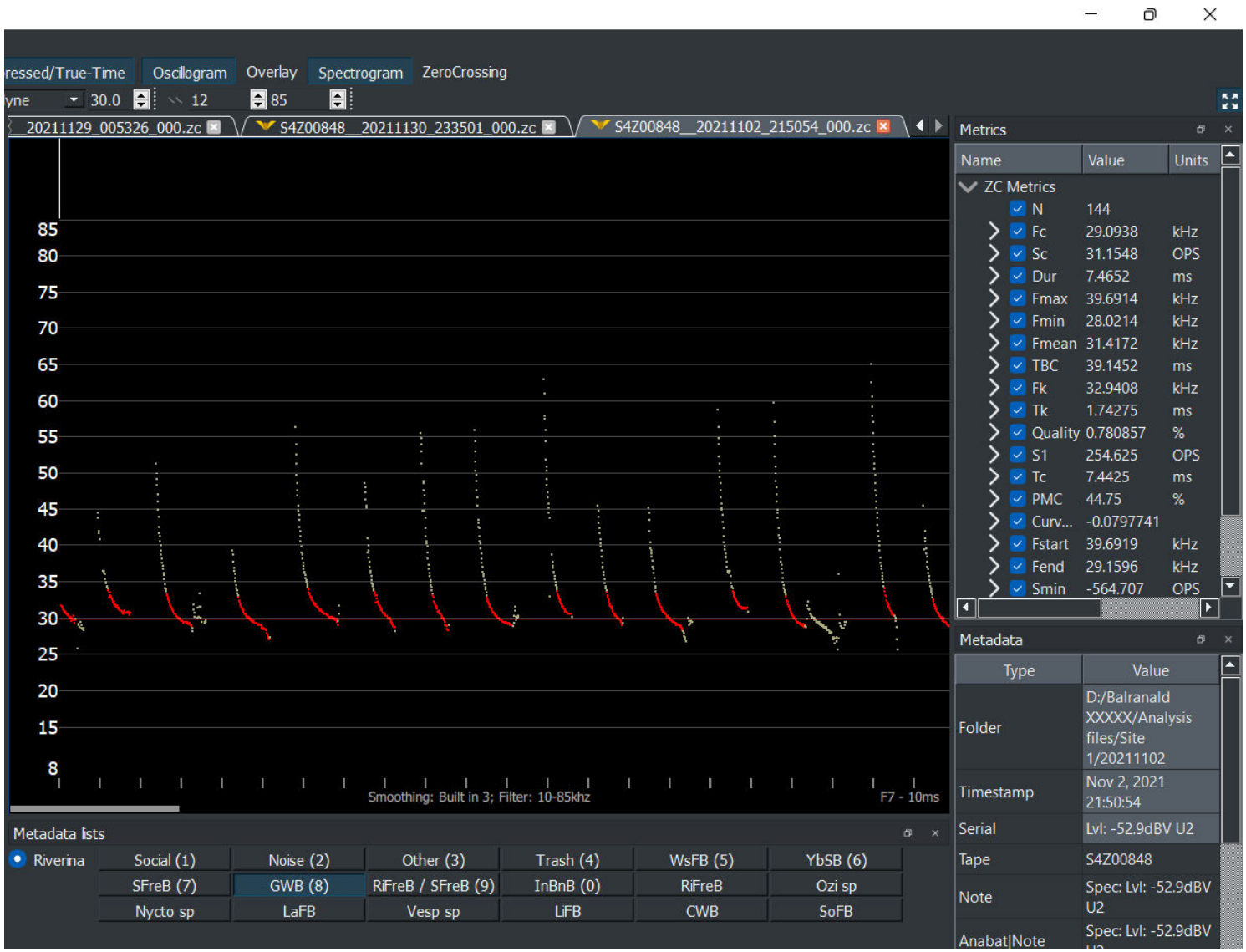
# 5. References

Department of Environment, Water, Heritage and the Arts 2010. *Survey Guidelines for Australia's threatened bats.* Australian Government. Canberra.

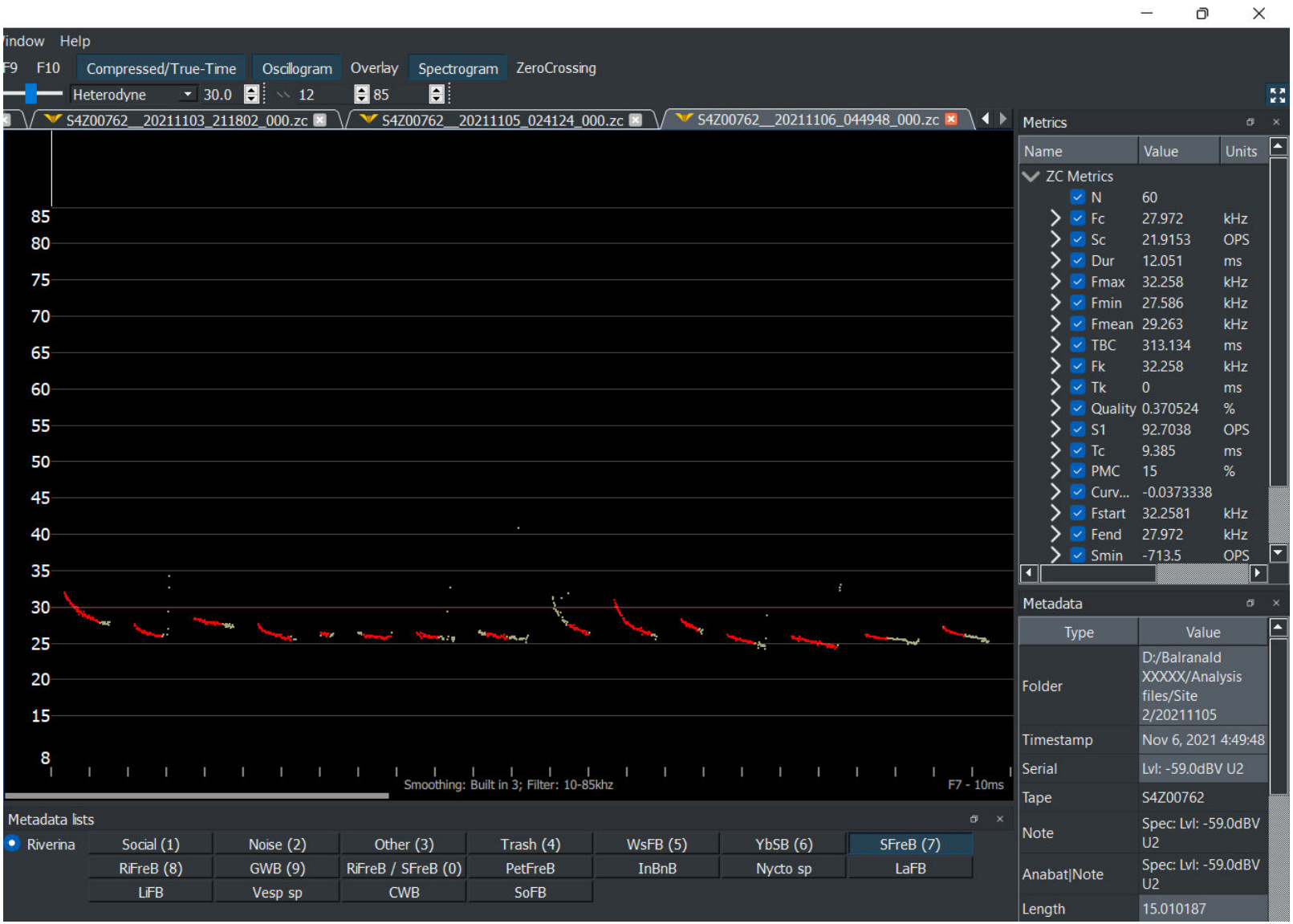
## Appendix 1: Examples of bat sonograms recorded at Junction Rivers Wind Project



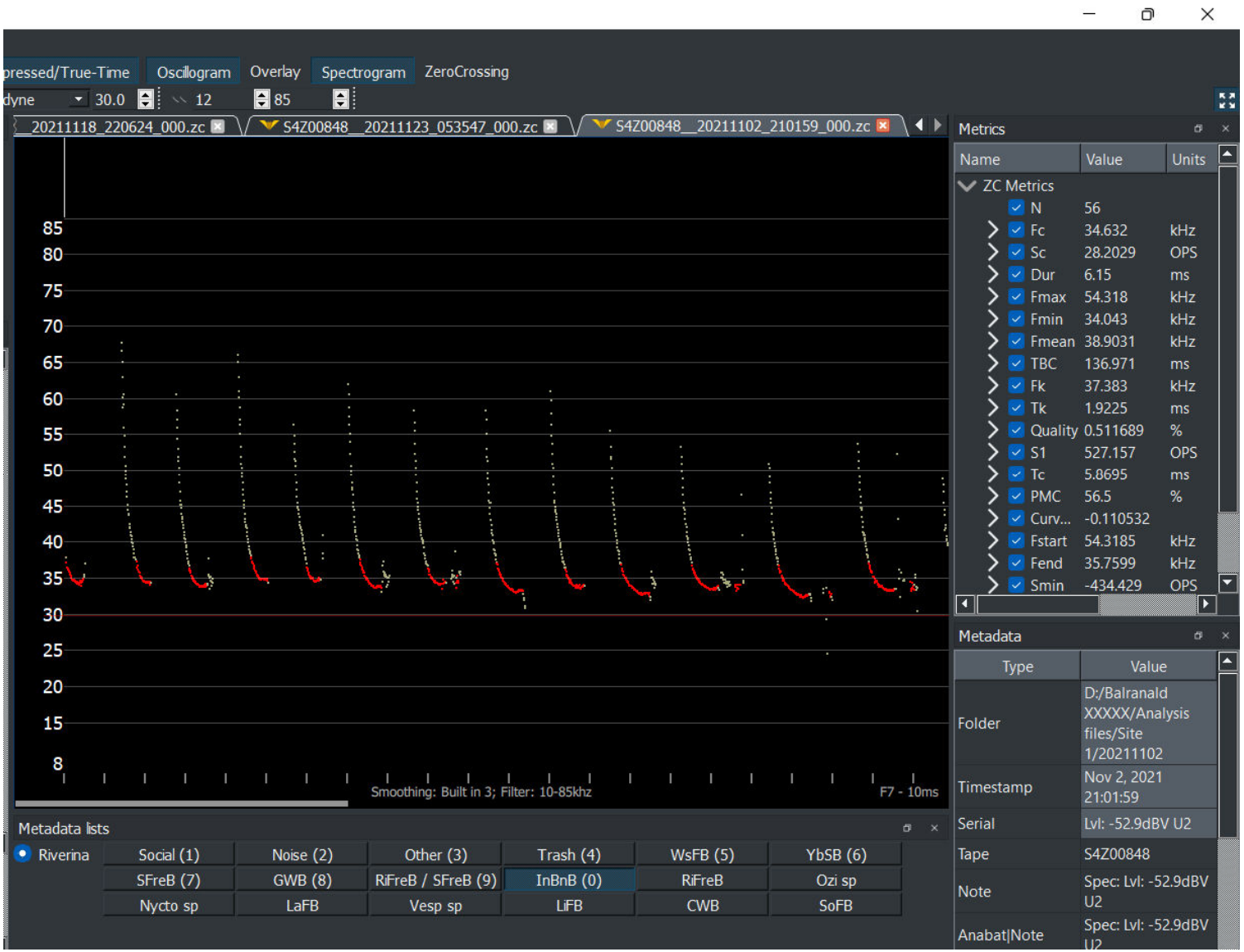

White-striped Freetail Bat



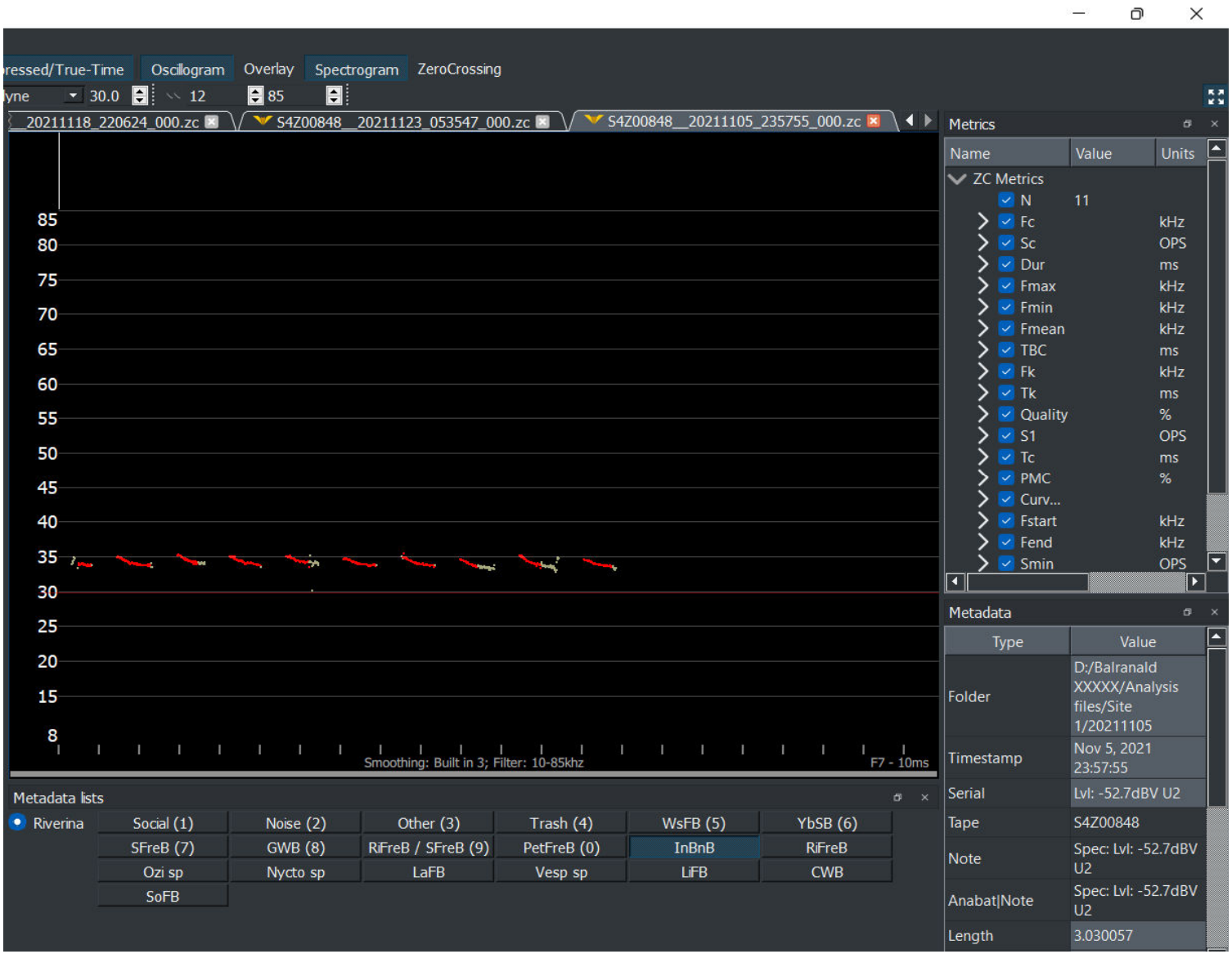

Gould's Wattled Bat



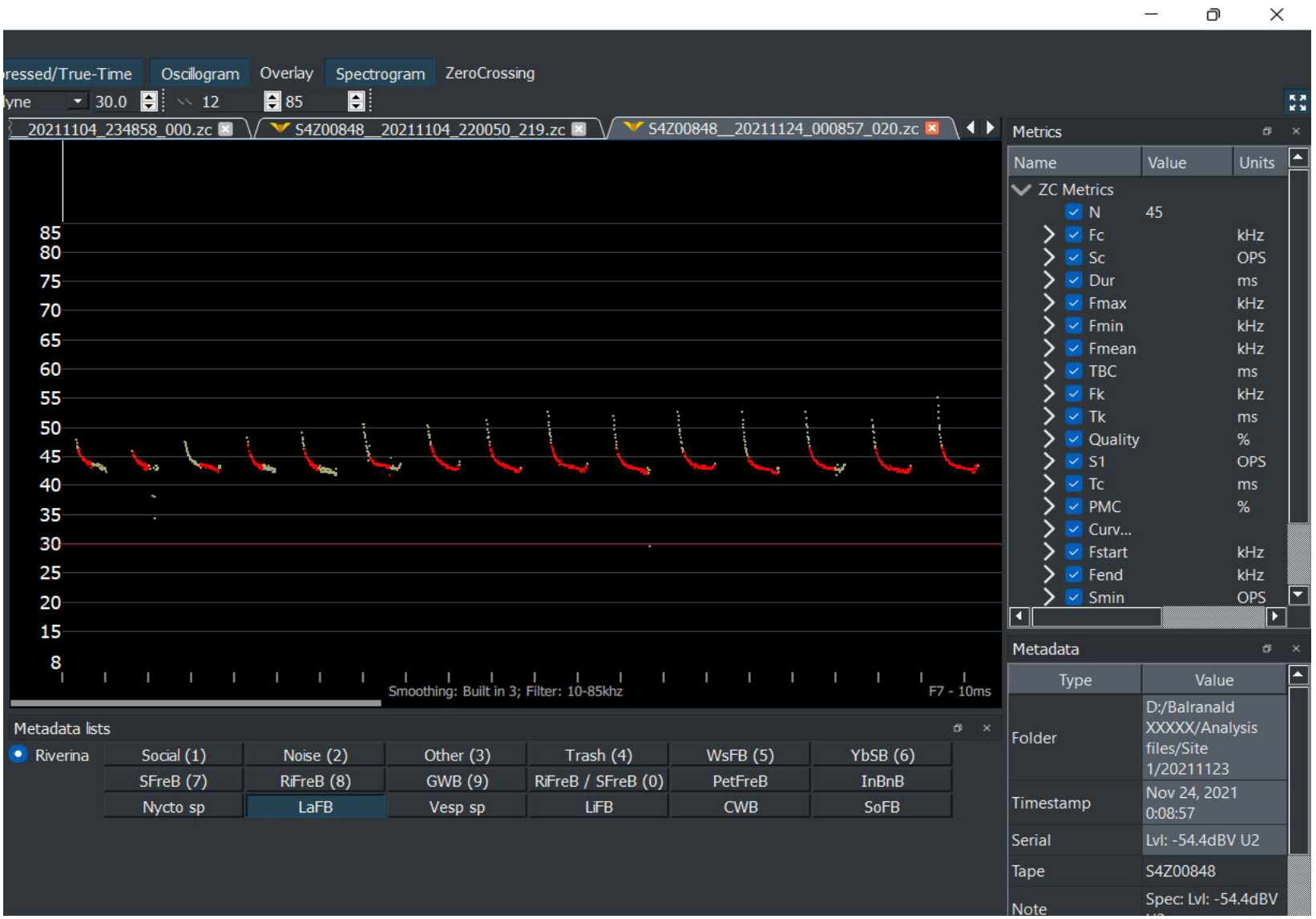

Southern Freetail Bat



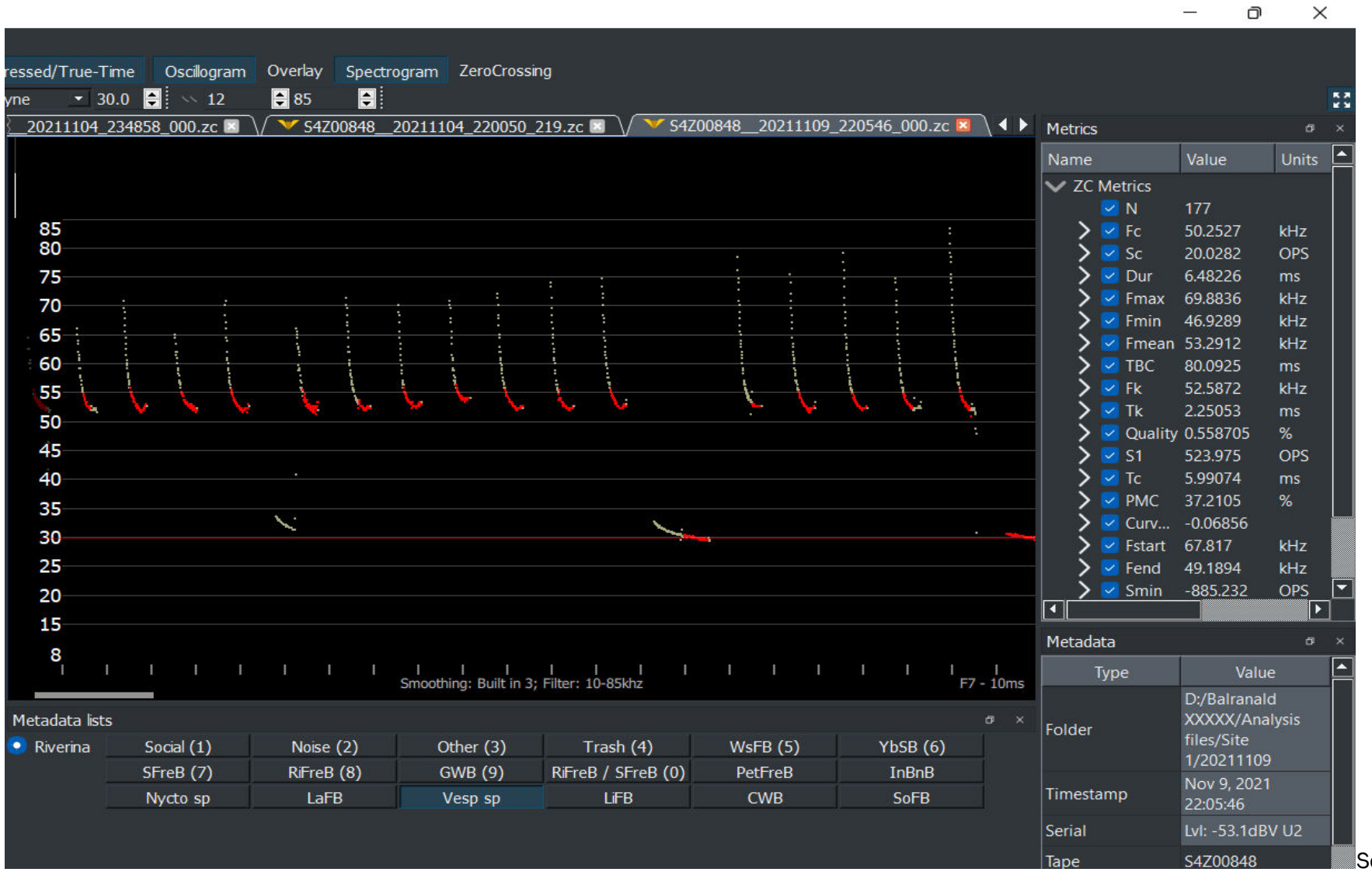

Inland Broad-nosed Bat



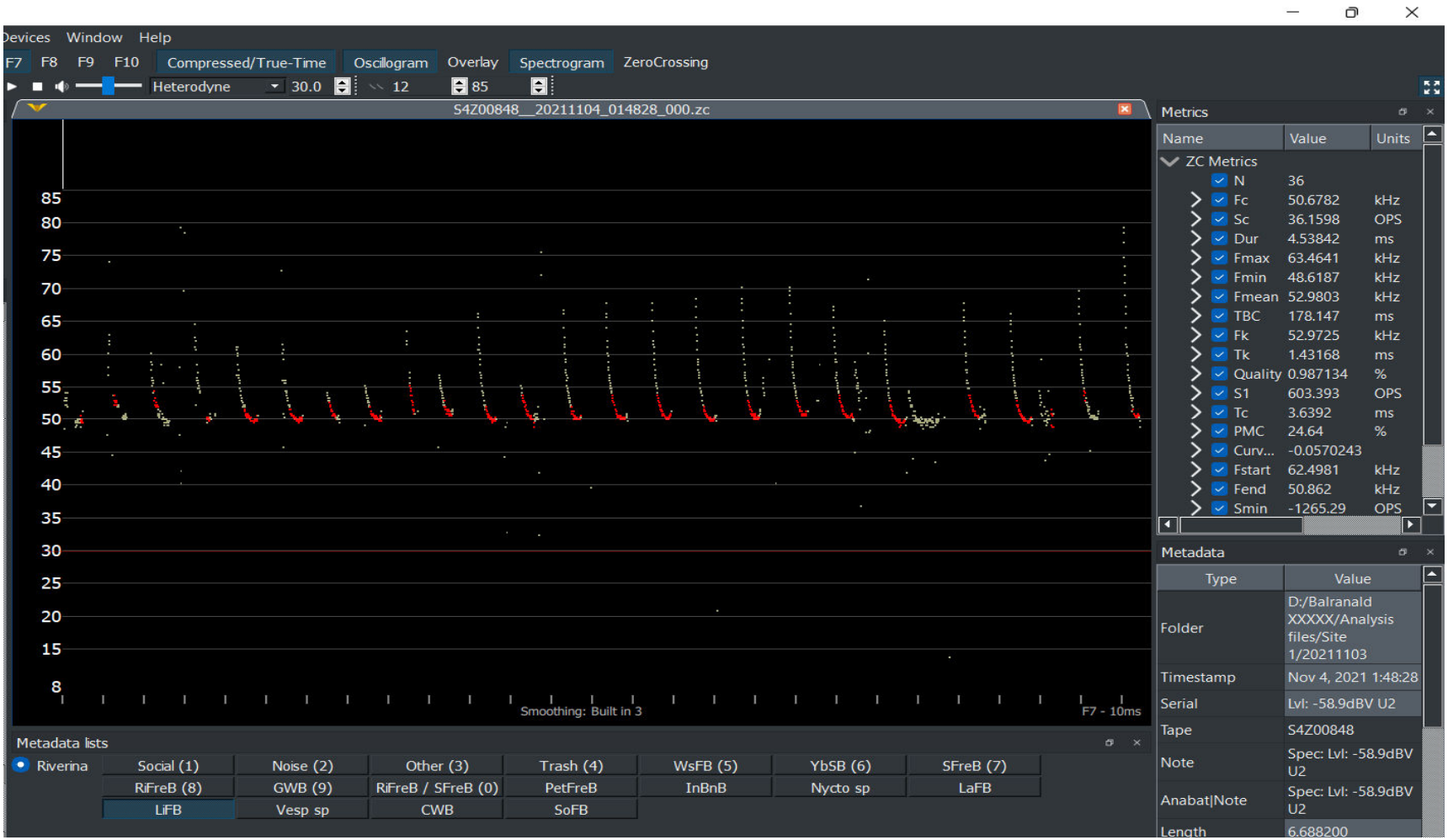

Inland Freetail Bat



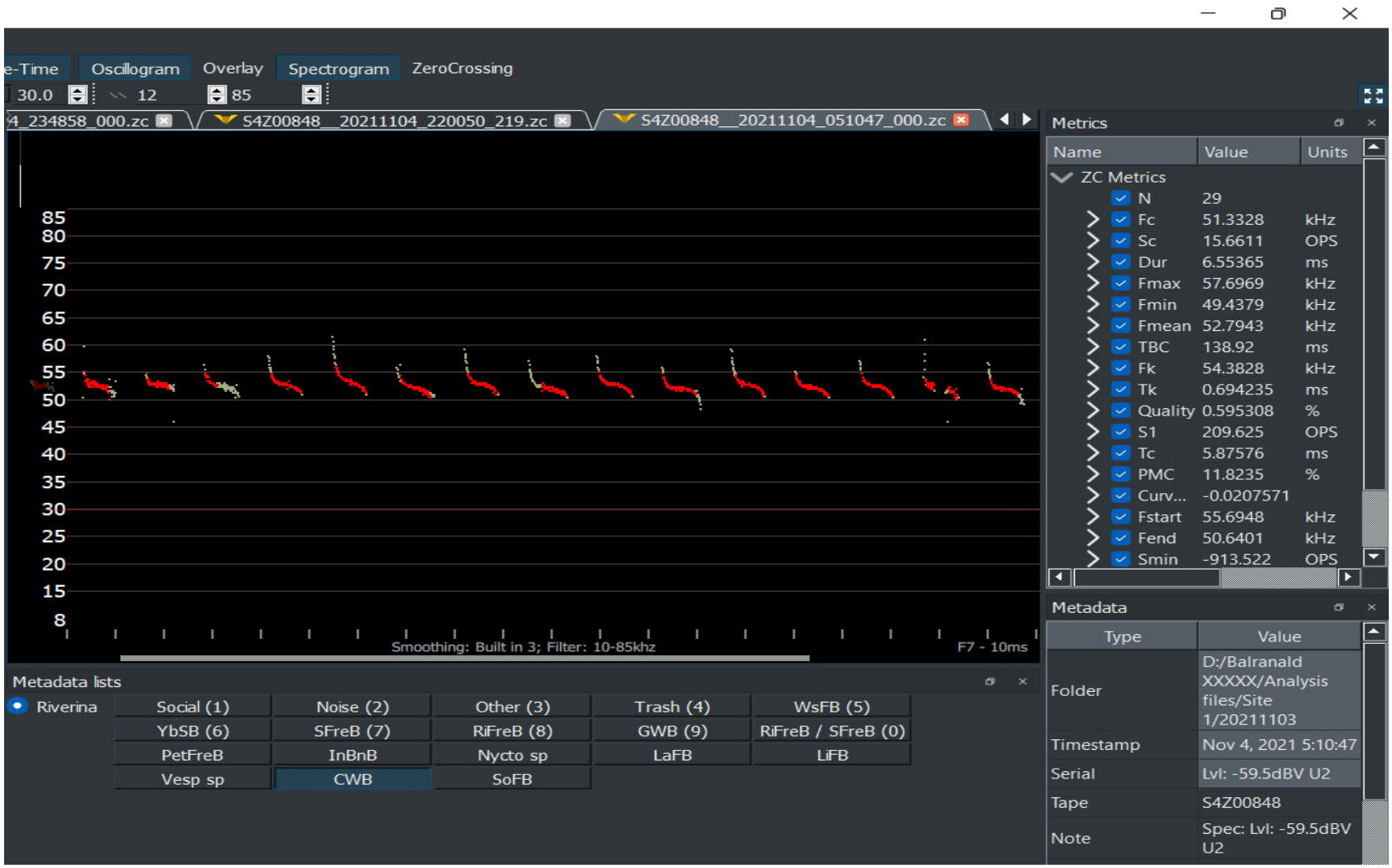

Large Forest Bat



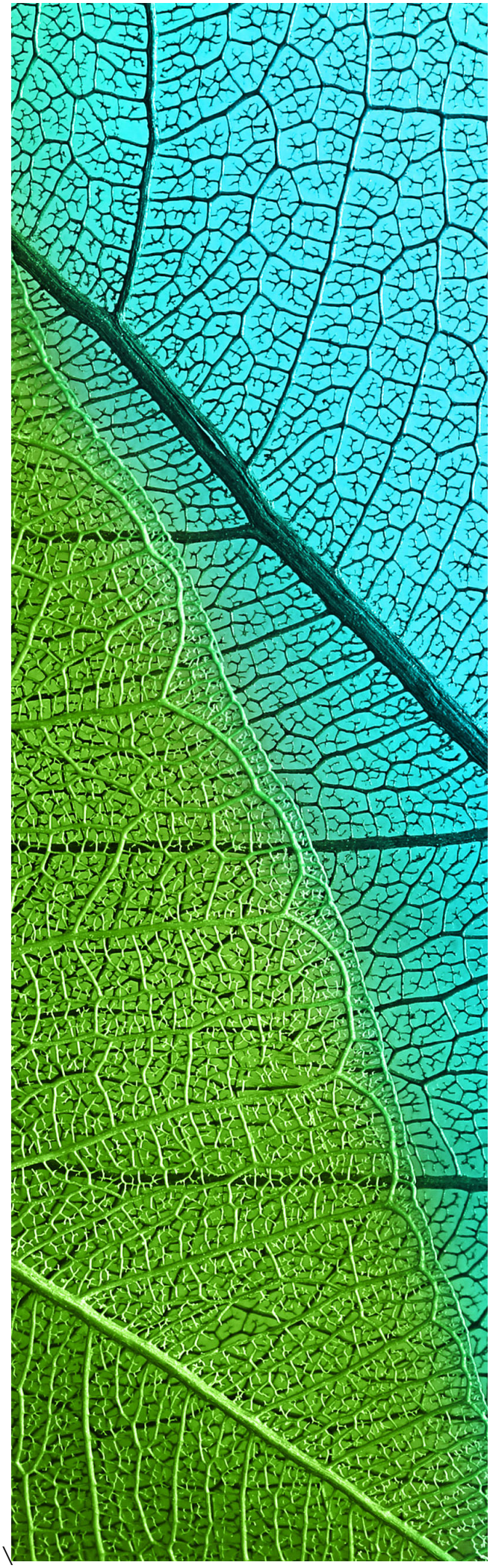

Southern Forest Bat- high frequency call form




Little Forest Bat




Chocolate Wattled Bat



# Junction Rivers Wind Project

## Bird and Bat Baseline Report

**Prepared for Windlab Pty Ltd.**

February 2024
Report No. 20195.05 (1.2)

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# 1. Introduction

Windlab Pty Ltd (Windlab) engaged Nature Advisory Pty Ltd (Nature Advisory) to provide baseline data on the pre-construction utilisation by birds and bats of the proposed Junction Rivers Wind Project (JRWP) study area. The study area for the windfarm includes all areas within the windfarm boundary as currently proposed in Figure 1.

Bird utilisation surveys (BUS) were undertaken consistent with the requirements for a "Level One" bird risk assessment in accordance with 'Wind Farms and Birds - Interim Standards for Risk Assessment' issued by the Australian Wind Energy Association (AusWEA 2005) which has also been adopted by the Best Practice Guidelines for Wind Energy Developments in Australia issued by the Clean Energy Council (2018).

Eight pre-construction bird utilisation surveys were undertaken by experienced zoologists across 2021 and 2022: two in each season to account for seasonal differences in bird activity and presence of species (due to migration). The dates and surveyors are detailed below.

- Summer: 23/02/21 – 28/02/21 (Eamon O'Meara)
- Autumn: 17/05/21 – 20/05/21 (Eamon O'Meara)
- Winter: 01/08/21 – 06/08/21 (Gavin Thomas)
- Spring: 02/11/21 – 06/11/21 (Eamon O'Meara)
- Summer: 15/02/22 – 19/02/22 (Philip Allen)
- Autumn: 26/04/21 – 30/04/22 (Philip Allen)
- Winter: 11/07/21 – 16/07/22 (Gavin Thomas)
- Spring: 06/10/21 – 11/10/22 (Clinton Schipper).

All Surveys were undertaken in accordance with the *Onshore Wind Farms – interim guidance on bird and bat management* (DAWE 2021) and are consistent with methods adopted at many windfarms in eastern Australia. Bat surveys were undertaken to collect information on bat species, including any threatened species using the study area, and the activity levels of these species. Surveys were undertaken using Song Meter® detectors (SM4BAT ZC; Wildlife Acoustics) distributed across habitat types at the proposed JRWP.

Detailed survey and analysis have been undertaken across six locations at the proposed JRWP and are detailed below.

- Summer: 22/02/21 – 27/02/21
- Spring: 02/11/21 – 30/11/21.

It is intended that this will also satisfy the expectations of the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for assessment and approval under the *Environment Protection and Biodiversity Act 1999* (EPBC Act).

This report is divided into the following sections.

**Section 2** describes the methods and results used for the bird utilisation survey.

**Section 3** describes the methods and results used for the bat survey.

**Section 4** describes proposed monitoring for 'at risk' groups.

**Section 5** provides conclusions and recommendations.

This investigation was undertaken by a team from Nature Advisory comprising Clinton Schipper (Zoologist), Eamon O'Meara (Zoologist), Philip Allen (Zoologist), Gavin Thomas (Senior Ecologist, Team Leader NSW), Curtis Doughty (Senior Zoologist, Zoology Team Leader) and Bernard O'Callaghan (Director).

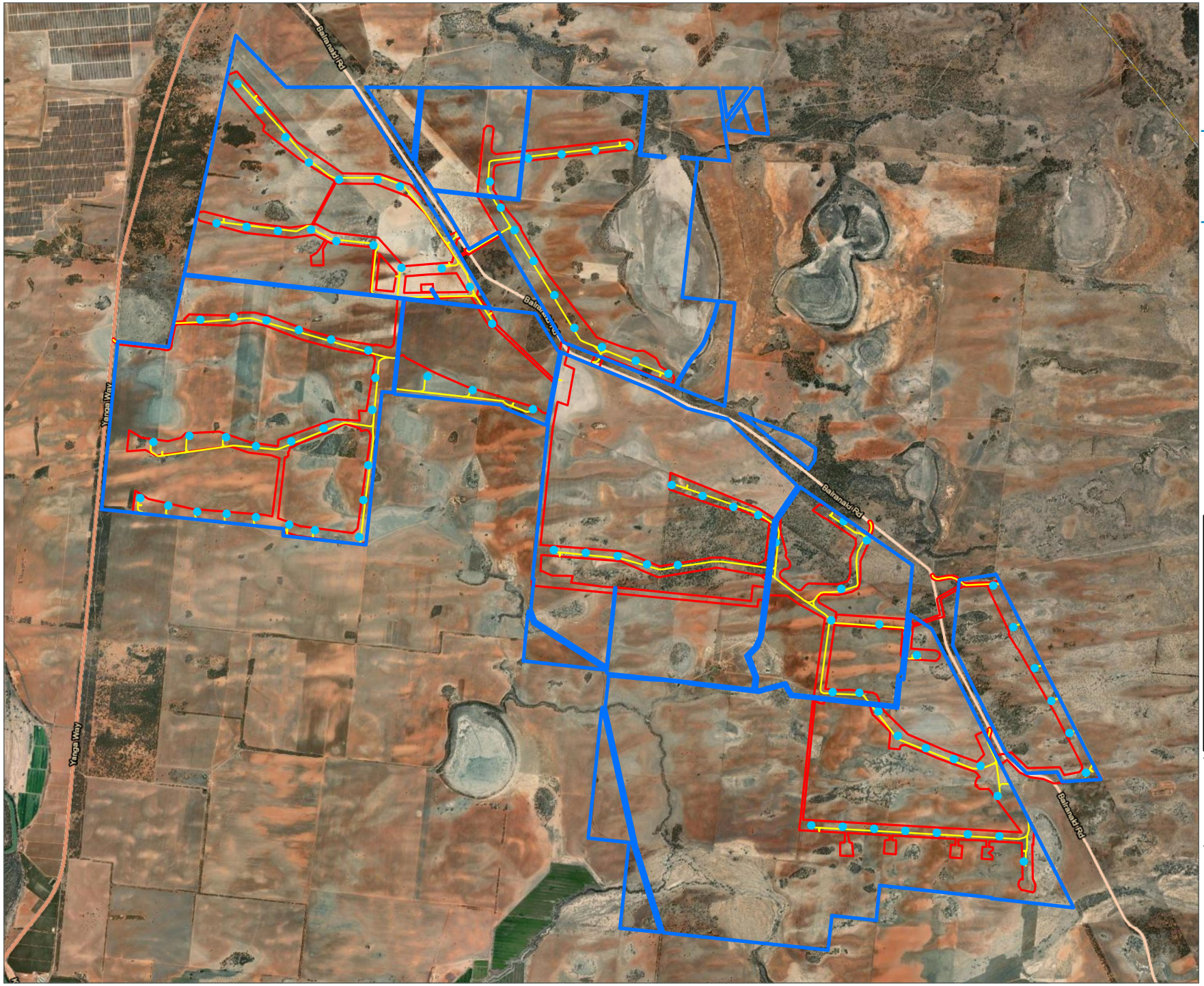



**Figure 1:** Junction Rivers **Wind** Project
**layout and location**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

- Wind Farm Boundary
- Development corridor
- Turbine
- Access tracks




N

Metres
0 1,200

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# 2. Bird Utilisation Survey

## 2.1. Methods

### *2.1.1. Fixed-point bird count*

The fixed-point bird count method involved an observer stationed at a survey point for 15 minutes. The adequacy of using 15 minutes as an interval to record the presence of birds during bird utilisation surveys was investigated in an earlier study at another wind farm study area. This showed that 82 to 100 percent (average 88 percent) of species actually seen in one hour of surveying were seen in the initial 15 minutes of the survey. Based on this result, the period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area.

During this period, all bird species and numbers of individual birds observed as far as the eye can see were recorded. The species, the number of birds and the height of the bird when first observed were documented. For species of concern (listed threatened and migratory species and raptors), the minimum and maximum heights were recorded.

Flight height is presented as below, at or above rotor swept area (RSA) height as detailed below.

- **A =** Below RSA (≤ 50 metres above ground)
- **B =** At RSA (51 - 300 metres above ground)
- **C =** Above RSA (≥ 301 metres above ground)

Table 1 indicates when each point was counted on each survey day. This schedule ensured that all points were visited equally at different times of day to allow for time-of-day differences in bird movements and activity. Every survey point (impact and reference) was visited eight times over the survey period.

**Table 1: Times when points were counted for each fixed-point bird count survey day**

| Time | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 |
|---|---|---|---|---|---|---|
| 8:00 - 8:30 | Travel to study area | 7 | 1 | 2 | 5 | Travel from study area |
| 8:30 - 9:00 | | 8 | R1 | 4 | 6 | |
| 9:00 - 9:30 | | 1 | R2 | 5 | 7 | |
| 9:30 - 10:00 | | R1 | 3 | 6 | 8 | |
| 10:00 - 10:30 | | 3 | 2 | 8 | R1 | |
| 10:30 - 11:00 | | R2 | 4 | 7 | 1 | |
| 11:00 - 11:30 | | 2 | 5 | 3 | R2 | |
| 11:30 - 12:30 | | 4 | 6 | R2 | 3 | |
| 12:30 - 13:00 | | 5 | 7 | 1 | 2 | |
| 13:00 -13:30 | | 6 | 8 | R1 | 4 | |
| 13:30 - 14:00 | | 7 | 1 | 2 | 5 | |
| 14:00 - 14:30 | | 8 | R1** | 4 | 6 | |
| 14:30 - 15:00 | | R2 | 3 | 5 | 7 | |
| 15:00 - 15:30 | | 3 | R2 | 6 | 8 | |
| 15:30 - 16:00 | | 1 | 2 | 7 | R1 | |
| 16:00 - 16:30 | | R1 | 4 | 8 | 1 | |
| 16:30 – 17:00 | Deploy Song Meters | 2 | 5 | 1 | 3 | |
| 17:00 – 17:30 | | 4 | 6 | R1 | R2 | |
| 17:30 – 18:00 | | 5 | 7 | R2 | 2 | |
| 18:00 – 18:30 | | 6 | 8 | 3 | 4 | |

** The prefix 'R' refers to reference points.

### 2.1.2. Locations of survey points

Over the eight survey periods, 10 fixed survey points were established: eight impact points and two reference points. Impact points were located near proposed turbine locations and reference points were located at least 500 metres away from impact points in areas of similar habitat.

The survey points were distributed as evenly as possible (subject to access constraints) across the windfarm to maximise coverage in areas where wind turbines are likely to be sited. Impact points were positioned as far as possible on elevated ground, allowing a clear view in all directions. Table 2 below provides a description of the habitats associated with each impact and reference point. Habitat descriptions have been used as a guide only to drive the selection of the survey points and are not intended as an exhaustive examination of the vegetation community or species to be found at the relevant location.

**Table 2: Habitat description for each bird utilisation survey point***

| Survey point | Habitat description | Latitude | Longitude |
|---|---|---|---|
| 1 | Cropping paddock on small rise/dune 180 metres from western fence line and Mallee Woodland. | -34.803521 | 143.5302 |
| 2 | Woodland dominated by *Casuarina* sp. adjacent to cropping paddock. | -34.805993 | 143.5669 |
| 3 | Cropping paddock on rise/dune 160 metres from western fence line and Mallee Woodland. | -34.849708 | 143.5071 |
| 4 | Woodland dominated by *Casuarina* sp. adjacent to cropping paddock. | -34.823316 | 143.5953 |
| 5 | Cropping paddock adjacent to dry lakebed surrounded by Black Box (*Eucalyptus largiflorens*) - landholder of 30 years has never seen lake hold water. | -34.832609 | 143.6159 |
| 6 | Dune, grass covered, under transmission line, scattered *Acacia* spp. and *Casuarina* sp. | -34.882554 | 143.6713 |
| 7 | Rehabilitated saltbush and tumbleweed dune adjacent to Mallee Woodland | -34.882726 | 143.6887 |
| 8 | Rehabilitated Saltbush and Casuarina sand dune country. | -34.915506 | 143.7096 |
| R1 | Fence line, cropping paddock and *Casuarina* sp./Mallee Woodland remnant near high voltage powerline. Water troughs in the vicinity. | -34.785023 | 143.5344 |
| R2 | Mallee Woodland adjacent to an open cropping paddock. | -34.885065 | 143.5006 |

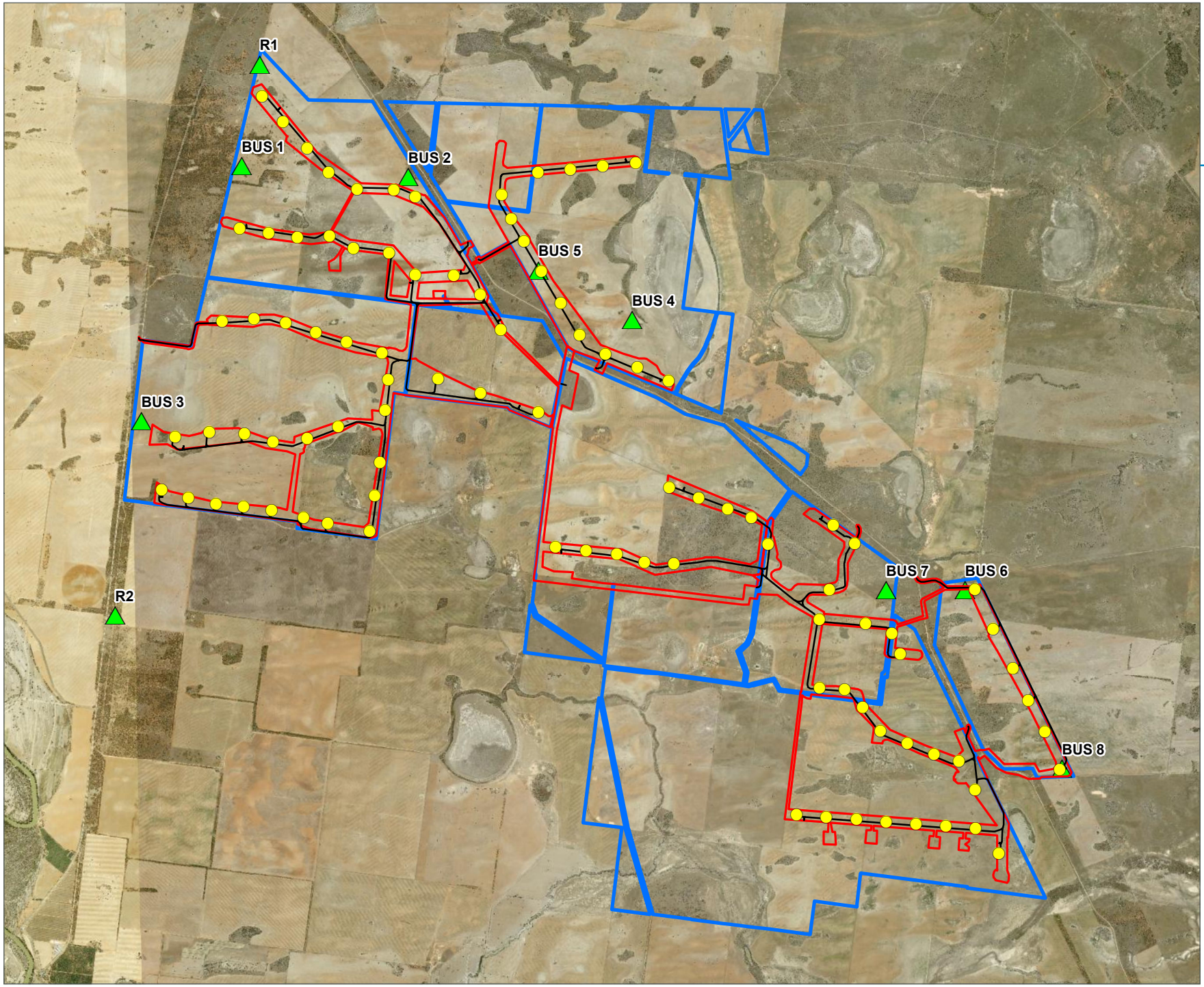



**Figure 2:** Junction Rivers Wind Project
**BUS points**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

- Wind Farm Boundary
- Development corridor
- Turbine
- Access tracks
- BUS point

N

Metres
0 1,400

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

#### 2.1.3. Incidental observations

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (listed threatened, migratory species and raptors) were made whilst travelling throughout the windfarm study area. Notes were made on woodland birds observed in remnant woodlands and any early morning and evening roosting movements. Emphasis was placed on observing birds that were moving through the study area at RSA height.

#### 2.1.4. Data preparation and statistical analysis

Observations were recorded in pre-defined field observation forms. Raw data were then entered into spreadsheet file and tables and graphs were extracted. Graphs were generated in Microsoft Excel and R (R Core Team 2018).

The suitability of the survey method was checked using a cumulative species number graph and these results are presented in Figure 3 below.

#### 2.1.5. Limitations

The bird utilisation survey was undertaken during each season of the year, and surveys were completed twice over two years.  over two years.

In autumn and winter, birds such as starlings, cockatoos, magpies or ravens usually occur in flocks generating larger counts. However, there may be lack of observations for several surveys if the flocks are elsewhere. Furthermore, migrant species are generally not present in the region in autumn and winter and more likely to be present during spring and summer.

For these reasons, and the reasons explained in section 3.1, the utilisation rates and species abundances recorded during the two years of survey show the variability in bird assemblages within the study area. The data collected over two years is considered to provide a good basis on which to assess the risks to birds associated with the development of the proposed Junction Rivers Wind Project.

### 2.2. Results

#### 2.2.1. Survey suitability

The cumulative number of species observed from the consecutive fixed-point bird counts conducted at the observation points during the survey period has been plotted (Figure 3). The data indicated during the survey period that the number of species recorded levelled out after 40 counts for most seasons. Spring 2022 was the exception to this and is likely a result of increased rain throughout 2020, resulting in increased productivity in the region overall and therefore less competition for resources amongst species. This may be an anomaly in the data or may indicate a need for further survey effort. However, at this time, we are confident that this survey effort supports the adequacy of using eight replicates and 15-minute surveys to generate representative data on bird species in the study area during the relevant times of year.

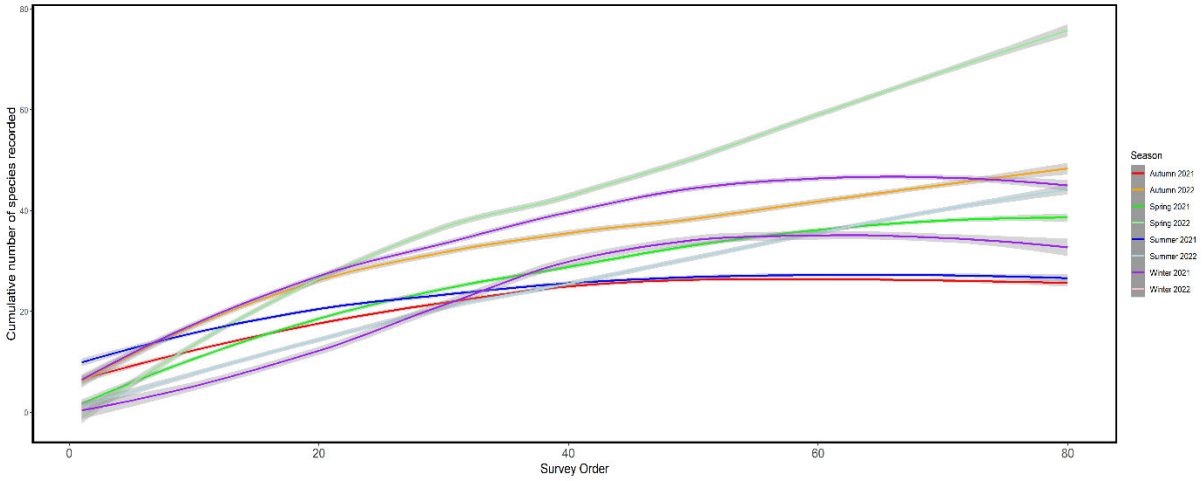



**Figure 3: The cumulative number of species of birds recorded during consecutive counts at the impact points on the proposed Junction Rivers Wind Project during 2021 and 2022.**

### *2.2.1. Species composition*

Total utilisation (cumulative counts) of each species recorded at each point is presented in Table 3. A total of 81 species including one genus (*Corvus*) were recorded during the combined eight seasonal surveys over two years of observations. In 2021 and 2022, 62 and 73 species (including *Corvus*) respectively, were recorded (Table 3). Of all species recorded, 51 species (including *Corvus*) were recorded at impact points in 2021 and 63 in 2022. In 2021 and 2022, 41 and 50 species (both including *Corvus*) were recorded at the reference points respectively. Species recorded during surveys were predominantly farmland and woodland species, with nine raptor species and three threatened species. The raw data is presented in Appendix 1. One additional species of raptor was observed incidentally, outside of the formal surveys. Given that the observations of *Corvus* genus could not be reduced to a single species, it has been included in all analysis despite the low likelihood of it being a new species.

Species diversity varied between each season, with the highest diversity occurring in spring and the lowest in autumn. Species composition (diversity and abundance) differs between months due to seasonal changes in presence and abundance, activity, changes in foraging behaviour and seasonal distribution of birds among various habitats. Where Australian Raven (*Corvus coronoides*) and Little Raven (*Corvus mellori*) could not be separated in the field they have been grouped into *Corvus* and are included in the dataset as such.

**Table 3: Number and height distribution of bird species at survey points during eight seasons surveys at the proposed Junction Rivers Wind Project**

| Species | 1 | | | 2 | | | 3 | | | 4 | | | 5 | | | 6 | | | 7 | | | 8 | | | Total Impact Points | | | R1 | | | R2 | | | Total Reference Points | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | |
| Apostlebird | 7 | | | 25 | | | | | | | | | | | | | | | 78 | | | 7 | | | 117 | 0 | 0 | 193 | | | 16 | | | 209 | 0 | 0 | **326** |
| Australasian Pipit | | | | | | | 7 | | | 15 | 2 | | 7 | | | | | | 2 | | | 9 | | | 40 | 2 | 0 | | | | | | | 0 | 0 | 0 | **42** |
| Australian Magpie | 50 | | | 93 | | | 86 | | | 53 | | | 56 | | | 110 | | | 98 | 5 | | 114 | | | 660 | 5 | 0 | 76 | | | 68 | | | 144 | 0 | 0 | **809** |
| Australian Pelican | | | | | | | | | | | | | | | | | 1 | | | | | | | | 0 | 1 | 0 | | | | 1 | | | 1 | 0 | 0 | **2** |
| Australian Raven | 24 | 5 | | 26 | 7 | | 16 | 1 | | 5 | | | 35 | 12 | | 80 | | | 19 | | | 20 | | | 225 | 25 | 0 | 50 | | | 31 | 2 | | 81 | 2 | 0 | **333** |
| Australian Ring-necked Parrot | 8 | | | 6 | | | 6 | | | 2 | | | | | | 4 | | | 11 | | | | | | 37 | 0 | 0 | 16 | | | 5 | | | 21 | 0 | 0 | **58** |
| Australian Wood Duck | | | | | | | | | | | | | | | | 7 | | | | | | | | | 7 | 0 | 0 | | | | | | | 0 | 0 | 0 | **7** |
| Banded Lapwing | 6 | | | 2 | | | | | | | | | | | | | | | | | | 2 | | | 10 | 0 | 0 | | | | | | | 0 | 0 | 0 | **10** |
| Black Kite | | | | 3 | | | | | | 3 | | | | | | | | | | | | | | | 6 | 0 | 0 | | | | 2 | | | 2 | 0 | 0 | **8** |
| Black Swan | | | | | | | | | | | | | | | | | | | 7 | | | | | | 7 | 0 | 0 | | | | | | | 0 | 0 | 0 | **7** |
| Black-faced Cuckoo-shrike | 4 | | | 1 | | | 4 | | | | | | 8 | | | 17 | | | 3 | | | 2 | | | 39 | 0 | 0 | 8 | | | 24 | | | 32 | 0 | 0 | **71** |
| Black-faced Woodswallow | | | | | | | | | | | | | | | | 6 | | | | | | | | | 6 | 0 | 0 | | | | | | | 0 | 0 | 0 | **6** |
| Black-shouldered Kite | | | | | | | | | | 5 | | | 2 | | | | | | 2 | | | 1 | | | 10 | 0 | 0 | 2 | | | | | | 2 | 0 | 0 | **12** |
| Bluebonnet | 33 | | | 203 | | | 62 | | | 19 | | | 102 | | | 79 | | | 190 | | | 239 | | | 927 | 0 | 0 | 107 | | | 156 | | | 263 | 0 | 0 | **1190** |
| Blue-faced Honeyeater | 3 | | | | | | | | | | | | | | | | | | | | | | | | 3 | 0 | 0 | 2 | | | | | | 2 | 0 | 0 | **5** |
| Brown Falcon | | | | | | | 1 | | | | | | 2 | | | | | | 2 | | | 6 | 1 | | 11 | 1 | 0 | | | | 1 | | | 1 | 0 | 0 | **13** |
| Brown Goshawk | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 1 | | | 1 | 0 | 0 | **1** |
| Brown Songlark | | | | | | | | | | 2 | | | 6 | | | 1 | | | 23 | | | 12 | | | 44 | 0 | 0 | 24 | | | | | | 24 | 0 | 0 | **68** |
| Brown-headed Honeyeater | | | | | | | | | | | | | | | | | | | 4 | | | | | | 4 | 0 | 0 | | | | | | | 0 | 0 | 0 | **4** |
| Buff-rumped Thornbill | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 3 | | | 2 | | | 5 | 0 | 0 | **5** |
| Chestnut-crowned Babbler | | | | 74 | | | | | | 1 | | | | | | 63 | | | 20 | | | 7 | | | 165 | 0 | 0 | | | | 67 | | | 67 | 0 | 0 | **232** |
| Chestnut-rumped Thornbill | 9 | | | | | | | | | 1 | | | | | | 5 | | | 4 | | | | | | 19 | 0 | 0 | 5 | | | 132 | | | 137 | 0 | 0 | **156** |
| Cockatiel | | | | | | | 1 | | | | | | 3 | | | 11 | | | | | | | | | 15 | 0 | 0 | 1 | | | 1 | | | 2 | 0 | 0 | **17** |
| Common Bronzewing | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | 0 | 0 | | | | 2 | | | 2 | 0 | 0 | **3** |
| Common Starling | | | | | | | 1 | | | | | | | | | | | | | | | 19 | | | 20 | 0 | 0 | 1 | | | | | | 1 | 0 | 0 | **21** |
| *Corvus* sp. | | | | 7 | | | 1 | | | | | | | | | 5 | | | | | | 1 | | | 14 | 0 | 0 | 21 | | | 1 | | | 22 | 0 | 0 | **36** |
| Crested Pigeon | 7 | | | 39 | | | 62 | | | 6 | | | 13 | | | 13 | | | 38 | | | 29 | | | 207 | 0 | 0 | 83 | | | 103 | | | 186 | 0 | 0 | **393** |
| Eastern Rosella | 4 | | | 2 | | | 2 | | | | | | | | | | | | 6 | | | | | | 14 | 0 | 0 | | | | 8 | | | 8 | 0 | 0 | **22** |
| Emu | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 5 | | | 5 | 0 | 0 | **5** |
| Fairy Martin | | | | | | | | | | | 1 | | | | | | | | | 100 | | | | | 0 | 101 | 0 | 15 | | | | | | 15 | 0 | 0 | **116** |
| Galah | 17 | | | 97 | | | 18 | | | 58 | | | 74 | 2 | | 39 | 31 | | 40 | | | 38 | 26 | | 381 | 59 | 0 | 282 | | | 27 | | | 309 | 0 | 0 | **749** |
| Golden Whistler | 3 | | | | | | | | | | | | | | | | | | | | | | | | 3 | 0 | 0 | | | | | | | 0 | 0 | 0 | **3** |
| Great Cormorant | 13 | | | | | | 5 | | | | | | | | | | | | | | | | | | 18 | 0 | 0 | | 30 | | | | | 0 | 30 | 0 | **48** |
| Grey Butcherbird | 16 | | | 6 | | | 7 | | | 3 | | | 2 | | | 12 | | | 10 | | | 21 | | | 77 | 0 | 0 | 7 | | | 15 | | | 22 | 0 | 0 | **99** |
| Grey Fantail | 1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | 0 | 0 | | | | | | | 0 | 0 | 0 | **1** |
| Grey Shrike-thrush | | | | | | | 2 | | | | | | | | | 6 | | | | | | | | | 8 | 0 | 0 | | | | 2 | | | 2 | 0 | 0 | **10** |
| Ground Cuckoo-shrike | | | | | | | | | | | | | | | | 25 | | | | | | | | | 25 | 0 | 0 | | | | | | | 0 | 0 | 0 | **25** |
| Little Raven | 59 | 35 | | 9 | 32 | | 7 | | | 5 | 45 | | 2 | | | 49 | | | | | | 16 | | | 147 | 112 | 0 | 156 | | | 7 | | | 163 | 0 | 0 | **422** |
| Little Wattlebird | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 4 | | | 4 | 0 | 0 | **4** |
| Magpie-lark | 20 | | | 11 | | | 3 | | | | | | 3 | | | 19 | | | 7 | | | 51 | | | 114 | 0 | 0 | 46 | | | 7 | | | 53 | 0 | 0 | **167** |
| Major Mitchell's Cockatoo | | | | | | | 6 | | | | | | | | | 15 | | | 6 | | | 2 | | | 29 | 0 | 0 | 42 | | | 22 | | | 64 | 0 | 0 | **93** |
| Masked Woodswallow | | | | | | | | | | | | | | | | 12 | | | | | | | | | 12 | 0 | 0 | | | | | | | 0 | 0 | 0 | **12** |
| Mistletoebird | 1 | | | | | | | | | | | | | | | | | | 1 | | | | | | 2 | 0 | 0 | | | | | | | 0 | 0 | 0 | **2** |

| Species | 1 | | | 2 | | | 3 | | | 4 | | | 5 | | | 6 | | | 7 | | | 8 | | | Total Impact Points | | | R1 | | | R2 | | | Total Reference Points | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C | |
| Musk Lorikeet | 2 | | | | | | | | | | | | | | | | | | | | | | | | 2 | 0 | 0 | | | | | | | 0 | 0 | 0 | **2** |
| Nankeen Kestrel | 1 | | | | | | 3 | | | 3 | | | 4 | | | 7 | | | 4 | | | 1 | | | 23 | 0 | 0 | 2 | | | 2 | | | 4 | 0 | 0 | **27** |
| Noisy Miner | 8 | | | 25 | | | 1 | | | 6 | | | 25 | | | 58 | | | 47 | | | 91 | | | 261 | 0 | 0 | 28 | | | 6 | | | 34 | 0 | 0 | **295** |
| Peregrine Falcon | 1 | | | | | | | | | | | | 1 | | | | | | | | | | | | 2 | 0 | 0 | | | | 1 | | | 1 | 0 | 0 | **3** |
| Pied Butcherbird | 3 | | | 7 | | | 2 | | | 12 | | | 14 | | | 9 | | | 9 | | | 11 | | | 67 | 0 | 0 | 12 | | | 13 | | | 25 | 0 | 0 | **92** |
| Rainbow Bee-eater | | | | | | | | | | | | | | | | 2 | | | 6 | | | | | | 8 | 0 | 0 | | 2 | | 13 | | | 13 | 2 | 0 | **23** |
| Red Wattlebird | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 2 | | | 2 | 0 | 0 | **2** |
| Red-rumped Parrot | 19 | | | 30 | | | 7 | | | 26 | | | 12 | | | 32 | | | 28 | | | 13 | | | 167 | 0 | 0 | 62 | | | | | | 62 | 0 | 0 | **229** |
| Regent Parrot | | | | | | | 2 | | | | | | | | | | | | | | | | | | 2 | 0 | 0 | 77 | | | 23 | | | 100 | 0 | 0 | **102** |
| Restless Flycatcher | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 11 | | | 11 | 0 | 0 | **11** |
| Rufous Songlark | | | | 1 | | | | | | | | | | | | | | | | | | | | | 1 | 0 | 0 | 15 | | | 25 | | | 40 | 0 | 0 | **41** |
| Silvereye | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 4 | | | 4 | 0 | 0 | **4** |
| Singing Honeyeater | 3 | | | | | | 21 | | | 1 | | | | | | | | | 9 | | | 18 | | | 52 | 0 | 0 | 1 | | | 14 | | | 15 | 0 | 0 | **67** |
| Southern Whiteface | | | | | | | | | | | | | | | | 2 | | | 2 | | | 3 | | | 7 | 0 | 0 | | | | | | | 0 | 0 | 0 | **7** |
| Spiny-cheeked Honeyeater | 4 | | | | | | 6 | | | | | | | | | | | | | | | 21 | | | 31 | 0 | 0 | 6 | | | 59 | | | 65 | 0 | 0 | **96** |
| Splendid Fairy-wren | | | | | | | | | | 3 | | | | | | | | | | | | | | | 3 | 0 | 0 | | | | | | | 0 | 0 | 0 | **3** |
| Spotted Harrier | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | 0 | 0 | | | | 1 | | | 1 | 0 | 0 | **2** |
| Spotted Pardalote | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 1 | | | 2 | | | 3 | 0 | 0 | **3** |
| Straw-necked Ibis | | | | | | | | | | | | | | | | | | | 1 | | | 2 | | | 3 | 0 | 0 | | | | | | | 0 | 0 | 0 | **3** |
| Striated Pardalote | 5 | | | | | | | | | | | | | | | | | | 1 | | | | | | 6 | 0 | 0 | 8 | | | 22 | | | 30 | 0 | 0 | **36** |
| Stubble Quail | | | | 1 | | | 1 | | | | | | 3 | | | 2 | | | | | | | | | 7 | 0 | 0 | 3 | | | | | | 3 | 0 | 0 | **10** |
| Sulphur-crested Cockatoo | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | | | | 1 | | | 1 | 0 | 0 | **1** |
| Superb Fairy-wren | | | | | | | | | | 1 | | | | | | | | | | | | | | | 1 | 0 | 0 | | | | | | | 0 | 0 | 0 | **1** |
| Wedge-tailed Eagle | | | | 2 | | | | | | | 1 | | | 1 | | 3 | 2 | | | 2 | | 3 | 2 | | 8 | 8 | 0 | | 4 | | 3 | | | 3 | 4 | 0 | **23** |
| Weebill | 27 | | | | | | 1 | | | | | | | | | | | | | | | 2 | | | 30 | 0 | 0 | 2 | | | 5 | | | 7 | 0 | 0 | **37** |
| Welcome Swallow | 2 | | | | | | 4 | | | | | | 1 | | | | | | 1 | | | | | | 8 | 0 | 0 | | | | | | | 0 | 0 | 0 | **8** |
| Whistling Kite | | | | 2 | | | 2 | | | | | | | | | | | | | | | | | | 4 | 0 | 0 | | | | | | | 0 | 0 | 0 | **4** |
| White-browed Babbler | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 10 | | | | | | 10 | 0 | 0 | **10** |
| White-browed Woodswallow | | | | 5 | | | | | | | | | | | | | | | | | | | | | 5 | 0 | 0 | | | | 94 | | | 94 | 0 | 0 | **99** |
| White-fronted Chat | | | | | | | | | | 8 | | | | | | | | | 1 | | | 2 | | | 11 | 0 | 0 | 1 | | | | | | 1 | 0 | 0 | **12** |
| White-necked Heron | | | | | | | | | | | | | | | | | 1 | | | | | 1 | | | 1 | 1 | 0 | | | | | | | 0 | 0 | 0 | **2** |
| White-plumed Honeyeater | 6 | | | | | | | | | | | | | | | | | | | | | | | | 6 | 0 | 0 | | | | 11 | | | 11 | 0 | 0 | **17** |
| White-winged Chough | 31 | | | | | | | | | | | | | | | 15 | | | 30 | | | | | | 76 | 0 | 0 | 41 | | | 8 | | | 49 | 0 | 0 | **125** |
| White-winged Fairywren | | | | | | | | | | | | | | | | 5 | | | | | | | | | 5 | 0 | 0 | | | | | | | 0 | 0 | 0 | **5** |
| Willie Wagtail | 1 | | | 1 | | | 10 | | | | | | | | | 3 | | | 2 | | | 10 | | | 27 | 0 | 0 | 4 | | | 1 | | | 5 | 0 | 0 | **32** |
| Yellow-faced Honeyeater | | | | | | | 6 | | | | | | | | | | | | | | | | | | 6 | 0 | 0 | | | | | | | 0 | 0 | 0 | **6** |
| Yellow-plumed Honeyeater | 2 | | | | | | | | | | | | | | | | | | | | | | | | 2 | 0 | 0 | | | | | | | 0 | 0 | 0 | **2** |
| Yellow-rumped Thornbill | 5 | | | | | | | | | | | | | | | | | | | | | 21 | | | 26 | 0 | 0 | 10 | | | 23 | | | 33 | 0 | 0 | **59** |
| Yellow-throated Miner | 70 | | | 117 | | | 57 | | | 8 | | | 45 | | | 20 | | | 48 | | | 35 | | | 400 | 0 | 0 | 77 | | | 122 | | | 199 | 0 | 0 | **599** |
| Grand Total | **475** | **40** | **0** | **795** | **39** | **0** | **420** | **1** | **0** | **246** | **49** | **0** | **420** | **15** | **0** | **736** | **35** | **0** | **762** | **107** | **0** | **830** | **29** | **0** | **4684** | **315** | **0** | **1500** | **36** | **0** | **1176** | **2** | **0** | **2676** | **38** | **0** | **7713** |

**Notes:** R = Reference; A = Below RSA height; B = At RSA height; C = above RSA height. No birds were recorded above RSA height.

### 2.2.2. Commonly recorded species

At the proposed JRWP, five species comprised 58.2% and 54.4% of all birds recorded at the impact points in 2021 and 2022 respectively, and 53.5% and 39.8% at the reference points in 2021 and 2022 respectively. Impact points in both years showed high abundance of woodland birds that are commonly observed in landscapes that have remnant woodland elements and have been cleared for agriculture. In 2021 there were numerous observations of Chestnut-crowned Babbler (*Pomatostomus ruficeps*) across multiple survey points, suggesting that there are multiple large cooperatively breeding groups supported by the study area.

In 2021 the total number of birds observed at impact points during the surveys varied between 78 at impact point 4, and 477 at impact point 2. Birds observed at reference points varied between 638 at reference point 1, and 675 at reference point 2. In 2022 the total number of birds observed at impact points during the surveys varied between 169 at impact point 1, and 355 at impact point 6. Birds observed at reference points varied between 375 at reference point 2 and 638 at reference point 1.

Bird diversity differed between impact and reference points, but also differed between impact points. Impact point 4 had the lowest average diversity of all points, being situated in an open cropping paddock. Diversity was highest at impact point 8. This survey point is situated in an open pasture but included two patches of mallee woodland nearby. Numerous common bird species moved through the study area during surveys.

The abundance of birds recorded was at a high of 2277 in autumn (793 in 2021 and 1484 in 2022), dropping to 1899 in summer (964 in 2021 and 935 in 2022), 1796 in spring (1024 in 2021 and 772 in 2022), and 1741 in winter (972 in 2021 and 769 in 2022). Species diversity varied between each season, with overall diversity very similar across spring, summer, and winter in 2021, with a drop in diversity in autumn.

**Table 4: The five most common bird species recorded at impact and reference points at the proposed Junction Rivers Wind Project**

| 2021 | | 2022 | |
|---|---|---|---|
| Impact points | Reference points | Impact points | Reference points |
| Bluebonnet | Bluebonnet | Bluebonnet | Galah |
| Australian Magpie | Apostlebird | Australian Magpie | Yellow-throated Miner |
| Galah | Crested Pigeon | Noisy Miner | Chestnut-rumped Thornbill |
| Yellow-throated Miner | Galah | Galah | Bluebonnet |
| Chestnut-crowned Babbler | Yellow-throated Miner | Yellow-throated Miner | Australian Magpie |

### 2.2.3. Flight heights

Bird heights were classified as below (≤ 50 metres), at (51-300 metres), and above (≥ 301 metres) RSA height. Detailed results of the number of birds recorded at the different flight heights are presented in (Table 3). The raw data are presented in Appendix 1.

Most birds were recorded flying below RSA height at impact (93.6%), and reference (98.6%) points (Table 5).

**Table 5: Summary of flight heights of all birds recorded over two years of survey 2021 - 2022**

| Flight Height | Impact points | | Reference points | |
|---|---|---|---|---|
| | Number of birds | Percentage of all birds | Number of birds | Percentage of all birds |
| A (below RSA) | 4679 | 93.6% | 2675 | 98.56% |
| B (at RSA) | 320 | 6.4% | 39 | 1.44% |
| C (above RSA) | 0 | 0.0% | 0 | 0.00% |
| **Total birds recorded** | **4999** | 100.0% | **2714** | 100.00% |

The comparative number of birds flying below RSA observed between impact and reference points did not differ significantly between years, with the percentage of birds observed flying below RSA at impact points in 2021 being 95.7%, compared with 91.2% in 2022, and the percentage of birds observed flying below RSA at reference points was 100% in 2021 and 97.3% in 2022.

The most abundant species flying at RSA are detailed below in Table 6. These accounted for 6.6% of the total birds observed at impact points, and 1.5% of the total birds observed at reference points.

**Table 6: The most abundant species flying at RSA height at the proposed Junction Rivers Wind Project site**

| Impact points | Flight count | Reference points | Flight count |
|---|---|---|---|
| Little Raven | 112 | Great Cormorant | 30 |
| Fairy Martin | 101 | Wedge-tailed Eagle | 4 |
| Galah | 64 | Australian Raven | 2 |
| Australian Raven | 25 | Rainbow Bee-eater | 2 |
| Wedge-tailed Eagle | 8 | Australian Magpie | 1 |
| **Totals** | **310** | | **39** |

These data suggest that a small proportion of flights by common species are occurring at RSA height, for the majority of species there is no consistent activity at RSA height. The most observed species flying at RSA are species that normally tend to exhibit flocking behaviour, such as the Little and Australian Raven, Fairy Martin (*Petrochelidon ariel*) and Galah (*Eolophus roseicapilla*). Members of the *Corvus* genus and *Cacatuidae* families can gather in large numbers, particularly when foraging or prior to pairing. Little Raven was observed in flocks and were observed on site flying both at and below RSA height. They are a common species on site with potential collision risk.

The most observed species at reference points was the Great Cormorant (*Phalacrocorax carbo*), which may move between bodies of water during wetter seasons such as the current La Niña cycle. Flock size may vary, and no consistent observable were evident across the study area. In this case, a single flock of 30 birds were observed at reference point 1. Waterfowl records and potential impacts are discussed in detail in this report.

## 2.3. Listed threatened and migratory species

### *2.3.1. 'At risk' birds.*

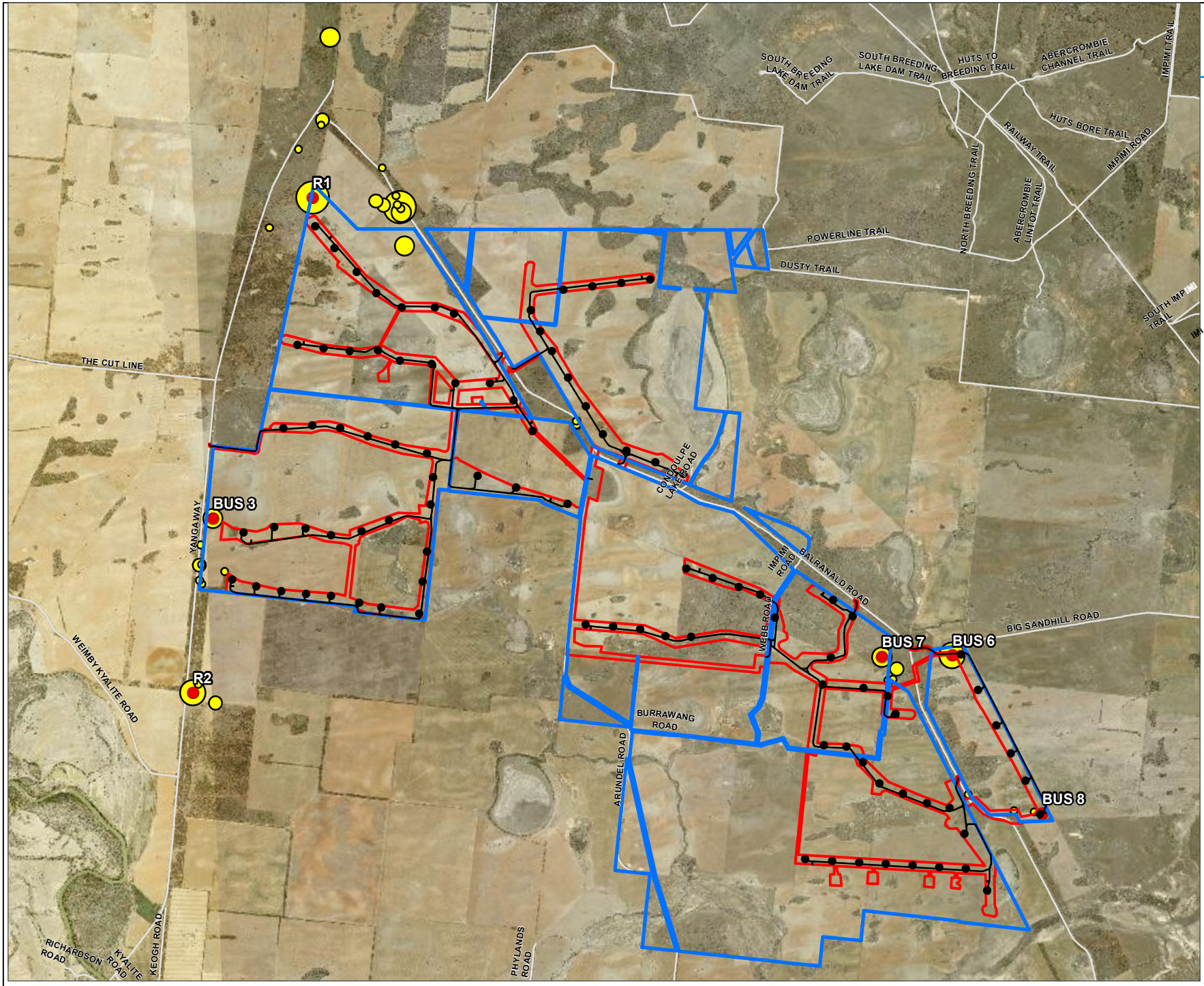
Most bird species found utilising the proposed wind farm study area were common birds. Of the species recorded during the bird utilisation surveys and incidentally while on site, the following species were listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or the NSW *Biodiversity Conservation Act 2016* (BC Act).

### 2.3.2. Black Falcon

The Black Falcon (*Falco subniger*) was observed twice in 2022, once at a reference point and once offsite on the western edge of the wind farm boundary. Both occurrences were incidental observations. The record at reference point 1 was of the individual drinking from a livestock trough and then flying low away from the observer. The offsite observation indicated the individual was flying at RSA height. While this observation was not recorded within the proposed windfarm boundary, this species is highly mobile – moving in response to food availability and seasonal conditions (Marchant and Higgins 1993). The two observations were made during the beginning and middle of the Black Falcon breeding season (June to December). This record has not been included in the category of 'threatened aerial resident' in this report due to insufficient data regarding the species utilisation of the study area and surrounds. Black Falcon is at collision risk with operating turbines and has been recorded at RSA height.

### 2.3.3. Major Mitchell's Cockatoo

The Major Mitchell's Cockatoo (*Lophochoa leadbeateri*) was recorded during formal BUS (n=93) and incidentally (n=114) in both years and most seasons, we consider the species to be resident in the study area. During the spring BUS survey in November three individuals were observed investigating and excavating suitable sized nesting hollows on the eastern side of the windfarm, equidistant between BUS points 4 and 5, west of Balranald Road. The species was recorded feeding in Emubush (*Eremophila* sp.) near a mixed stand of Black Box (*Eucalyptus largiflorens*) and Belah (*Casuarina pauper*). Records for the species are illustrated in Figure 4 and this shows the relative abundance of individuals observed at each location.




# Figure 4: Major Mitchell's Cockatoo Occurrences

**Project**: Junction Rivers Wind Project
**Client**: Windlab Pty Ltd
**Date** 22/02/2024

- Wind Farm Boundary
- Development corridor
- Turbine
- BUS points
- Access tracks

**Major Mitchell's Cockatoo records**

- 1 - 2
- 3 - 5
- 6 - 10
- 11 - 22
- 23 - 59

N

Metres
0 1,800

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The species was recorded in all seasons except for spring of 2022. They were recorded most frequently in summer 2022, during the targeted species survey for Regent Parrot.

The Major Mitchell's Cockatoo was not observed at or above the proposed minimum RSA height. This species primarily forages primarily on the ground, and in low growing vegetation (maximum canopy height in the study area is approximately eight metres). The species is not expected to fly at RSA height even when transiting between foraging areas within the study area. We have no observational data on how birds may be disbursing away from the study area.

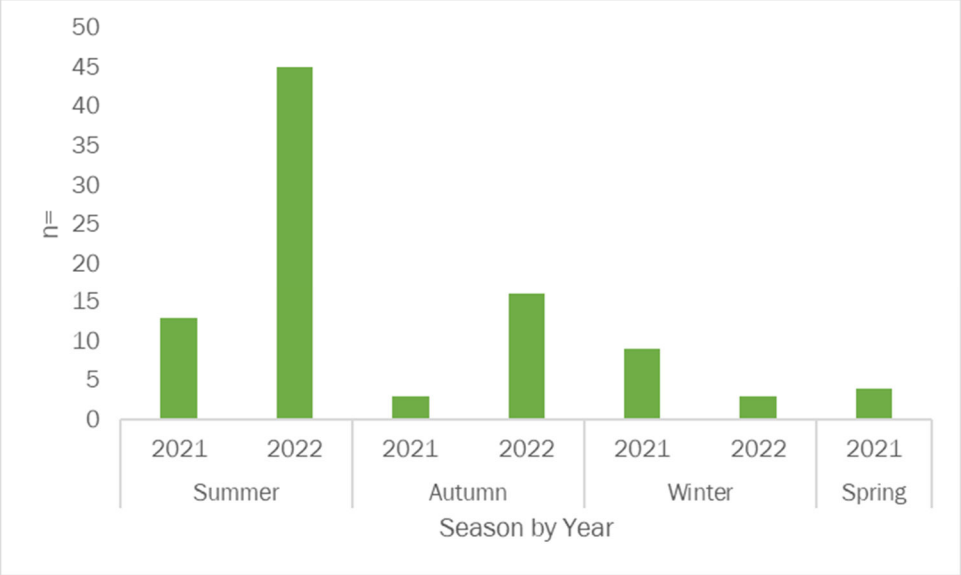



**Figure 5. Counts of Major Mitchell's Cockatoo during formal BUS surveys**

### 2.3.4. *Regent Parrot*

The Regent Parrot (*Polytellis anthopeplus monarchoides*) was recorded during formal BUS (in both impact and reference locations) and incidentally. As such, itis likely that this species is resident in the study area. It was observed a total of 117 times, twice at impact locations, 100 at reference, and 15 incidentally. Regent Parrot was not observed at or above the proposed minimum RSA height. This species forages primarily in mallee and other low growing vegetation it is unlikely this species will fly at or above the proposed RSA height. In light of the above information and the potential for a significant impact to occur during the operation off the proposed windfarm Nature Advisory has conducted a separate investigation into the utilisation by the species within the study area. Nature Advisory has produced a separate report presenting the findings from this investigation and is presented in:

- Junction Rivers Wind Project: Regent Parrot Targeted Assessment Report 2023.

### 2.3.5. *Spotted Harrier*

The Spotted Harrier (*Circus assimilis*) was recorded twice, once at an impact site and once at a reference site. No nesting activity was observed but the species is likely to be a resident raptor in the area.

### 2.3.6. White-fronted Chat

The White-fronted Chat (*Epthianura albifrons*) was recorded in 2021 and 2022 and is likely to a frequent visitor or resident to the study area. The species was not observed at or above the minimum proposed RSA height.

### 2.3.7. Raptors

Ten raptor species were recorded across two years of surveys, with 87 observations in total, comprising 67 at impact locations (Table 7), 18 at reference locations, and two Black Falcon recorded as incidental observations. The presence of these raptors varied between the seasons and generally they were recorded in low numbers. The raw data is presented in Appendix 1.

Nankeen Kestrel (*Falco cenchroides*) was the most abundant raptor species at study site. It was observed in low numbers at every survey point across the two years. The species is frequently seen hovering over farmland, perched on power lines and fences. A key hunting strategy of this species is to hover over fixed locations before diving on prey from height. No birds were observed at or above the minimum RSA height throughout the two years of observations. Although birds were not observed at RSA height, we do consider the species to be at risk of turbine collision. Birds appear to be undeterred by operating turbines and a frequently recorded hunting within the footprint of operating turbines at other windfarm sites. Juvenile birds may be especially vulnerable to collision.

The Wedge-tailed Eagle (*Aquila audax*) was recorded during formal survey 23 times over the two years, during which 47.8% of their flights were observed at RSA height. The Wedge-tailed Eagle is one of the most vulnerable species to collision with operating turbines because of their soaring habits while hunting.

The Spotted Harrier was recorded twice, once in each year of surveys. The species was recorded in winter 2021 at a reference point, and in spring 2022 at an impact point (south-eastern location). This species is listed as vulnerable under the BC Act of NSW.

The number of raptors was low in relation to the total number of birds recorded during the survey. Raptors formed approximately 0.2% of birds seen at RSA height (Table 7). Based on the low utilisation rate of raptors at impact points, other than the Wedge-tailed Eagle, the collisions risk to other observed raptors species is considered to be low.

**Table 7: Raptor species recorded at impact points during four seasons across two years at the proposed Junction Rivers Wind Project site**

| Raptor species | Summer 2021-2022 | | | Autumn 2021-2022 | | | Winter 2021-2022 | | | Spring 2021-2022 | | | Grand Total | Total at RSA | Total Raptor Flights (%) | Flights at RSA (%) | Flights recorded at RSA compared with all bird flights at RSA (%) | Flights recorded at RSA compared with all bird flights observed (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | A | B | C | | | | | | |
| Black Kite | | | | 5 | | | | | | 1 | | | 6 | 0 | 8.96% | 0.00% | 0.00% | 0.00% |
| Black-shouldered Kite | | | | | | | 5 | | | 5 | | | 10 | 0 | 14.93% | 0.00% | 0.00% | 0.00% |
| Brown Falcon | 3 | 1 | | 3 | | | | | | 2 | | | 9 | 1 | 13.43% | 1.49% | 0.31% | 0.02% |
| Nankeen Kestrel | 8 | | | 7 | | | | | | 4 | | | 19 | 0 | 28.36% | 0.00% | 0.00% | 0.00% |
| Peregrine Falcon | | | | 1 | | | | | | 1 | | | 2 | 0 | 2.99% | 0.00% | 0.00% | 0.00% |
| Spotted Harrier | | | | | | | | | | 1 | | | 1 | 0 | 1.49% | 0.00% | 0.00% | 0.00% |
| Wedge-tailed Eagle | 2 | 2 | | 4 | 2 | | 2 | 4 | | | | | 16 | 8 | 23.88% | 88.89% | 2.50% | 0.16% |
| Whistling Kite | 1 | | | 3 | | | | | | | | | 4 | 0 | 5.97% | 0.00% | 0.00% | 0.00% |
| **Total** | **14** | **3** | **0** | **23** | **2** | **0** | **7** | **4** | **0** | **14** | **0** | **0** | **67** | **9** | **100.00%** | **100.00%** | **2.81%** | **0.18%** |

**Notes:** A=below rotor swept area (RSA) height (≤50 m); B= at RSA height (51-300 m); C= above RSA height (≥301 m).

### *2.3.8. Waterbirds*

Seven waterbird species were recorded across two years of surveys, comprising 46 observations in total (Table 8). The presence of these species varied between the seasons with the majority of records occurring in spring and summer of 2022. The raw data is presented in Appendix 1.

All observations were of species flying below minimum RSA height.

**Table 8 Waterbirds species recorded at survey points during four seasons across two years at the proposed Junction Rivers Wind Project site**

| Waterbirds | Summer 2021-2022 | | | Autumn 2021-2022 | | | Winter 2021-2022 | | | Spring 2021-2022 | | | Grand Total | Total at RSA | Total Waterbird Flights (%) | Flights at RSA (%) | Flights recorded at RSA compared with all bird flights at RSA (%) | Flights recorded at RSA compared with all bird flights observed (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | A | B | C | | | | | | |
| Australian Pelican | | | | | | | | | | 1 | | | 1 | 0 | 2.19% | 0.0% | 0.0% | 0.0% |
| Australian Wood Duck | | | | | | | 7 | | | | | | 7 | 0 | 15.25% | 0.0% | 0.0% | 0.0% |
| Banded Lapwing | | | | | | | 8 | | | | | | 8 | 0 | 17.41% | 0.0% | 0.0% | 0.0% |
| Black Swan | | | | | | | | | | 7 | | | 7 | 0 | 15.25% | 0.0% | 0.0% | 0.0% |
| Great Cormorant | 13 | | | | | | | | | 5 | | | 18 | 0 | 39.15% | 0.0% | 0.0% | 0.0% |
| Straw-necked Ibis | | | | | | | | | | 3 | | | 3 | 0 | 6.56% | 0.0% | 0.0% | 0.0% |
| White-necked Heron | 1 | | | | | | | | | 1 | | | 2 | 0 | 2.19% | 0.0% | 0.0% | 0.0% |
| Total | **14** | **0** | **0** | **0** | **0** | **0** | **15** | **0** | **0** | **17** | **0** | **0** | **46** | **0** | **100.00%** | **0.0%** | **0.0%** | **0.0%** |

**Notes:** A=below rotor swept area (RSA) height (≤50 m); B= at RSA height (51-300 m); C= above RSA height (≥301 m).

# 3. Bat Survey

## 3.1. Methods

Automated bat recorders (Song Meter®) recorded the species-specific echolocation calls of free-flying bats at survey locations that were representative of the habitat types of the windfarm study area and located near proposed wind turbine locations. Song Meters were secured to trees or fence posts approximately 1.5 - 2 metres above ground. The detectors were programmed to commence operation approximately 30 minutes before dusk, and to cease approximately 30 minutes after dawn. Each Song Meter unit used an 64GB SDHC card that recorded bat echolocation calls, along with the date and time of each call.

Calls from the units were downloaded and sent to Rob Gration (EcoAerial Environmental Services) for identification. The files from the recording locations were viewed in Kaleidoscope Pro analysis software (Wildlife Acoustics, USA), which provides a sonogram display of frequency versus time. Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded across Australia. Identification is largely based on changes to frequency patterns over time, with such changes being characteristic of individual species for most genera. Only those recordings that contained at least two definite and discrete calls were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently.

In both surveys, a broad analysis was undertaken, looking at the presence or absence of all possible species predicted to occur in the area. Particular attention was focused on threatened species with the potential to occur within the study area.

### *3.1.1. Timing of surveys*

Deployment of Song Meters occurred during spring and summer 2021 under conditions when bat activity was likely to be high. Six units were placed in the field during the following periods:

- Spring: 2nd to the 30th of November 2021 capturing between 24–29 consecutive nights of data, depending on the location. A total of 130 bat recorder-nights or 1560 bat recording hours were completed.
- Summer: 22nd to the 27th of February 2021, totalling 36 bat recorder-nights or 432 bat recording hours.

### *3.1.2. Location of survey points*

The location and a description of the recording locations are described in Table 9 below and their locations are shown in

**Table 9: Habitat description associated with each recording location**

| Location | Description | Latitude | Longitude |
|---|---|---|---|
| 1 | Cropping paddock on small rise/dune 180 metres from western fence line and mallee woodland | -34.803521 | 143.5302 |
| 2 | *Casuarina pauper* woodland adjacent to cropping paddock | -34.805993 | 143.5669 |
| 3 | Cropping paddock adjacent to a patch of remnant vegetation | -34.849708 | 143.5071 |
| 4 | Cropping paddock adjacent to *Casuarina pauper* woodland | -34.823316 | 143.5953 |
| 5 | Dune, grass covered, under telephone line, scattered *Acacia* spp. and *Casuarina pauper* | -34.882554 | 143.6713 |
| 6 | Rehabilitated saltbush and *Casuarina pauper* sand dune country | -34.915506 | 143.7096 |

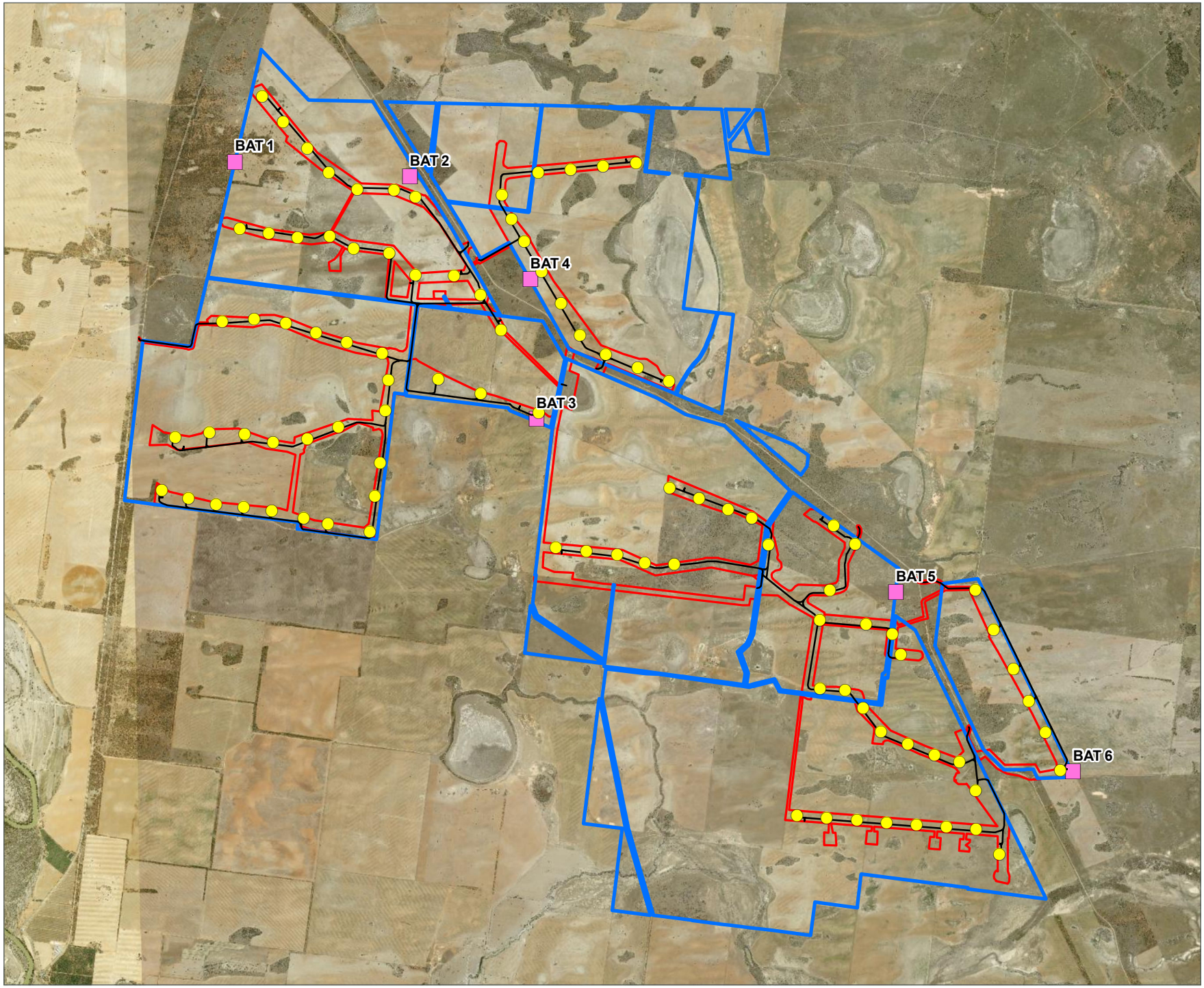



**Figure 6:** Junction Rivers **Wind** Project
**Bat recorder locations**

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 15/06/2023

- Wind Farm Boundary
- Development corridor
- Turbine
- Access tracks
- Bat recorder location

N

Metres
0 1,400

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### 3.1.3. Limitations

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific. Calls that could not be identified definitively were allocated to an individual species complex.

A further limitation in the use of this technique is that it is not possible to census bat numbers. For example, 10 calls of a particular species may be recorded but it is not known if this represents ten bats or a single individual of that species flying past the bat recorder 10 times. Therefore, it is not possible to determine overall utilisation rates of bats within the study area. We have provided analysis on the frequency of observed calls by individual species (or species complexes) across all recording locations during spring and summer of 2021.

Occasionally recording devices such as those used in the survey experience technical difficulties, which are not uncommon. As a result, short periods of time may not be recorded, and total hours of recordings vary between the different recorders. The device deployed at Bat 4 (Figure 6) experienced such technical difficulties during the spring survey in 2021. No recordings were retrieved from this location. Weather conditions including severe storms during the recording period may at times interfere with the recording process. All bat recorders are fitted with an external microphone that is able sample a limited airspace to approximately 20 - 30 metres.

Finally, bat activity levels may vary in response to weather variables such as air temperature, relative humidity, barometric pressure, wind speed, direction and gusts, rain, and moonlight. Typically, bats are found to be less active during the following circumstances:

- During periods of full moon, and when the moon is high in the sky;
- At higher wind speeds a decrease in activity may be observed at wind speeds over 10 metres per second; and
- During moderate to heavy rainfall.

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific, however not all species can be consistently or reliably identified using this technique. Some groups of taxa are not possible to identify to species level using call analysis alone. Groupings where identification is not possible are assigned to a “species call complex”. Alternative methods of examination would be required to confirm the status of some species – particularly threatened species known or thought to occur within the study area. Some examples of a species call complex where further study may be required are:

- Long-eared Bats (*Nyctophilus* spp.) calls are not distinguishable to species level by acoustic analysis and hence are grouped under their generic name. Corben’s Long-eared Bat (*N. corbenii*) is known to occur close to the study area (Australian Bat Society 2023). Mapping data would suggest the species occurs within the study area (OEH 2023a). This species has not been detected within the study area but further investigation may be warranted to confirm the presence of the species within the study area. The three species that are likely to occur are:
    - Lesser Long-eared Bat (*N. geoffroyi*)
    - Gould’s Long-eared Bat (*N. gouldi*)
    - Corben’s Long-eared Bat (*N. corbenii*).
- *N. gouldi* and *N. geoffroyi* are not listed as threatened, *N. corbenii* is listed as Vulnerable under the BC Act in NSW and under the EPBC Act.

- Calls of species of Forest Bats (*Vespadelus* spp.) can be difficult to differentiate and, therefore, some of their calls have been combined into the species complex for the purposes of analysis; and
- Similarly, calls of Broad-nosed Bats (*Scoterepens* spp.) can be difficult to differentiate, therefore some of their calls have been combined into a species complex.

## 3.2. Results

Across the two survey periods (summer and spring 2021), nine species of bats were positively identified to occur on the windfarm study area. Seven species were confirmed as occurring during the summer survey, with two additional species detected in spring as outlined in Table 10 below. The nine bat species identified were common, secure, and widespread species that occur in farmland and woodland habitats throughout eastern and south-eastern Australia.

In addition to the species identified to species level, three species complexes were also recorded.

**Table 10: Bat diversity at proposed Junction Rivers Wind Project during summer and spring 2021**

| Common name | Scientific name | Conservation status | Summer 21 | Spring 21 |
|---|---|---|---|---|
| Gould's Wattled Bat | *Chalinolobus gouldi* | common, secure | All locations | 1, 2, 3, 5, 5 |
| Chocolate Wattled Bat | *Chalinolobus morio* | common, secure | 1, 2, 3, 5, 6 | 1, 2, 3, 5, 6 |
| Inland Free-tailed Bat | *Ozimops petersi* | common, secure | 6 | 1, 5, 6 |
| Southern Free-tailed bat | *Ozimops planiceps* | common, secure | All locations | 1, 2, 5, 6 |
| Inland Broad-nosed Bat | *Scotorepens balstoni* | common, secure | 2, 3, 5, 6 | 1, 2, 5, 6 |
| White-striped Freetail Bat | *Austronomus australis* | common, secure | 4 | 1, 2, 5, 6 |
| Large Forest bat | *Vespadelus darlingtoni* | common, secure | | 1 |
| Little Forest Bat | *Vespadelus vulturnus* | common, secure | All locations | 1, 2, 3, 5, 6 |
| Southern Forest Bat | *Vespadelus regulus* | common, secure | | 1, 2 |
| **Species complexes** | | | | |
| Free-tailed Bat | *Ozimops planiceps & O. petersi* | common, secure | 2, 3, 4, 5, 6 | 1, 2, 3, 5, 6 |
| Long-eared Bat | *Nyctophilus geoffroyi, N. gouldi & N. corbenii complex* | common, secure and Vulnerable (*N. corbenii*) | 2, 3, 4, 5, 6 | 1, 2 |
| Forest Bat sp. | *Vespadelus regulus / V. vulturnus/V. regulus* | common, secure | 2, 3, 5, 6 | 1, 2, 3, 5, 6 |

**Note**: No bats were recorded at location 4 during spring due to technical a technical malfunction of the Song Meter.

### *3.2.1. Bat activity*

Calls were recorded across most locations during both summer and spring 2021 surveys (Table 11). Bats were common across the windfarm study area, with no pattern detectable among the various locations or between the two seasons. Overall, there were more calls recorded in spring (19259 calls) than in summer (3562 calls). The number of calls recorded seems to be the product of season, habitat structure and prevailing weather conditions at time of recording. Location 2, located within a *Casuarina pauper* woodland recorded the most bat calls. During spring surveys at location 4 the bat recorder malfunctioned.

**Table 11: Total bat calls across summer and spring surveys.**

| Season | No. of bat calls per location | | | | | | Total calls |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| Summer 21 | 265 | 1525 | 631 | 272 | 588 | 281 | 3562 |
| % of calls | 7.4 | 42.8 | 17.7 | 7.6 | 16.5 | 7.9 | 100 |
| Spring 21 | 6471 | 8345 | 431 | 0 | 1258 | 2754 | 19259 |
| % of calls | 33.6 | 43.3 | 2.2 | 0 | 6.5 | 14.3 | 100 |

### 3.2.2. Relative abundance of bats

The relative abundance (or activity) of bats is usually measured by number of calls of different species per recording night, but such measure was not possible due to the very large number of calls recorded from common species and requires considerable effort to separate the individual species calls from each other. Instead, the percentage occurrence of each species over all recording nights was used in evaluating bat relative abundance (activity) at the study area.

### 3.2.3. Summer 2021

Records of bats during summer were made from six locations over six nights. Seven species of common and secure bats were positively identified and three species complexes. The number of recording nights each species or species complex was recorded was combined with the number of location(s) at which the species or species complex was observed to give and overall frequency of occurrence for each species or species complex. The results of this are shown in Table 12 and depicted graphically in

Figure 67.

The most abundant species recorded are listed below.

- Gould's Wattled Bat 91.7%
- Southern Free-tailed Bat 80.6%
- Free-tailed Bat complex 58.3%
- Little Forest Bat 47.2%
- Chocolate Wattled Bat 44.4%.

With all other species being detected from an average of 2.8% (rare species) to 41.7% (moderately abundant) over the six nights of recordings during the survey period.

### 3.2.4. Spring 2021

Records of bats during spring were made from five locations for a period varying from 24 to 29 nights. Nine species of common and secure bats were positively identified, and three species complexes were identified.

As in the summer survey, the number of recording nights each species or species complex was recorded was combined with the number of location(s) at which the species or species complex was observed to give and overall frequency of occurrence for each species or species complex. The results of this are shown in 3 and depicted graphically in Figure 7. The most abundant species recorded are listed below.

- Gould's Wattled Bat 90.4%

- Free-tailed Bat complex 83.5%
- Southern Free-tailed Bat 78.1%
- Chocolate Wattled Bat 72.9%
- Southern Forest Bat 67.3%.

With all other species being detected from an average of 3.4% (rare species) to 66.8% (moderately abundant) over the recording nights during the survey period.

The dominant bat species were almost the same during both seasons, with the highest counts for Gould's Wattled Bat and Free-tailed Bats. Similarly, activity was consistent across the six recording locations, with the same species dominating at each location, indicating the homogenous nature of habitats across the study area.

**Table 12: Percentage of detector nights each species was recorded across the six survey locations of recording during summer 2021.**

| Recording location/ No. nights of recording | Species of bats recorded at the six locations | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GWB | CWB | InFB | SFB | InBnB | WsFB | LiFB | FtBC | LeBC | FBC |
| 1 / 6 | 66.7 | 33.3 | | 16.7 | | | 50 | | | |
| 2 / 6 | 100 | 66.7 | | 100 | 16.7 | | 83.3 | 33.3 | 66.7 | 16.7 |
| 3 / 6 | 100 | 66.7 | | 100 | 66.7 | | 66.7 | 33.3 | 66.7 | 16.7 |
| 4 / 6 | 100 | | | 100 | | 16.7 | 33.3 | 83.3 | 33.3 | |
| 5 / 6 | 100 | 66.7 | | 100 | 33.3 | | 50 | 100 | 50 | 33.3 |
| 6 / 6 | 83.3 | 33.3 | 16.7 | 66.7 | 16.7 | | | 100 | 33.3 | 16.7 |
| Average | 91.7 | 44.4 | 2.8 | 80.6 | 22.2 | 2.8 | 47.2 | 58.3 | 41.7 | 13.9 |

**Notes**: GWB = Gould's Wattled Bat; CWB = Chocolate Wattled Bat; InFB = Inland Free-tailed Bat; SFB = Southern Free-tailed Bat; InBnB = Inland Broad-nosed Bat; WsFB = White-striped Free-tailed Bat; LiFB = Little Forest Bat; FtBC = Free-tailed Bat complex; LeBC = Long-eared Bat complex; FBC = Forest Bat complex.

**Table 13: Percentage of detector nights each species was recorded across five survey locations during spring 2021**

| Recording location/ No. nights of recording | Species of bats recorded at the five locations | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GWB | CWB | InBnB | LFB | LiFB | LeBC | InFB | FtBC | SFB | SoFB | FBC | WsFB |
| 1 / 29 | 89.7 | 89.7 | 58.6 | 17.2 | 48.3 | 3.4 | | 96.6 | 93.1 | 86.2 | 69 | 41.4 |
| 2 / 28 | 96.4 | 92.9 | 89.3 | | 85.7 | 64.3 | | 100 | 82.1 | 89.3 | 32.1 | 60.7 |
| 3 / 24 | 91.7 | 33.3 | 91.7 | | 20.8 | | | 20.8 | | 8.3 | 4.2 | |
| 5 / 25 | 87 | 69.6 | 69.6 | | 73.9 | 21.7 | 8.7 | 100 | 65.2 | | 21.7 | 34.8 |
| 6 / 24 | 87.5 | 79.2 | 25 | | 25 | 33.3 | 4.2 | 100 | 95.8 | | 33.3 | 41.7 |
| Average | 90.4 | 72.9 | 66.8 | 3.4 | 50.7 | 24.6 | 2.6 | 83.5 | 67.3 | 36.8 | 32.1 | 35.7 |

**Notes**: GWB = Gould's Wattled Bat; CWB = Chocolate Wattled Bat; InBnB = Inland Broad-nosed Bat; LFB = Large Forest Bat; LiFB = Little Forest Bat; LeBC = Long-eared Bat complex; InFB = Inland Free-tailed Bat; FtBC = Free-tailed Bat complex; SFB = Southern Free-tailed Bat; SoFB = Southern Forest Bat; FBC = Forest Bat complex; WsFB = White-striped Free-tailed Bat.

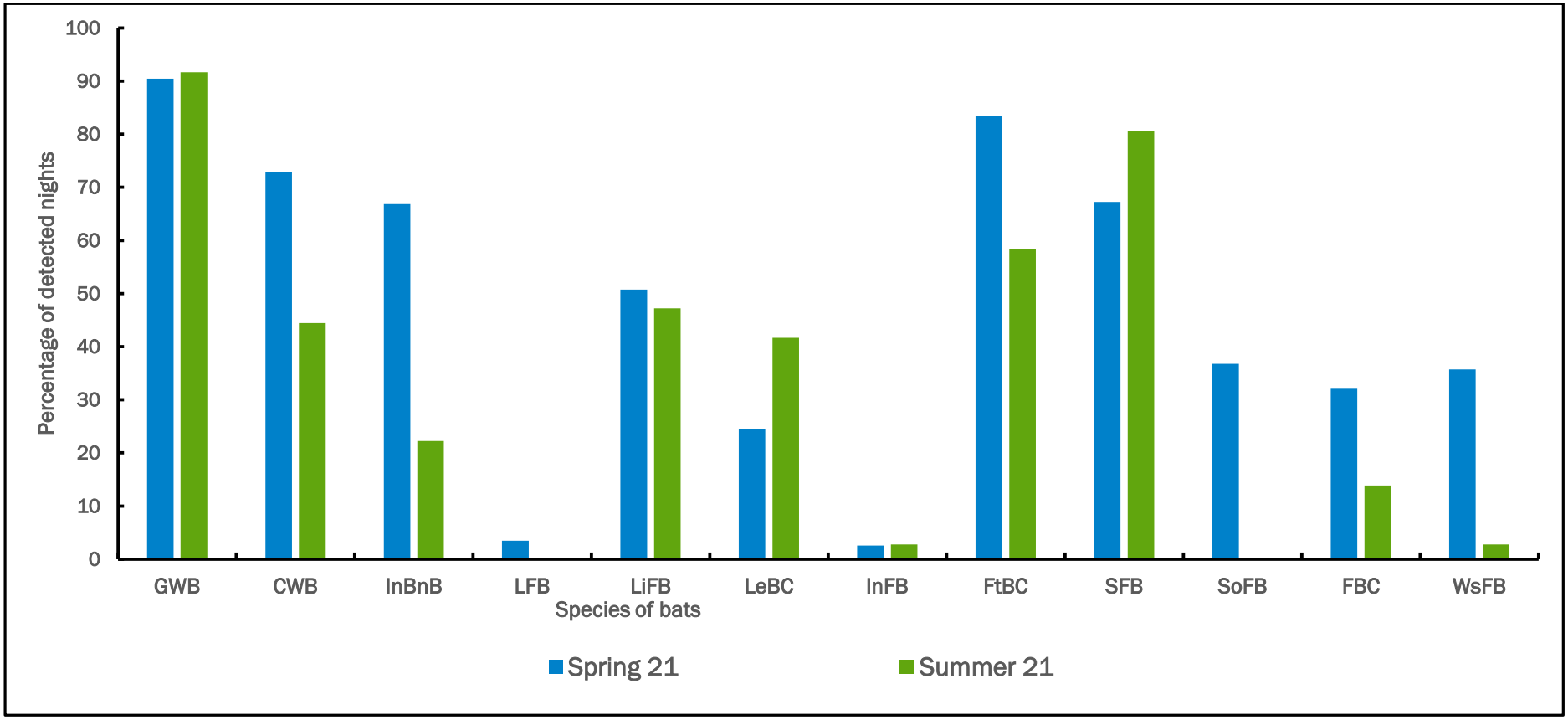



**Figure 7: Percentage of detector nights each species was recorded across the combined summer and spring 2021 surveys**

Number of nights of recordings and species abbreviations as in Table 13 and 13.

# 4. Conclusions and recommendations

The conclusions from the BUS and Bat surveys of the proposed Junction Rivers Wind Project are presented below.

## 4.1. Bird utilisation summary

The study area largely consists of cleared agricultural land with corridors of woodland within road reserves and along fence lines. The study area also has patches of remnant woodland and scattered trees within large cropping paddocks. The combination of open and woodland habitats supports a relatively high diversity of common farmland and woodland birds and this is reflected in the wide range of species observed within the study area. A total of 81 species including one genus (*Corvus*) were recorded during the combined eight seasonal surveys over two years of observations. In 2021 and 2022, 62 and 73 species (including *Corvus*) respectively, were recorded over the two-year period. Records of nine raptor species and six threatened species were made over the two years of survey. Only a small proportion of all flights at impact points (6.6%) were within RSA height. The five most common species flying with this height range at impact points were Little Raven, Fairy Martin, Galah, Australian Raven and Wedge-tailed Eagle.

The cumulative count of birds recorded flying at RSA height was varied for the four seasons with higher utilisation rates in autumn and summer for birds observed flying at RSA height. Little Ravens were observed flying at RSA height during autumn in both 2021 and 2022, and Galah was observed flying at RSA height during autumn and winter in 2021. There were no other observable consistencies between years or seasons, but there were large flocks (Fairy Martin and Australian Raven) recorded flying at RSA height in 2022. Raptors were not common at RSA height. The Wedge-tailed Eagle was observed flying at RSA height during the winter survey of both 2021 and 2022 which correlated with the lambing season but were also observed flying at RSA height in low numbers during autumn and summer in 2022, suggesting that the species has multiple resident pairs within or close to the study area.

The five threatened species recorded during formal surveys and incidentally were:

### *4.1.1. Black Falcon*

The Black Falcon is listed as Vulnerable under the BC Act of New South Wales. They are partly dispersive, with migratory movements heavily reliant on seasonal conditions and food availability. They are attracted to plagues of locusts and other abundant food sources, but apparently not attracted to plagues of mice (Marchant and Higgins 1993). They are found along tree-lined watercourses and in isolated woodland patches, open country including farmland, cropland, and terrestrial wetlands of tropical and temperate Australia. The stronghold of the species is within arid and semi-arid zones, generally below 500 metres above sea level (Marchant and Higgins 1993, Debus et al 2017).

### *4.1.2. Major Mitchell's Cockatoo*

Major Mitchell's Cockatoo is listed as Vulnerable under the BC Act of New South Wales. This species is uncommon and patchily distributed across arid and semi-arid inland woodland and treeless habitats (Menkhorst et al. 2017). This species feeds on a wide variety of seeds of native saltbush, *Acacia* spp., *Callitris* spp. and exotic melons. Established pairs and small family groups tend to be resident with large home ranges (Menkhorst et al. 2017). Nature Advisory has proposed that it is likely the species breeds within the study area. The observations onsite are focused along the eastern and western sides of the windfarm boundary as indicated in Figure 4. The species is likely to occur over most if not all of the study area. The current records are focused on BUS points and easily accessed roadways that were regularly driven while onsite and does not suggest the species does not occur elsewhere. However, the species may prefer locations that are lightly wooded or have more structurally complex plant community types.

#### 4.1.3. Regent Parrot

Regent Parrot is listed as Vulnerable under the EPBC Act and Endangered under the BC Act of New South Wales. This species breeds in riverine forests of River Red Gum (*Eucalyptus camaldulensis*) and forages widely in mallee and agricultural landscapes (Menkhorst et al. 2017). Corridors of tree cover are required for commuting between breeding and feeding areas. Although we consider the risk to this species to be low, the potential threat to the population is unclear at this stage as we are unclear as to how the species is occupying the windfarm study area. As a result, species has been subject to a separate investigation by Nature Advisory to determine the extent to which the species is utilising the windfarm study area. The results of that assessment will be presented in a separate report.

#### 4.1.4. Spotted Harrier

The Spotted Harrier is listed as Vulnerable under the BC Act of New South Wales. The species is often observed in grassy open woodland, inland riparian woodland, grassland, shrubland and remnants within these vegetation communities (OEH 2023b). This species prefers habitat that is unobstructive to low flight, being regularly observed in native grasslands and agricultural land. It has also been observed hunting over the edges of inland wetlands (OEH 2023b). This species is likely to range across the entire study area while hunting for prey. It was observed onsite flying well below RSA height and is considered a low collision risk. It is unlikely to be deterred by operational turbines.

#### 4.1.5. White-fronted Chat

White-fronted Chat is listed as Vulnerable under the BC Act of New South Wales. This species is found in small groups near damp salt-pan samphire flats and other inland habitats (Menkhorst et al. 2017). This species feeds on insects, spiders, *Acacia* seeds and nectar. This species forages primarily on or close to ground level and inhabits low-growing vegetation. It is unlikely this species will fly at the proposed RSA height and is a minimal risk of colliding with operating turbines. It also unlikely to be impacted any barrier effects from constructed turbines.

#### 4.1.6. Raptors

The study area supports 10 raptors species, very few of which are considered vulnerable to collision with operating wind turbines. The utilisation rates of Wedge-tailed Eagle were low during both years of survey, being recorded eight times at impact locations and four (two in 2021, and six in 2022) times at reference locations (four in 2022). Turbines should be located at least 200 metres from Wedge-tailed Eagle nesting sites. These nests have not been observed onsite, but the behaviour seen suggests there may be. We suggest a roaming survey to ascertain the data.

Aside from the Wedge-tailed Eagle, the Brown and Black Falcon were the only other raptor species to be observed flying at RSA height. The Brown Falcon was observed in low numbers across the two years (n=9), including once at RSA. The flight and foraging behaviour of this species suggest that it has overall low collision risk, as it often forages on the ground and is seen perched on fence posts at ground level.

The Black Falcon was observed twice in 2022, once at a reference point and once off site. Both occurrences were incidental observations. The record at reference point 1 was of the individual drinking from a livestock trough and then flying low. The observation offsite shows the individual flying at RSA height. While this observation was not recorded within the proposed windfarm boundary, this species is highly mobile – moving in response to food availability and seasonal conditions (Marchant and Higgins 1993). The two observations were made during the beginning and middle of the Black Falcon breeding season (June to December).

Nankeen Kestrel are common across farmland environments and were observed 23 times during surveys, but never at RSA height The species behaviour suggests that while it likely will be present during and post-construction, it poses a low risk of collision.

The results from the BUS support a Before-After-Control-Impact (BACI) monitoring framework.

The results of this BUS add to the baseline data. The Commonwealth have provided interim advice for assessing impacts on birds and bats at wind farms (DAWE 2022). The interim advice state that bird utilisation surveys are to be undertaken for each relevant season over a minimum of two years. The current assessments have complied with the Commonwealth interim advice.

## 4.2. Bat summary

Survey effort and findings from this survey are summarised below.

Two surveys were undertaken; first in summer 2021 (22–27/02/2021); and second in spring (2–30/11/2021). Bat call recording was made using Song Meter detectors distributed across all habitat types on the proposed wind farm study area. Bat recordings were undertaken at six locations during summer and spring surveys. A total of 36 detector-nights, totalling 432 recording-hours and 130 detector-nights totalling 1560 recording-hours of recordings were made during summer and spring surveys, respectively.

A total of nine bat species were positively identified. Calls that could not be definitively assigned to a species were attributed to a species complex. All species of bat recorded were common, secure, and widespread bat species that occur in farmland and other habitats throughout eastern and south-eastern Australia. One species complex identified may include N. corbenii which is listed under the BC Act and EPBC Act. Further work may be warranted to clarify the presence or absence of this species within the study area.

The three most common species on the wind farm during both seasons of the survey, in order of activity levels were: Gould's Wattled Bat, Southern Free-tailed Bat and Free-tailed Bat complex. The White-striped Free-tailed Bat, a species of special interest was not commonly recorded at the study area and recorded only in spring survey.

The results of this bat survey add to the baseline data. The Commonwealth have provided interim advice for assessing impacts on birds and bats at wind farms (DAWE 2022). The interim advice state that bat surveys are to be undertaken for each relevant season over a minimum of two years. The current assessment presents results for two seasons over one year. As no threatened bat species were recorded or considered likely to occur no further surveys are recommended.

## 4.3. Recommendations

New models of turbines, including those with the height of the lowest tip of blades between 50-70 are noted as likely to have lesser impacts on bats when compared to those constructed at lower minimum RSA heights. As the wind farm is in the design stage the proponents are encouraged to ensure the minimum RSA is not lower than 50 metres above the ground to avoid and minimise impacts to the majority of bird and bat species. We recommend also recommend the following actions:

### *4.3.1. Raptors*

- Undertake a stick nest survey to locate any active raptor nests within 200 metres of proposed turbine positions.
- Establish a 200-metre turbine free zone around any confirmed nesting locations of threatened raptors and Wedge-tailed Eagle.

### 4.3.2. Major Mitchell's Cockatoo

- Clearly identify hollow bearing trees that may be suitable nesting locations for Major Mitchell's Cockatoo within the development corridor and any other impacted areas of the windfarm site.
- Nest hollows should be clearly marked and avoided during any vegetation removal. Buffers should be placed around established breeding locations.

### 4.3.3. Regent Parrot

- Enact the 100-metre turbine free buffer as proposed by Nature Advisory.
- Avoid the removal of suitable foraging and roosting habitat for the Regent Parrot.
- Ensure a 100-metre turbine free buffer (from blade tip) around all areas of suitable foraging and roosting habitat (Mallee woodland) present within the study area and along the western boundary of the study area is maintained.
- Nature Advisory advises that habitat surveys be undertaken to identify all possible areas of important roosting and foraging habitat (not identified by Nature Advisory) to ensure these areas are not impacted during construction or subject too ongoing disturbance.
- Clearly mark established foraging and roosting habitat zones and buffers for Regent Parrot and indicate that these areas are no-go zones to avoid being impacted during construction and operation throughout the life of the windfarm.
- A Bird and Bat Adaptive Management Plan will need to be developed and a monitoring program designed and implemented to monitor impacts on the Regent Parrot and Major Mitchell's Cockatoo.

### 4.3.4. Bird and Bat Adaptive Management Plan

- It is a requirement that a Bird and Bat Adaptive Management Plan be produced for the project that includes a BACI monitoring program using the established BUS and bat survey points.

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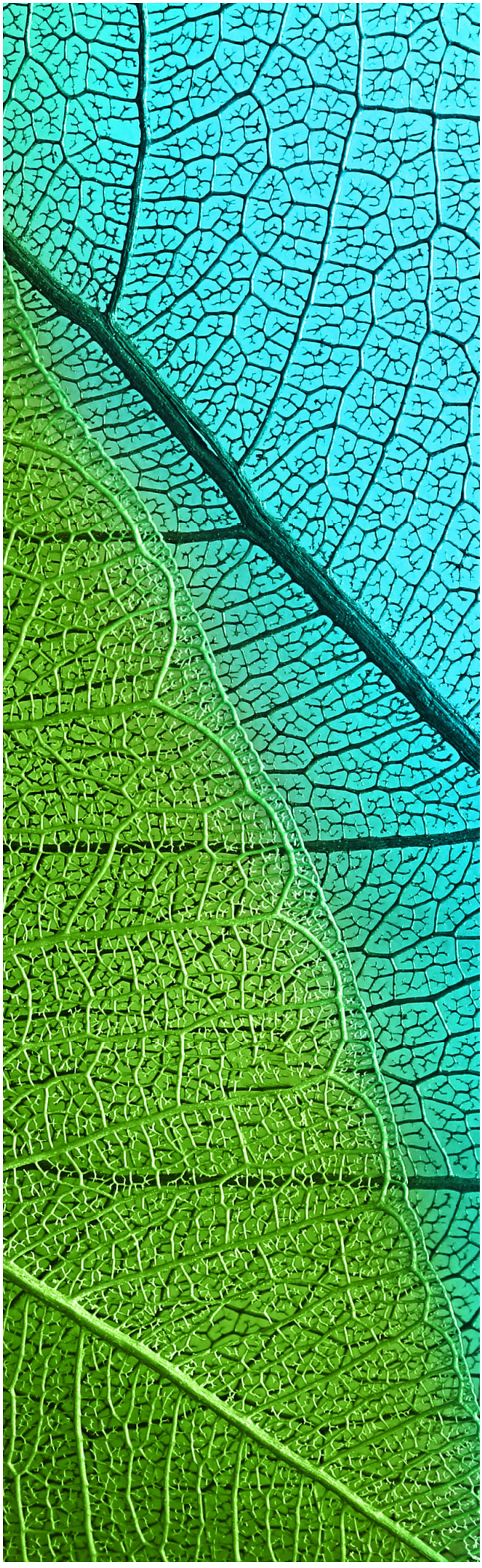
**Appendix 1: Raw data for the two years of BUS survey at impact and reference points at Junction Rivers Wind Project**

Raw data file sent to client. Further copies available on request with approval from Wind Lab.

## Appendix 2: Table of results classifying all recorded species into representative categories at Junction Rivers Wind Project

| Common Name | Scientific Name | Count | EPC Act | BC Act | Resident Raptor | Resident threatened aerial | Migratory/Nomadic |
|---|---|---|---|---|---|---|---|
| Apostlebird | *Struthidea cinerea* | 326 | | | | | |
| Australasian Pipit | *Anthus novaeseelandiae* | 42 | | | | | |
| Australian Magpie | *Cracticus tibicen* | 809 | | | | | |
| Australian Pelican | *Pelecanus conspicillatus* | 2 | | | | | ✓ |
| Australian Raven | *Corvus coronoides* | 333 | | | | | |
| Australian Ring-necked Parrot | *Barnardius zonarius* | 58 | | | | | |
| Australian Wood Duck | *Chenonetta jubata* | 7 | | | | | |
| Banded Lapwing | *Vanellus tricolor* | 10 | | | | | ✓ |
| Black Falcon | *Falco subniger* | 2 | | V | | | ✓ |
| Black Kite | *Milvus migrans* | 8 | | | | | |
| Black Swan | *Cygnus atratus* | 7 | | | | | ✓ |
| Black-faced Cuckoo-shrike | *Coracina novaehollandiae* | 71 | | | | | |
| Black-faced Woodswallow | *Artamus cinereus* | 6 | | | | | |
| Black-shouldered Kite | *Elanus axillaris* | 12 | | | ✓ | | |
| Bluebonnet | *Northiella haematogaster* | 1190 | | | | | |
| Blue-faced Honeyeater | *Entomyzon cyanotis* | 5 | | | | | |
| Brown Falcon | *Falco berigora* | 13 | | | ✓ | | |
| Brown Goshawk | *Accipiter fasciatus* | 1 | | | | | |
| Brown Songlark | *Cincloramphus cruralis* | 68 | | | | | ✓ |
| Brown-headed Honeyeater | *Melithreptus brevirostris* | 4 | | | | | |
| Buff-rumped Thornbill | *Acanthiza reguloides* | 5 | | | | | |
| Chestnut-crowned Babbler | *Pomatostomus ruficeps* | 232 | | | | | |
| Chestnut-rumped Thornbill | *Acanthiza uropygialis* | 156 | | | | | |
| Cockatiel | *Nymphicus hollandicus* | 17 | | | | | ✓ |
| Common Bronzewing | *Phaps chalcoptera* | 3 | | | | | |
| Common Starling | *Sturnus vulgaris* | 21 | | | | | |
| Corvid spp. | | 36 | | | | | |
| Crested Pigeon | *Ocyphaps lophotes* | 393 | | | | | |
| Eastern Rosella | *Platycercus eximius* | 22 | | | | | |
| Emu | *Dromaius novaehollandiae* | 5 | | | | | |
| Fairy Martin | *Petrochelidon ariel* | 116 | | | | | ✓ |
| Galah | *Eolophus roseicapilla* | 749 | | | | | |
| Golden Whistler | *Pachycephala pectoralis* | 3 | | | | | |
| Great Cormorant | *Phalacrocorax carbo* | 48 | | | | | |
| Grey Butcherbird | *Cracticus torquatus* | 99 | | | | | |
| Grey Fantail | *Rhipidura albiscapa* | 1 | | | | | |
| Grey Shrike-thrush | *Colluricincla harmonica* | 10 | | | | | |
| Ground Cuckoo-shrike | *Coracina maxima* | 25 | | | | | |
| Little Raven | *Corvus mellori* | 422 | | | | | |
| Little Wattlebird | *Anthochaera chrysoptera* | 4 | | | | | |
| Magpie-lark | *Grallina cyanoleuca* | 167 | | | | | |
| Major Mitchell's Cockatoo | *Lophochroa leadbeateri* | 93 | | V | | ✓ | |
| Masked Woodswallow | *Artamus personatus* | 12 | | | | | ✓ |
| Mistletoebird | *Dicaeum hirundinaceum* | 2 | | | | | ✓ |
| Musk Lorikeet | *Glossopsitta concinna* | 2 | | | | | ✓ |
| Nankeen Kestrel | *Falco cenchroides* | 27 | | | ✓ | | |
| Noisy Miner | *Manorina melanocephala* | 295 | | | | | |
| Peregrine Falcon | *Falco peregrinus* | 3 | | | ✓ | | |
| Pied Butcherbird | *Cracticus nigrogularis* | 92 | | | | | |
| Rainbow Bee-eater | *Merops ornatus* | 23 | | | | | ✓ |
| Red Wattlebird | *Anthochaera carunculata* | 2 | | | | | |
| Red-rumped Parrot | *Psephotus haematonotus* | 229 | | | | | |
| Regent Parrot | *Polytelis anthopeplus* | 102 | V | En | | ✓ | |

| Common Name | Scientific Name | Count | EPC Act | BC Act | Resident Raptor | Resident threatened aerial | Migratory/Nomadic |
|---|---|---|---|---|---|---|---|
| Restless Flycatcher | *Myiagra inquieta* | 11 | | | | | ✓ |
| Rufous Songlark | *Cincloramphus mathewsi* | 41 | | | | | ✓ |
| Silvereye | *Zosterops lateralis* | 4 | | | | | ✓ |
| Singing Honeyeater | *Lichenostomus virescens* | 67 | | | | | |
| Southern Whiteface | *Aphelocephala leucopsis* | 7 | | | | | |
| Spiney-cheeked Honeyeater | *Acanthagenys rufogularis* | 96 | | | | | |
| Splendid Fairy-wren | *Malurus splendens* | 3 | | | | | |
| Spotted Harrier | *Circus assimilis* | 2 | | V | | | ✓ |
| Spotted Pardalote | *Pardalotus punctatus* | 3 | | | | | |
| Straw-necked Ibis | *Threskiornis spinicollis* | 3 | | | | | ✓ |
| Striated Pardalote | *Pardalotus striatus* | 36 | | | | | |
| Stubble Quail | *Coturnix pectoralis* | 10 | | | | | |
| Sulphur-crested Cockatoo | *Cacatua galerita* | 1 | | | | | |
| Superb Fairy-wren | *Malurus cyaneus* | 1 | | | | | |
| Wedge-tailed Eagle | *Aquila audax* | 23 | | | | | |
| Weebill | *Smicrornis brevirostris* | 37 | | | | | |
| Welcome Swallow | *Hirundo neoxena* | 8 | | | | | |
| Whistling Kite | *Haliastur sphenurus* | 4 | | | | | |
| White-browed Babbler | *Pomatostomus superciliosus* | 10 | | | | | |
| White-browed Woodswallow | *Artamus superciliosus* | 99 | | | | | ✓ |
| White-fronted Chat | *Epthianura albifrons* | 12 | | V | | | |
| White-necked Heron | *Ardea pacifica* | 2 | | | | | ✓ |
| White-plumed Honeyeater | *Ptilotula penicillata* | 17 | | | | | |
| White-winged Chough | *Corcorax melanorhamphos* | 125 | | | | | |
| White-winged Fairywren | *Malurus leucopterus* | 5 | | | | | |
| Willie Wagtail | *Rhipidura leucophrys* | 32 | | | | | |
| Yellow-faced Honeyeater | *Lichenostomus chrysops* | 6 | | | | | |
| Yellow-plumed Honeyeater | *Lichenostomus ornatus* | 2 | | | | | |
| Yellow-rumped Thornbill | *Acanthiza chrysorrhoa* | 59 | | | | | |
| Yellow-throated Miner | *Manorina flavigula* | 599 | | | | | |
| **Grand Total** | | **7715** | | | | | |



# Junction Rivers Wind Project

## Initial Bird and Bat Risk Assessment

**Prepared for Windlab Pty Ltd**

February 2024
Report No. 20195.04 (2.2)

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# 1. Introduction

The aim of this risk assessment is to inform the impact assessment of the proposed Junction Rivers Wind Project (BWF)by identifying those species or groups of birds and bats considered at potential risk of collision with turbines. We also examine the potential impact on birds and bats that may be subject to disturbance and/or barrier effects posed by constructed wind turbines. The outcomes of this risk assessment enable targeted monitoring and assessment of key species to be considered in the preparation of the impact assessment for Junction Rivers Wind Project.

In addition to the threat of direct loss of habitat from windfarm construction, wind farm impacts on birds and bats can arise from three potential pathways listed below:

- Direct collision of birds and bats with operating wind turbine blades or towers at rotor swept area (RSA) heights;
- Disturbance effects that exclude birds and bats from habitat; and
- Barrier effects that limit bird and bat movements between essential resources, such as foraging and roosting areas.

The risk assessment has followed the procedure for risk assessment of AS ISO 31000 2018. The assessment has been undertaken as follows:

- Species or groups of concern have been short-listed based on their likelihood of occurrence at the site;
- Two impact pathways have been assessed: a) collision with turbines; and b) indirect effects (including both disturbance and barrier effects);
- Impact likelihood criteria have been developed and applied to each impact pathway for each species or group of concern;
- Impact consequence criteria have been developed and applied to each impact pathway for each species or group of concern; and
- The risk level for each species or group of concern from the two impact pathways has been determined consistent with a risk matrix.

We have endeavoured to include

This report presents the results of this risk assessment under the headings below.

**Section 2** summarises the sources of information used to understand the likelihood of occurrence of each species or group on the BWF site and their likely behaviour on the site.

**Section 3** lists the species of concern that have been subject to this risk assessment.

**Section 4** provides an overview of the risk assessment method adopted, including the likelihood and consequence criteria and the risk matrix.

**Section 5** presents the results and conclusions of the risk assessment and identifies the focus for the BBAMP for BWF.

This report was prepared by a team from Nature Advisory Pty Ltd including; Eamon O'Meara (Zoologist), Clinton Schipper (Zoologist), Gavin Thomas (Senior Ecologist - team leader (NSW)), Bernard O'Callaghan (Director),and Brett Lane (Managing Director).

# 2. Sources of Information

## 2.1. Sources of information on bird and bats

To ascertain the species of concern that may occur on the BWF site the following sources were used:

- The NSW BioNet Atlas Search tool (OEH 2021a), using a 10-kilometre search region from the boundary of the BWF site, with limits being -34.69° to -34.96°S, 143.46° to 143.96°E (searched in November 2021);
- The EPBC Act Protected Matters Search Tool (PMST) using a search region that included the proposed site and a 10-kilometre buffer from the boundaries of BWF, i.e. -34.7629° to -34.9019°S, 143.4999° to 143.7125°E (Department of the Agriculture Water and the Environment 2020); and,
- The bird utilisation survey data that were collected by Nature Advisory over eight seasonal surveys from 2021- 22.
- The analysed data from acoustic monitoring for bats conducted during 2021 and 2022.
- Where appropriate we endeavoured to included information pertaining to species identified by Biosis Pty Ltd during their assessment of the windfarm site. These species are included in our assessment below and are identified as such.

## 2.2. Proposed models for turbines

It is understood that the proposed size of the turbines of the BWF is based on the turbine number and dimensions in Table 1 below. This initial risk assessment is based on these specifications.

Table 1: Proposed turbine specifications for the Junction Rivers Wind Project.

| | Representative turbine |
|---|---|
| No of turbines | 107 turbines |
| Rotor radius | 100 metres |
| Max upper RSA (tip) | 300 metres |
| Hub Height (max) | 200 metres |
| Absolute Lower Minimum RSA | 50 metres |
| Total Rotor Swept Area / turbine ($m^2$) | 31,416$m^2$ |

# 3. Species and groups of concern

Species of concern are those that are known, likely or have the potential to occur on the windfarm site that are listed as threatened or migratory under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) or threatened under the NSW *Biodiversity Conservation Act 2016* (BC Act) or that are known to be particularly vulnerable to wind turbine impacts. The species that have been the subject of this risk assessment include the following:

- Species listed as threatened under legislation;
- Species known to be vulnerable to collision with turbines based on collision data from other wind farms in eastern Australia; and
- Species for which a population concentration, or a population of significance, occurs on the site and that species may exhibit "risk behaviour" and potentially interact with the operating turbines.

Most listed threatened and migratory waterbirds have been assessed and considered unlikely to occur based on a lack of suitable habitat on the windfarm site. Most migratory shorebirds occur along open coastal shorelines or inland lakes sometimes requiring dense vegetation and muddy substrate (e.g., Australian Painted Snipe *Rostratula australis*); these habitats are absent and therefore these species are unlikely to occur at the site and or be impacted. The short-listed species and groups are presented in Table 2. This table excludes such species from further consideration, even though they appeared in the EPBC Act Protected Matters Search Tool (PMST) output, or there are records in the search region (e.g. NC Act listed waterbird species). Excluded species are highlighted in grey.

Note that Night Parrot is extinct in south-eastern Australia and Regent Honeyeater occurs well south and east of the site so these are also excluded from further consideration. The PMST also failed to nominate the White-throated Needletail as likely to occur in the search region; this is because it generally avoids the arid and semi-arid parts of Australia when in Australia for the northern hemisphere non-breeding season. The site lies beyond the usual range of the species and it is therefore not considered to warrant short-listing.

Table 2: Risk assessment – Short-listed bird and bat species

| EPBC Act Listed Migratory Species |
|---|
| ▪ Common Greenshank<br>▪ Common Sandpiper<br>▪ Fork-tailed Swift<br>▪ Latham's Snipe<br>▪ Pectoral Sandpiper<br>▪ Sharp-tailed Sandpiper<br>▪ White-throated Needletail<br>▪ Yellow Wagtail |
| **EPBC Act and BC Act listed threatened birds** |
| ▪ Australasian Bittern (Endangered – EPBC & BC Act)<br>▪ Australian Painted Snipe (Critically Endangered – EPBC Act & Endangered – BC Act)<br>▪ Curlew Sandpiper (Critically Endangered – EPBC Act & Endangered – BC Act)<br>▪ Eastern Curlew (Critically Endangered – EPBC Act & Endangered – BC Act)<br>▪ Grey Falcon (Vulnerable – EPBC Act & Endangered – BC Act)<br>▪ Malleefowl (Vulnerable – EPBC Act & Endangered – BC Act)<br>▪ Night Parrot (Endangered – EPBC Act & Extinct – BC Act)<br>▪ Painted Honeyeater (Vulnerable – EPBC Act & BC Act)<br>▪ Plains Wanderer (Critically Endangered – EPBC Act & BC Act)<br>▪ Regent Honeyeater (Critically Endangered – EPBC Act & BC Act) |

- Regent Parrot (Vulnerable – EPBC Act & Endangered – BC Act)
- Superb Parrot (Vulnerable – EPBC Act & BC Act)
- Swift Parrot (Critically Endangered – EPBC Act & Endangered – BC Act)

**EPBC Act and BC Act listed threatened bats**

- Corben's Long-eared Bat (Vulnerable – EPBC Act & BC Act)

**BC Act listed threatened birds**

- Australian Bustard (Endangered)
- Barking Owl (Vulnerable)
- Black Falcon (Vulnerable)
- Black-breasted Buzzard (Vulnerable)*
- Black-chinned Honeyeater (Vulnerable)
- Black-eared Miner (Critically Endangered) *
- Black-tailed Godwit (Vulnerable)
- Blue-billed Duck (Vulnerable)
- Brolga (Vulnerable)
- Brown Treecreeper (Vulnerable)
- Bush Stone-curlew (Endangered)
- Chestnut Quail-thrush (Vulnerable)
- Diamond Firetail (Vulnerable)
- Dusky Woodswallow (Vulnerable)
- Flame Robin (Vulnerable)
- Freckled Duck (Vulnerable)
- Gilbert's Whistler (Vulnerable)
- Grey-crowned Babbler (Vulnerable)
- Hooded Robin (Vulnerable)
- Little Eagle (Vulnerable)
- Magpie Goose (Vulnerable)
- Major Mitchell's Cockatoo (Vulnerable)
- Masked Owl (Vulnerable)
- Pied Honeyeater (Vulnerable)
- Purple-crowned Lorikeet (Vulnerable)
- Purple-gaped Honeyeater (Vulnerable)
- Red-lored Whistler (Endangered)*
- Redthroat (Vulnerable)
- Rufous Fieldwren (Vulnerable)
- Scarlet Robin (Vulnerable)
- Speckled Warbler (Vulnerable)
- Spotted Harrier (Vulnerable)
- Square-tailed Kite (Vulnerable)
- Striated Grasswren (Critically Endangered) *
- Turquoise Parrot (Vulnerable)
- Varied Sitella (Vulnerable)
- White-bellied Sea-Eagle (Vulnerable)*
- White-fronted Chat (Vulnerable)

**BC Act listed threatened bats**

- Inland Forest Bat (Vulnerable
- Little Pied Bat (Vulnerable)
- Southern Myotis (Vulnerable)
- Yellow-bellied Sheathtail Bat (Vulnerable)

**Bird species (NSW *National Parks and Wildlife Act 1967*)**

- Raptors – includes Black-shouldered Kite, Brown Falcon, Brown Goshawk, Nankeen Kestrel, Peregrine Falcon, Wedge–tailed Eagle, Whistling Kite

| Bat species (NSW *National Parks and Wildlife Act 1967*) |
| --- |
| ▪ Gould's Wattled Bat<br>▪ White-striped Freetail Bat |

*Biosis record introduced for analysis

A risk assessment was undertaken for each of the foregoing species and groups and is presented in Section 5.

# 4. Risk Assessment Process

The risk assessment process was based on the Risk Evaluation Matrix Model used to measure the overall risk of a potential impact event on the local population of the species of concern (i.e., within and adjacent to the wind turbines, where monitoring is undertaken), in this case birds or bats striking wind turbine blades or being deterred from using part of the wind farm due to disturbance or barrier effects. The assessment is based on the likelihood of that event, and should it occur, its consequences. This model is currently used across a wide range of industry sectors, in particular for assessing environmental risk.

The Risk Evaluation Matrix Model also complies with the AS ISO 31000:2018 Risk Management Guidelines. The risk assessment will continue to be reviewed and updated following the completion of the baseline reports, as well as following the completion of each annual monitoring report, to ensure that the monitoring and mitigation measures are adaptive.

The assessment requires criteria to be developed for likelihood and consequence. These criteria are provided respectively in Table 3 and Table 4. Table 5 shows the risk levels used and how they are determined from the assessed likelihood and consequence levels.

Table 3: Likelihood criteria for a risk event to occur

| Likelihood | Description |
|---|---|
| Certain | It is very probable that the risk event could occur in any year (>95%) |
| Almost Certain | It is more probable than not that the risk event could occur in any year (>50%) |
| Likely | It is equally probable that the risk event could or could not occur in any year (50%) |
| Unlikely | It is less probable than not that the risk event could occur in any year (<50%) |
| Rare | It is improbable that the risk event could occur in any year. (<5%)<br>The risk event is only theoretically possible, or would require exceptional circumstances to occur. |

Table 4: Consequence Criteria

| Negligible | Low | Moderate | High | Severe |
|---|---|---|---|---|
| Occasional individuals lost but no reduction in population viability. | Repeated loss of small numbers of individuals but no reduction in population viability. | Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. | Major loss in numbers of individuals, leading to reduction in population viability for between five and ten years. | Extreme loss in numbers of individuals, leading to reduction in population viability for a period of at least 10 years |

Table 5: Risk matrix defining risk level based on likelihood and consequence

| | | Consequence | | | | |
|---|---|---|---|---|---|---|
| | | Negligible | Low | Moderate | High | Severe |
| Likelihood | Certain | Negligible | Low | High | Severe | Severe |
| | Almost Certain | Negligible | Low | Moderate | High | Severe |
| | Likely | Negligible | Low | Moderate | High | High |
| | Unlikely | Negligible | Negligible | Low | Moderate | High |
| | Rare | Negligible | Negligible | Negligible | Low | Low |

The relevant likelihood and consequence levels were determined by using data recorded from the wind farm site and with reference to any available information on the population and distribution of the species and bird groups concerned (see Section 2.1).

# 5. Risk Assessment Results

Table 6 provides the detailed results of the initial risk assessment, including evaluation of the impacts of the project on each species against the foregoing likelihood and consequence criteria. It includes the following information as part of the risk assessment process:

- Environmental value to be protected;
- Reasons for inclusion;
- Threatened species status;
- Hazard (i.e., turbine collision or indirect disturbance);
- Consequence and likelihood scores for each hazard;
- Risk rating; and
- Comments relating to risk rating scores.

The risk associated with wind turbine collision and indirect effects at the BWF for most assessed bird and bat species was rated as **negligible**. The exceptions are described below.

## 5.1. Threatened bird species

Historic records of the **Black Falcon** (*Falco subniger*) would indicate that this species is rare in BWF search region with only one record listed in BioNet (DPIE 2021). However, during the two years of baseline surveys at the wind farm site the species has been recorded twice (both in 2022) by Nature Advisory. Both records were incidental observations on the western side of the proposed wind farm and occurred during the excepted breeding period of the species. In one instance the species was recorded flying at RSA height. The **Black Falcon** is a highly mobile species and it's not clear from the few records made by Nature Advisory if the species is resident in the area. The **Black Falcon** is at risk of colliding with operating turbines, however we consider the overall risk of a collision event to be unlikely and the consequence to the species as a whole from a collision event continues to be **low**. Impacts to a local population would however be considered to be higher. Consideration should be given to conducting targeted surveys in the event that the species is recorded within the study area in the future. Survey efforts should focus on assessing if the species is breeding on or in the vicinity of the wind farm and how it is utilising the area.

The **Fork-tailed Swift** (*Apus pacificus*) migrates from north-east Asia and flies regularly at turbine height. Flocks may pass over the BWF site during the warmer months of November to April. Collisions have been recorded at wind farms elsewhere in NSW and eastern Australia. The risk to this species from the BWF is considered to be **low** as the species has only been recorded once within the BWF search region (DPIE 2021), however, if it was to occur frequently at the site, this species is considered almost certain to collide with operating turbines resulting in a moderate loss of individuals, leading to minor reduction in population viability for between one and five years.

The **Little Eagle** (*Hieraaetus morphnoides*) is rare in the BWF search region with only one record listed in BioNet (DPIE 2021). This raptor species has shown a 50% decline in numbers in NSW over three generations and is considered to have a low recruitment rate (Debus 2017). The species was not recorded by Nature Advisory during two years of baseline surveys. We consider the study area to be habitat for the species and is likely to utilise the area at low frequency and/or density in the future. The Little Eagle is considered to be at risk of collision, however the risk of a collision event is considered unlikely and the risk to the species continues to be **low**.

The **Major Mitchell's Cockatoo** (*Lophochroa leadbeateri*) has been recorded regularly over the two years of survey at the proposed wind farm. Nature Advisory considers the species breeds within the study area. The species was not recorded at RSA height throughout the surveys in 2021 and 2022. The numerous records of the species are examined in more detail in the baseline bird and bat for the proposed Junction Rivers Wind Project (Nature Advisory 2023). Despite the large number of individuals recorded we consider the collision risk to the unlikely and the consequence to the overall population is **low.** Given the species is considered resident and breeds on the study area impacts on the local population from potential clearing of hollow bearing trees and foraging habitat is likely to adversely affect the species.

The **Regent Parrot** (*Polytelis anthopeplus monarchoides*) has been recorded regularly over the two years of survey at the proposed wind farm. The species was not recorded at RSA height throughout the surveys in 2021 and 2022. The numerous records of the species are examined in more detail in the baseline bird and bat for the proposed Junction Rivers Wind Project (Nature Advisory 2023). The species has also been subject to a separate investigation and reporting by Nature Advisory. We consider the collision risk to be unlikely and the affect on the population to be moderate. Nature Advisory has proposed measures (in the form of no-go buffer zones around important habitat) to mitigate possible impacts to the species and these have been adopted by Windlab Developments. If the proposed measures are adopted, we consider the overall risk to the species to be **low**.

## 5.2. Non-threatened raptor species

The **White-bellied Sea-eagle** (*Aquila audax*) is known to occur just to the north of the study area (EOH 2022b). The low density of this species and the lack of records from the study area itself suggests that a likelihood of a collision with turbines unlikely. However, if this was to occur the impact to the species would be moderate and therefore the overall risk to this species is **low.**

Given the frequency of collisions involving **Wedge-tailed Eagle** (WTE) at many wind farms, this raptor species is addressed in this risk assessment. There is a low incidence of disturbance of WTE at most wind farms, successful breeding within 200 metres of operating turbines has been observed at some sites. Thus, risks to this species arise from likely collisions but not indirect disturbance. The overall collision risk to the Wedge-tailed Eagle is considered to be **low**. Local population impacts may be higher and we consider the risk is elevated to **moderate**.

Based on experience at other wind farms in eastern Australia, collisions of more commonly occurring **raptor species** are likely. Commonly occurring raptor species recorded to collide with turbines include Nankeen Kestrel, Brown Falcon and Black-shouldered Kite. The Brown Goshawk, Black Kite and Whistling Kite also recorded at the Junction Rivers Wind Project site may collide with turbines infrequently. Raptors appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. Overall, the risk from collision with turbines to these raptors is considered to be **low** as these species are widespread and common, making local population impacts unlikely as affected individual would be readily replaced by individuals from unaffected areas.

## 5.3. Threatened bat species

**Yellow-bellied Sheath-tailed Bat** (*Saccolaimus flaviventris*) has a wide distribution across tropical northern Australia and migrates to southern Australia during summer, typically from January to April (Churchill 2008). They are an open-space adapted species that regularly flies high above the canopy. Nature Advisory has recorded occasional collisions with turbines at operational wind farms in south-eastern Australia. It is expected that there will be infrequent collisions with turbines at BWF and this species is at **low** risk of local population scale impacts within the study area and surrounds throughout the operational phase.

## 5.4. Non-threatened bat species

The **Gould's Wattled Bat** (*Chalinolobus gouldii*) is common and widespread across most of Australia except Cape York (Churchill 2008) and is not listed as threatened. It has been recorded flying at height at other sites in Eastern Australia and has been regularly recorded colliding with turbines at other wind farms in south-eastern Australia. It is expected that there will be regular collisions with turbines and therefore is at **low** risk, with minor impacts on the local population.

The **White-striped Freetail Bat** (*Austronomus australis*) is common and widespread across southern Australia and is not listed as threatened. It has been recorded flying at height at other sites in Eastern Australia and has been regularly recorded colliding with turbines at other wind farms in south-eastern Australia. It is expected that there will be regular collisions with turbines and therefore is at **low** risk, with minor impacts on the local population.

## Table 6: Bird and Bat Risk Assessment – Junction Rivers Wind Project

| Species | Reason for inclusion | Threatened species status | | | Hazard or source event | Likelihood of risk event | Consequence | Risk Rating | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | BC Act | EPBC Act | Records - BioNet NSW | | | | | |
| **Birds** | | | | | | | | | |
| Australasian Bittern | Species or species habitat may occur within search region | E | E1, P | 0 | Collision with operating turbine | Rare | Moderate | Negligible | Australasian Bittern occurs in terrestrial wetlands, including a range of wetland types but prefers permanent water bodies with tall dense vegetation, particularly those dominated by sedges, rush, reeds or cutting grass (Marchant & Higgins 1990). There are no records for this species in the search region and suitable habitat is unlikely to occur in the study area and as such no collision or indirect risks. |
| *Botaurus poiciloptilus* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Australian Bustard | Species or species habitat may occur in area | E1, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | An arid and semi-arid grassland/savannah species and is nomadic or partially migratory (Menkhorst et al. 2021). It predominantly forages on the ground, however it will fly off when disturbed. There are no records from the search region (DPIE 2021). There is potential for it to occur irregularly in habitats at BWF but it is unlikely to fly at RSA height regularly given its preference for foraging on the ground. |
| *Ardeotis australis* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Barking Owl | Species or species habitat may occur in area | V, P, 3 | - | 0 | Collision with operating turbine | Rare | Moderate | Negligible | There is some potential for the species to occur as there is suitable habitat and BWF falls within the species range (Menkhorst et al. 2017). Collision is likely to be very infrequent, if at all, due to the species' tendency to stick to treed habitats or to fly below turbine height over open habitats where it often obtains prey. |
| *Ninox connivens* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Black Falcon | Recorded by Nature Advisory during 2022 | V, P | - | 1 | Collision with operating turbine | Unlikely | Moderate | Low | Mostly occurs in the western plains and in the drier lowland parts of NSW. There is one record in BioNet for the search region (DPIE 2021), so the species may occasionally reach the Balranald region and there is one record in the search region. Collision is likely to be very infrequent due to infrequent occurrence but in irruption years collision is almost certain given experience elsewhere in southern NSW. Consequences would be low due to the widespread distribution of the species (all of northern and eastern Australia; Menkhorst et al. 2017). |
| *Falco subniger* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Black-breasted Buzzard* | Species or species habitat identified as potential to occur by Biosis Pty Ltd | V | - | 0 | Collision with operating turbine | Rare | Moderate | Negligible | The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. Where it occupies a range of habitats, including grasslands and sparsely timbered woodlands especially along timbered watercourses which is the preferred breeding habitat (OEH 2022b). Just two records in the last 30 years to the east of the Darling River, the closest 70 km from the study area (OEH 2022b). With so few records from the region and no records in the study area or immediate surroundings this species is thought to unlikely occur in the study area. |
| *Hamirostra melanosternon* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Black-chinned Honeyeater | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Negligible | Negligible | This species is found mostly in rough-barked eucalyptus dry forest and woodland, and in River Red-gum along watercourses in southern Australia (Menkhorst et al. 2017). There are no records from the region (DPIE 2021), and it is unlikely to fly at RSA height at BWF, so risk to this species is negligible. |
| *Melithreptus gularis* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Black-tailed Godwit | Species or species habitat may occur in area | V | CR, M (Bonn A2H, ROKAMBA, JAMBA, CAMBA) | 0 | Collision with operating turbine | Rare | Moderate | Negligible | This species is a migratory shorebird that occurs along the coast and in a variety of inland wetlands (Marchant & Higgins 1993). In the last 30 years it has not been recorded in the vicinity of the study area (OEH 2022d), the nearest record is from the Deniliquin area 150 km to the east of the study area. Marginal habitat occurs within the study area. It would be exceedingly unlikely for this species to occur in the study area however because of its migratory nature individuals of this species could occur on site at any time during their residency in SE Australia. |
| *Limosa limosa* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Black-eared Miner* | Species or species habitat identified as potential to occur by Biosis Pty Ltd | CE | E | 0 | Collision with operating turbine | Rare | Moderate | Negligible | This species is restricted to large tracts of unfragmented mallee unburnt for at least 35 – 40 years (Menkhorst *et al.* 2017). There is no suitable habitat of this type within the study area or the region. The study area has highly to moderately fragmented patches of mallee and other woodland communities that we consider unsuitable for this species. The species was not observed during two year of survey at the study area. |
| *Manorina melanotis* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Brown Treecreeper | Species or species habitat may occur in area | V, P | - | 1 | Collision with operating turbine | Rare | Negligible | Negligible | It occurs in woodlands dominated by eucalyptus, especially Stringybarks or other rough-barked eucalypts, usually with open grassy understorey (Higgins *et al.* 2001). There is one record from within the search region (DPIE 2021). This species usually occurs in the lower canopy, low branches, trunks and ground and would not fly at RSA height. |
| *Climacteris picumnus victoriae* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Bush Stone-curlew | Species or species habitat likely to occur in area | E1,P | - | 1 | Collision with operating turbine | Rare | Low | Negligible | A ground-dwelling grassy woodland species, rare in southern Australia, it is typically observed lying flat on the ground or walking (Menkhorst et al. 2017). There is one record from within the search region (DPIE 2021). Given this behaviour, interaction with turbines is expected to be very infrequent. |
| *Burhinus grallarius* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Chestnut Quail-thrush | Species or species habitat may occur in area | V, P | - | 1 | Collision with operating turbine | Rare | Low | Negligible | A ground-dwelling, mallee woodland species, it rarely moves more than several metres off the ground and remains within vegetation cover. For this reason, the risk of collision is negligible. |

| Species | Reason for inclusion | Threatened species status | | | Hazard or source event | Likelihood of risk event | Consequence | Risk Rating | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | BC Act | EPBC Act | Records - BioNet NSW | | | | | |
| *Cinclosoma castanotum* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Curlew Sandpiper | Species or species habitat may occur in area | E, P | CR, M (Bonn A2H, ROKAMBA, JAMBA, CAMBA) | 0 | Collision with operating turbine | Rare | Moderate | Negligible | This species is a migratory shorebird that occurs along the coast and in a variety of inland wetlands (Marchant & Higgins 1993). In the last 30 years it has not been recorded in the vicinity of the study area (OEH 2022c), the nearest record is from the Mildura area 140 km to the west of the study area. Marginal habitat occurs within the study area. Because of its migratory nature individuals of this species could occur on site at any time during their residency in SE Australia. |
| *Calidris ferruginea* | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Diamond Firetail | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Negligible | Negligible | Found in woodlands, dry open forests and lightly timbered farmland where it feeds on native grasses (Higgins et al. 2006), it has been recorded regularly in farmland around wind turbines in southern NSW where it has never been observed flying at RSA height or colliding with turbines (Nature Advisory data). |
| *Stagonopleura guttata* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Dusky Woodswallow | Recorded in BioNet search region | V, P | - | 2 | Collision with operating turbine | Likely | Negligible | Negligible | Occurs in dry open sclerophyll forests and woodlands, usually dominated by eucalypts. Often found on the edges or in clearings of forest and woodland and sometimes recorded in shrubland and heathland and other various modified landscapes (Higgins et al. 2006). This species may occasionally fly at RSA height but usually flies within the canopy. Any collision would likely have minimal population impact since this species is still moderately common across most of its range. |
| *Artamus cyanopterus cyanopterus* | | | | | Indirect disturbance including barrier effects | Unlikely | Negligible | Negligible | |
| Flame Robin | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | Breeds in forests in south-eastern Australia, usually in the hills or high-country. Migrates in autumn and winter to lower altitudes and more open habitat, such as farmlands, plains and some urban areas (Higgins and Peter 2002). There are no records from the BWF search region (DPIE 2021) and the site lies outside the usual range of this species. For this reason, it is likely to occur on the site very infrequently and impacts are therefore unlikely to be of consequence for this species' population. |
| *Petroica phoenicea* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Fork-tailed Swift | Recorded in BioNet search region | P | C, J, K | 1 | Collision with operating turbine | Likely | Low | Low | This species is aerial, occurring over inland plains, sometimes above foothills or in coastal areas, over cliffs and urban areas (Higgins 1999). It occurs over much of Australia and infrequently in the Berrigan region, often following weather fronts. it flies at turbine height. Collision is likely to be infrequent due to the irregularity of its occurrence – there is one records to date from the BWF search region (DPIE 2021). Small numbers possibly affected do not represent a significant proportion of the total population, estimated as at least in the tens of thousands (Department of the Environment 2015b). |
| *Apus pacificus* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Gilbert's Whistler | Recorded in BioNet search region | V, P | | 1 | Collision with operating turbine | Rare | Low | Negligible | Gilbert's Whistler inhabits dry eucalypt and mallee woodlands in southern Australia. It forages on the ground or in low foliage. As a sedentary species it does not move long distances or regularly across open country. There is one record of Gilbert's Whistler in the search region (DPIE 2021), indicating that it is not widespread or abundant in the region. The species is therefore unlikely to occur frequently on the BWF site and if it did it would not fly at turbine height. Consequently, the possibility of impacts on this species from the BWF are considered remote. |
| *Pachycephala inornata* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Grey Falcon | Species or species habitat likely to occur in area | E1, P | V | 0 | Collision with operating turbine | Rare | Moderate | Negligible | Primarily inhabits open plains with treed watercourses in arid inland Australia, ambushing flocks of passerines coming to drink when not active aerial hunting (Menkhorst et al. 2017). It flies at RSA height while hunting. It is not recorded in search region (DPIE 2021). It is a rare raptor in the region, very unlikely to occur at BWF. |
| *Falco hypoleucos* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Grey-crowned Babbler | Recorded in BioNet search region | V, P | - | 15 | Collision with operating turbine | Rare | Low | Negligible | There are 15 records within the search region (DPIE 2021; Nature Advisory 2021). It inhabits open forests and woodlands and requires an open shrub layer with sparse ground cover and fallen timber and leaf-litter (Higgins and Peter 2002). It is a ground dwelling bird that lives in communal family groups and nests in small terminal branches at top or crowns of a wide variety of plants, usually small trees or saplings and also in tall shrubs. This species generally confines itself to areas of wooded country and is unlikely to fly at RSA height. Nature Advisory observations indicate that family parties of the species persist at operating wind farms. |
| *Pomatostomus temporalis temporalis* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Hooded Robin | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | This species occurs mostly in lightly timbered habitats such as dry woodlands with an open shrubby understorey, sparse grasses and patches of bare ground and leaf-litter, with scattered dead and fallen timber for foraging perches (Higgins and Peter 2002). No records have been obtained from the BWF search region (DPIE 2021). As a perch and pounce forager from branches or logs/posts to the ground, this species is unlikely to fly at RSA height and so is unlikely to be impacted by operating wind turbines. |
| *Melanodryas cucullata* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Little Eagle *Hieraaetus morphnoides* | Recorded in BioNet search region | V, P | - | 2 | Collision with operating turbine | Unlikely | Moderate | Low | The Little Eagle is distributed throughout the Australian mainland except in the most densely forested parts of the Great Dividing Range (Marchant and Higgins 1993). Turbine strikes of this raptor species could occur and the species has been recorded twice in the search region (DPIE 2021). It is expected that regular collision is unlikely in NSW given its very low population densities. In the 1990s, the Little Eagle was estimated globally as numbering tens of thousands to as many as 100 000 birds (Ferguson-Lees & Christie 2001), but in recent decades, it is believed to have undergone a moderate reduction in population size in NSW (OEH species listing advice). |
| | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Major Mitchell's Cockatoo *Lophochroa leadbeateri* | Recorded by Nature Advisory, and in BioNet search region | V, P, 2 | - | 38 | Collision with operating turbine | Unlikely | Moderate | Low | This species is uncommon in arid and semi-arid woodlands, mallee and mulga (Menkhorst et al. 2021). Some 38 records have been reported from the search region (DPIE 2021). It may fly at RSA height when dispersing, but it is mostly resident in a large home range. It was recorded on the BWF |

| Species | Reason for inclusion | Threatened species status | | | Hazard or source event | Likelihood of risk event | Consequence | Risk Rating | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | BC Act | EPBC Act | Records - BioNet NSW | | | | | |
| | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | site during bird surveys (Nature Advisory 2023). When undertaking longer distance movements, it is possible that this cockatoo flies at turbine height so there is a likelihood that it could interact with turbines. |
| Malleefowl | Species or species habitat may occur in area | E, P | V | 0 | Collision with operating turbine | Rare | Low | Negligible | Malleefowl is a ground-dwelling mallee woodland species. It is a poor flyer and confines its activity to the ground. There are no record in the search region (DPIE 2021) and the site is just east of the current range of the species. For these reasons, it is unlikely to be affected by the BWF. |
| *Leipoa ocellata* | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Masked Owl *Tyto novaehollandiae* | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Unlikely | Low | Negligible | Forest and woodland species, often observed in ecotones between forest and open country (Menkhorst et al. 2017). Predominantly a perch and pounce hunting species, feeding mostly on small to medium sized terrestrial mammals, therefor unlikely to fly at RSA height regularly. It is not expected to collide with wind turbines. |
| | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Painted Honeyeater *Grantiella picta* | Species or species habitat likely to occur in area | V, P | V | 0 | Collision with operating turbine | Unlikely | Negligible | Negligible | This species is strongly associated with mistletoe around the margins of open forests and woodlands; it occurs from the Gulf of Carpentaria to southern Victoria and eastern South Australia, mostly inland of the Great Divide (Higgins *et al*. 2001). There are no records from the BWF search region (DPIE 2021). This species usually flies within the tree canopy and would rarely visit the BWF site. |
| | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Pied Honeyeater *Certhionyx variegatus* | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | This species inhabits arid and semi-arid woodland and shrublands. It is highly mobile, and unpredictable in its movements across landscapes; however it is associated with flowering shrubs, particularly *Eremophila* spp. Display flights during territorial establishment involve vertical flights (Menkhorst et al. 2021). There is potential for it to fly at RSA height during movement between feeding grounds, and during territorial display, however the BWF region is not a stronghold, so it I unlikely to visit the region regularly. |
| | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Plains Wanderer | Species or species habitat may occur in area | E4, A, P | CE | 0 | Collision with operating turbine | Rare | Low | Negligible | This species is a ground-dwelling arid and semi-arid grassland adapted species, preferring sparsely vegetated inland plains (Menkhorst et al. 2017). It has not been recorded flying at RSA height. There is limited potential habitat within the wind farm study area and no records in the region, suggesting BWF is unlikely to support the species. |
| *Pedionomus torquatus* | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Purple-crowned Lorikeet | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | This is a dry eucalypt and mallee woodland species of southern Australia. There are not records in the search region (DPIE 2021) and a few records on the Victorian side of the Murray River nearby (ALA 2021). It flies rapidly at and above canopy height between patches of flowering eucalypts and may occasionally fly at turbine height. However, the lack of local records suggests that it is likely to occur infrequently and therefore turbine collision is likely to be rare. |
| *Glossopsitta porphyrocephala* | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Purple-gaped Honeyeater | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | This mallee woodland honeyeater occurs mostly to the west in Victoria and South Australia, with one record nearby in NSW (ALA 2021). Its occurrence on the BWF site is likely to be very infrequent. It tends to stick to cover and not fly above tree canopy height. Given these facts, it is highly unlikely to be affected by the BWF. |
| *Lichenostomus cratitius* | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Red-lored Whistler* | Species or species habitat identified as potential to occur by Biosis Pty Ltd | CE | E | 0 | Collision with operating turbine | Rare | Low | Negligible | This species occurs in dense Mallee-Broombush dominated woodland or cypress pine scrub (Menkhorst *et al.* 2017). In NSW only known to occur in and around Round Hill and Nombinnie Nature Reserves in central NSW (OEH 2022e). There is no suitable habitat in the study area or REGION and the known populations are 275km from the study area. It is therefore unlikely that this species will occur |
| Pachycephala rufogularis | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Redthroat | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Low | Negligible | This species inhabits low shrublands of plans, mostly north of the Murrumbidgee River. Remnant habitat on the site is unsuitable, although saltbush has been planted in the area. Given the lack of natural habitat and the fact that most regional records are north of the Murrumbidgee River (ALA 2021), the species is considered unlikely to occur on the BWF site. |
| *Pyrrholaemus brunneus* | | | | | Indirect disturbance including barrier effects | Rare | Low | Negligible | |
| Regent Parrot | Recorded by Nature Advisory, and in BioNet search region | E1, P, 3 | V | 10 | Collision with operating turbine | Unlikely | Moderate | Low | This species breeds in riverside forests of River Red Gum and forages widely in mallee and agricultural landscapes (Menkhorst et al. 2017). Corridors of tree cover are required for commuting between breeding and feeding areas. As this species was recorded on the BWF site during bird surveys, it is likely that these individuals are resident in the study area. Regent Parrot was not observed at the proposed RSA height (>50m above ground). This species forages primarily in mallee, in low growing vegetation (maximum canopy height in the study area is approximately 8 metres). When commuting, it flies at or just above the canopy, not at height. It is therefore unlikely that this species will fly at RSA height.<br>This species is subject to a separate investigation by Nature Advisory to more fully determine the utilisation this species within the study area and with be the subject of separate reporting. |
| *Polytelis anthopeplus monarchoides* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Regent Honeyeater | Species or species habitat likely to occur in area | Cr En | Cr En | 0 | Collision with operating turbine | Rare | Moderate | Negligible | The species inhabits dry open forest and woodland, particularly more fertile patches of Box-Ironbark woodland, on the inland slopes of the Great Dividing Range (Menkhorst *et al.* 1999). and along rivers with *Casuarina cunninghamiana* infested by mistletoe *Amyema cambagei* and wet |

| Species | Reason for inclusion | Threatened species status | | | Hazard or source event | Likelihood of risk event | Consequence | Risk Rating | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | BC Act | EPBC Act | Records - BioNet NSW | | | | | |
| *Anthochaera phrygia* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | forests of coastal Australia (Higgins et al. 2001). Regent Honeyeater occurs well south and east of the site. Only three records in the last 30 years, within 150 km of the study area, one in 1997 from Barham approximately 110km from the study area and two from Deniliquin, 1992 & 2006, approximately 150km from the study area. Thus, the location of these records and the lack of suitable habitat in the study area or immediate surroundings, it is considered unlikely this species will occur on the BWF. |
| Rufous Fieldwren | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Negligible | Negligible | This is a shrub-dwelling species. Remnant habitat on the site is unsuitable, although saltbush has been planted in the area. Given the lack of natural habitat and the fact that most regional records are west of the Murray River (ALA 2021), the species is considered unlikely to occur on the BWF site. |
| *Calamanthus campestris* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Scarlet Robin | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Negligible | Negligible | The Scarlet Robin lives in open forests and woodlands in Australia. During winter, it visits more open habitats, such as grasslands, and can be seen in farmland and urban parks and gardens at this time. This species forages on the ground or in the low branches of trees so would not fly at RSA heights. Nature Advisory has observed this species remaining on wind farm sites after turbines commence operation. |
| *Petroica boodang* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Speckled Warbler | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Negligible | Negligible | This species is a ground-dwelling insectivore, found in dry forests and open woodlands. It forages on the ground or in low shrubs, rarely from low in trees, only flying into trees or shrubs to avoid predators or when disturbed (Menkhorst et al. 2017). It is very unlikely to fly at turbine height. |
| *Chthonicola sagittata* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Spotted Harrier | Recorded by Nature Advisory onsite | V, P | - | 0 | Collision with operating turbine | Unlikely | Low | Negligible | This species prefers open woodlands that do not obstruct low flight, and natural and exotic grasslands in arid and semi-arid areas (Higgins & Davies 1996). Suitable habitat for the species exists and there are two records of it in the search region (DPIE 2021). Collision with turbines is unlikely or very infrequent. Risks to this species are therefore negligible. |
| *Circus assimilis* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Square-tailed Kite | Species or species habitat likely to occur in area | V, P | - | 0 | Collision with operating turbine | Unlikely | Low | Negligible | This species forages over open forest, woodland, heath and mallee. Square-tailed Kite migrates seasonally, heading south during the warmer months, avoiding the northern wet, and is likely to fly high during migration (Menkhorst et al. 2017). It has the potential to occur irregularly in the region, however there are no records of this species in the search region (DPIE 2021) or from the BWF and habitat is marginally suitable. Therefore, the species would only occur very infrequently. |
| *Lophoictinia isura* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Striated Grasswren | Species or species habitat identified as potential to occur by Biosis Pty Ltd | CE | - | 0 | Collision with operating turbine | Rare | Low | Negligible | This species is widely distributed through the arid and semi-arid regions of mainland Australia, confined to areas with well-developed Porcupine Grass (*Triodia irritans*), usually in association with mallee eucalypts and sandy soils (OEH 2022a). No suitable habitat of this type is available in the study area or in the immediate area of the study area and no records of this species occur within 110km of the study area. Bearing this in mind and the poor dispersal ability of this species it is considered unlikely to occur in the study area. The species is also not considered to be a collision risk or subject to barrier effects from constructed turbines. |
| Amytornis striatus | | | | | Indirect disturbance including barrier effects | Unlikely | Low | Negligible | |
| Superb Parrot | Species or species habitat may occur in area | V, P | V | 0 | Collision with operating turbine | Rare | Moderate | Negligible | The Superb Parrot occupies open woodlands of the inland slopes and southern Riverina of New South Wales and north-central Victoria. Breeding occurs in large eucalypts with hollows in the Riverina and south-west slopes regions; a proportion of the population moves north in autumn-winter (Higgins 1999; OEH 2021). Although listed under EPBC and BC Acts, Garnett et al. 2010 did not consider the species threatened citing new information that the population is over 10,000 birds and not declining. It has the potential to occur very irregularly in the region given the lack or nearby records (DPIE 2021; ALA 2021) and the species would only occur very infrequently on the BWF, if at all. |
| *Polytelis swainsonii* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Swift Parrot | Species or species habitat may occur in area | E1, P | CE | 0 | Collision with operating turbine | Rare | Moderate | Negligible | In NSW this species is a non-breeding autumn-winter visitor from its breeding grounds in Tasmania. It prefers a narrow range of eucalypts including Boxes, Ironbarks, Blakely's Red-gum, Swamp Mahogany, Blackbutt, Red Bloodwood and Spotted Gum (Higgins 1999; OEH 2021). It spends winter mostly inland of the Great Dividing Range, but some years reaches the coast (Higgins 1999; Kennedy and Tzaros 2005). There are no records from BWF or the surrounding region (DPIE 2021) so it is likely to occur only rarely, if at all. Most records in this part of its range come from River Red Gum woodlands associated with major watercourses, habitat that does not occur on the BWF site. |
| *Lathamus discolor* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Turquoise Parrot | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Rare | Moderate | Negligible | This parrot occurs in eucalypt woodlands and open forests, with ground cover of grasses and sometimes low, understorey of shrubs; usually in native grassy forests and woodlands composed of mixed assemblages of native pine and a variety of eucalyptus. It also occurs in savannah woodlands and riparian woodlands (Higgins 1999). It was not recorded at BWF or in the study region (DPIE 2021) and there are few record nearby (ALA 2021). Therefore, it is unlikely to occur regularly on the site and impacts on it are unlikely. |
| *Neophema pulchella* | | | | | Indirect disturbance including barrier effects | Rare | Moderate | Negligible | |
| Varied Sittella | Recorded in BioNet search region | V, P | - | 2 | Collision with operating turbine | Rare | Negligible | Negligible | The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Its range in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate |

| Species | Reason for inclusion | Threatened species status | | | Hazard or source event | Likelihood of risk event | Consequence | Risk Rating | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | BC Act | EPBC Act | Records - BioNet NSW | | | | | |
| *Daphoenositta chrysoptera* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | reduction over recent decades (OEH 2021). It inhabits eucalypt forests and woodlands flying at canopy level. The Varied Sittella forages in groups, flying into the tree canopy and working down the branches and trunks, probing through the bark in search of insects (Pizzey & Knight 2003). This species is unlikely to fly at RSA height. |
| Wedge-tailed Eagle | Recorded by Nature Advisory on site | P | | 19 | Collision with operating turbine | Almost certain | Moderate | Low | The Wedge-tailed Eagle is the species most exposed to collision risk due to its common habit of soaring and circling at height while foraging. Several birds of this species have been struck at other wind farms in NSW. Disturbance is not an issue, with the eagle breeding successfully as close as 200 metres from operating wind turbines. |
| *Aquila audax* | | | | | Indirect disturbance including barrier effects | Unlikely | Negligible | Negligible | |
| White-bellied Sea-eagle* | Species or species habitat identified as potential to occur by Biosis Pty Ltd | V | - | 23 | Collision with operating turbine | Unlikely | Moderate | Low | The White-bellied Sea-eagle has been recorded regularly at the Yanga Lakes 10km north of the study area. There is no suitable habitat within the study area, however White-bellied Sea-eagle could potentially soar over the study area while travelling between suitable wetland habitat. The low density of WBSE in the area suggests the potential of a collision with a wind turbine to be low. Disturbance to this species is not considered to be an issue since they have not been observed using the study area for foraging, resting or breeding. |
| *Haliaeetus leucogaster* | | | | | Indirect disturbance including barrier effects | Unlikely | Negligible | Negligible | |
| White-fronted Chat | Recorded in BioNet search region | V, P | - | 8 | Collision with operating turbine | Rare | Negligible | Negligible | This species inhabits open country, grasslands and low shrublands especially open wetlands and low fringing vegetation across southern Australia including southern NSW (Higgins et al. 2006; OEH 2021). The species has been recorded at several other wind farms in NSW, Victoria and South Australia by Nature Advisory, indicating a tolerance of operating wind turbines. It is unlikely to be affected by turbine collision as it rarely flies high enough, being a ground-feeding bird. |
| *Epthianura albifrons* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Yellow Wagtail | Species or species habitat may occur in area | P | M | 0 | Collision with operating turbine | Rare | Negligible | Negligible | Outside this species known range and distribution. Known from predominantly coastal regions in northern Australia, this migratory species has not been recorded further south than Newcastle in NSW, although range expansion is suggested (Menkhorst et al. 2017). Given the lack of records (DPIE 2021), unsuitable habitat and known distribution (OEH 2021), it is very unlikely this species will occur at BWF and it is unlikely to interact with turbines. |
| *Motacilla flava* | | | | | Indirect disturbance including barrier effects | Rare | Negligible | Negligible | |
| Other raptors:<br>Black Kite<br>Brown Falcon<br>Brown Goshawk<br>Nankeen Kestrel<br>Peregrine Falcon | Species recorded by Nature Advisory | P | - | Not applicable | Collision with operating turbine | Almost certain | Low | Low | Turbine strikes by commonly occurring raptors, such as Brown Falcon, Nankeen Kestrel and Peregrine Falcon are likely, based on experience at other wind farms in south-eastern Australia. The widespread and common status of these species makes population impacts unlikely. These species appear not to be deterred by the presence of operating wind turbines and occur regularly at other wind farms in NSW. |
| | | | | | Indirect disturbance including barrier effects | Unlikely | Negligible | Negligible | |
| **Mammals** | | | | | | | | | |
| Corben's Long-eared Bat | Species or species habitat may occur in area | V, P | V | 0 | Collision with operating turbine | Unlikely | Low | Negligible | The study area falls within the known distribution of the species (OEH 2022). The species inhabits a variety of vegetation types including mallee, Belah and Cypress Pine communities. Nature Advisory has identified suitable habitat on the study area for this species. It has however, not been formally identified through acoustic surveys conducted at the study area. The Long-eared Bats as a group are unlikely to fly at turbine height and therefore unlikely to collide with turbines. |
| *Nyctophilus corbeni* | | | | | Indirect disturbance including barrier effects | Unlikely | Negligible | Negligible | |
| Gould's Wattled Bat | Species or species habitat may occur in area; known to be at risk | P | - | 0 | Collision with operating turbine | Almost certain | Low | Low | Widely distributed, common species. Flies at RSA height. Known to be at risk from wind farms (Nature Advisory unpublished data) |
| *Chalinolobus gouldii* | | | | | Indirect disturbance including barrier effects | Unlikely | Negligible | Negligible | |
| Inland Forest Bat | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Unlikely | Low | Negligible | A dry woodland species not known from the region. Most records are north of the Murrumbidgee River (ALA 2021). It is a canopy and sub-canopy foraging bat that is unlikely to fly regularly at turbine height and therefore unlikely to collide with turbines. |
| *Vespadelus baverstocki* | | | | | Indirect disturbance including barrier effects | Unlikely | Low | Negligible | |
| Little Pied Bat | Species or species habitat may occur in area | V, P | - | 0 | Collision with operating turbine | Unlikely | Low | Negligible | An arid woodland species not known from the region. Most records are north of the Murrumbidgee River (ALA 2021). It is a canopy and sub-canopy foraging bat that is unlikely to fly regularly at turbine height and therefore unlikely to collide with turbines. |
| *Chalinolobus picatus* | | | | | Indirect disturbance including barrier effects | Unlikely | Low | Negligible | |
| Southern Myotis | Foraging, feeding or related behaviour may occur within area | V, P | - | 0 | Collision with operating turbine | Unlikely | Low | Negligible | A dry woodland species not known from the region. Most records are north of the Murrumbidgee River (ALA 2021). It is a canopy and sub-canopy foraging bat that is unlikely to fly regularly at turbine height and therefore unlikely to collide with turbines. |
| *Myotis macropus* | | | | | Indirect disturbance including barrier effects | Unlikely | Low | Negligible | |

| Species | Reason for inclusion | Threatened species status | | | Hazard or source event | Likelihood of risk event | Consequence | Risk Rating | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | | BC Act | EPBC Act | Records - BioNet NSW | | | | | |
| White-striped Freetail Bat | Species or species habitat may occur in area; known to be at risk | P | - | 0 | Collision with operating turbine | Almost certain | Low | Low | Widely distributed common species. Flies at RSA height. Known to collide regularly with wind turbines (Nature Advisory data). |
| *Austronomus australis* | | | | | Indirect disturbance including barrier effects | Unlikely | Low | Negligible | |
| Yellow-bellied Sheathtail Bat | Widely distributed species. Known to be at risk from wind warms | V, P | - | 0 | Collision with operating turbine | Likely | Low | Low | Highly mobile and high flying. Although there are no nearby records (DPIE 2021; ALA 2021), the site lies within its broader range. The species is known to have collided in small numbers with wind turbines. |
| *Saccolaimus flaviventris* | | | | | Indirect disturbance including barrier effects | Unlikely | Low | Negligible | |

**Notes:** BC Act (Biodiversity Conservation Act 2016) status; EPBC Act (Environment and Protection of Biodiversity and Conservation Act 1999) status; P= Protected, V = Vulnerable; E, E1= Endangered, E4A, CE = Critically Endangered, M = Migratory (Bonn Convention); C = China-Australia Migratory Bird Agreement; J= Japan-Australia Migratory Bird Agreement; K = Republic of Korea--Australia Migratory Bird Agreement. *Species included for analysis as a result of data provided by Biosis Pty Ltd.

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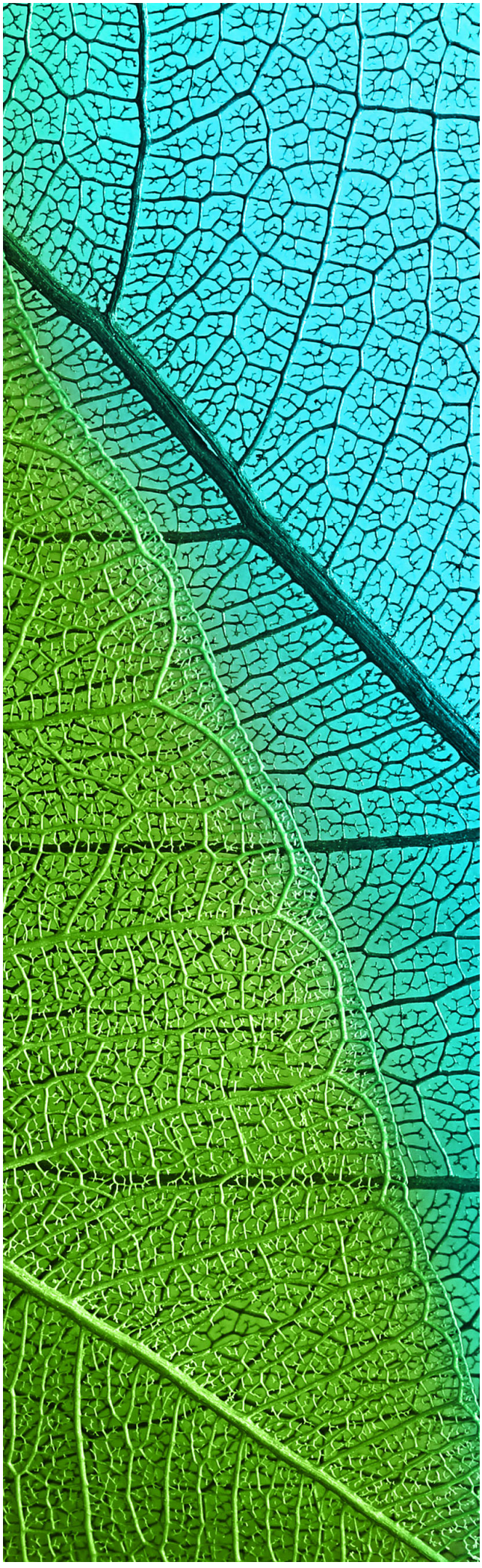
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# Junction Rivers Wind Project

## Preliminary Literature Review on Habitat Use of the Australasian Bittern in the Riverina

**Prepared for Windlab Pty Ltd**

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# 1. Executive summary

This literature review of the habitat use of the Australasian Bittern (*Botaurus poiciloptilus*), with particular reference to the Riverina region of New South Wales, found the following key facts to risk assessments for the Australasian Bittern and its habitat:

- The Australasian Bittern may inhabit different areas in the breeding (October-February/March) and non-breeding (March/April-September) seasons, or may remain as a permanent breeding resident within permanent wetlands large and complex enough to support them. Occasionally, the species will gather in ephemeral wetlands that have flooded to exploit the foraging opportunities they present. Both freshwater and brackish wetlands are used, although the former is more commonly used.

- Sedentary resident birds typically use large complex wetlands with relatively deep areas, but more importantly, shallow (30 cm or less) areas with mosaics of thick emergent and fringing aquatic vegetation (0.5-3.5 metres tall) and open areas, where the wetland water exhibits little or no turbidity. 200 birds are thought to be permanent breeding residents of permanent coastal wetlands.

- Birds that migrate to seasonal breeding grounds largely use rice fields in the Riverina (out of a total Australian population of 1300 birds, around 750 are thought to do this). They typically arrive in rice fields in December after they have been flooded in October. Birds can continue to breed until the rice is harvested in late March-early April. Another 200 birds may breed in the Murray-Darling Basin (MDB) within permanent or ephemeral inland wetlands. A total 950 birds are thought to use the Murray-Darling Basin, and half of them migrate 400-600 km out of the MDB to coastal permanent wetlands post-breeding. The remaining 475 birds may disperse to nearby or distant permanent inland wetlands post-breeding, or to nearby irrigation structures surrounding rice fields (e.g., recycle dams).

- There is a 50% chance that wetlands in the study area will flood and serve as breeding habitat for the species once in the 20-year lifespan of the proposed windfarm, with more frequent use of the study area unlikely. Based on the behaviour of other waterbirds, the flight behaviour of Australasian Bitterns using local habitat is not thought to expose them to unacceptably high risks of collision with turbines, provided a 400-m buffer between turbines and wetlands is observed. This is based on the better-known flight behaviour of other waterbirds and the fact that this species is normally very closely tied to their breeding wetlands when using them, and would normally only be found away from them on their approach in and exit out during the start and end of breeding.

- There are three two-way flight routes (six routes in total) that the species may take between seasonal breeding grounds and non-breeding season habitat that may cause them to cross through the airspace of the proposed windfarm. The species is known to fly at RSA height and is known to make long-distance flights at night and in low-light conditions, which are both factors potentially increasing the risk of collision. However, most waterbirds fly above RSA height when making long-distance flights, and only fly at RSA height when almost directly above their destination waterbody (within 400 m of it), and if Australasian Bitterns fly in a similar way, the risk of them colliding with turbines during long-distance flights is minimal.

- A worst-case scenario (in which most bitterns fly at RSA height when making long-distance movements) would involve a handful of birds colliding with turbines twice a year over the life of the windfarm, which could have long-term detrimental impacts on the migrating population within the Murray-Darling Basin (minimum roughly 475 birds). However, this is a very unlikely scenario, as based on the behaviour of other waterbirds, the species likely flies above RSA height when making long-distance movements, and cumulatively over a decade of mortality monitoring at various wind farms has never discovered either it, or higher-risk and more detectable waterbirds (Brolga) as a mortality attributable to collision with wind turbines.

# 2. Introduction

Nature Advisory has been retained by Windlab Pty Ltd to write a literature review concerning the spatial ecology and habitat use of the Australasian Bittern (*Botaurus poiciloptilus*) within the Riverina and Murray-Darling Basin and consider the risk to the species of collision with wind turbines at the proposed Junction Rivers Wind Project, south of Balranald NSW. This document is to be considered as fulfilling both of these requirements.

This investigation was conducted by Michael Sebastian (Zoologist), Gavin Thomas (Senior Ecologist – NSW Team Leader) and Bernard O'Callaghan (Director).

## 2.1. Methods

A variety of scientific literature on the Australasian Bittern was consulted in the course of this literature review, appropriately referenced and listed in the References section.

Australasian Bittern records in the Riverina within southern NSW were taken from BioNet and the Atlas of Living Australia (ALA), and mapped (Figure 2). The records closest to the study area were sorted into clusters that occurred relatively close together.

Flight routes were considered on Google Maps, by measuring distances between two plausible points between clusters, and between clusters and wetlands identified as potentially attracting the species over long distances. Such wetlands were identified by consulting the scientific literature and using the PMST Search Tool (DCCEEW 2023) to identify Ramsar wetlands downstream of the study area. Flight routes passing within roughly 10 km of the study area were considered to have potential to pass through the study area.

# 3. Overview of species biology and ecology

## 3.1. Description

The Australasian Bittern is a large, stocky, thick-necked, heron-like bird. The species grows to a length of 66-76 cm and has a wingspan of 1050-1180 cm. The average male weighs approximately 1400 g and the average female weighs approximately 900 g (Marchant & Higgins 1990).



**Figure 1: Image of a mature adult specimen of Australasian Bittern *Botaurus poiciloptilus*. Taken from southern Victoria, 18/09/19.**

## 3.2. Diet

The diet of the Australasian Bittern includes aquatic animals such as small fish, frogs, freshwater crayfish, spiders, insects, small reptiles. On occasion, they can feed away from water bodies in locations such as grasslands or crop stubble, particularly during rodent plagues (TSSC 2019, Garnett & Baker 2020).

## 3.3. Distribution and Population

Worldwide, there are fewer than 2,500 mature individuals. The estimate is 1300 mature Australasian Bitterns within the Australian population (Garnett & Baker 2020). The population is probably declining and has a particularly small area of habitat available during droughts (Garnett & Baker 2020). However, there is some uncertainty that there is continuing decline given the population appears to fluctuate and the species is so cryptic and difficult to monitor (Garnett & Baker 2020). Most key breeding habitats are now protected and others are being restored. Nowadays, the greatest threat to Australasian Bitterns is an increased frequency and intensity of droughts (Evans *et al.* 2017).

In Australia, the Australasian Bittern occurs from south-east Queensland to south-east South Australia as far as the Adelaide Region, southern Eyre Peninsula, Tasmania and in the south-west of Western Australia (Marchant & Higgins 1990; Garnett & Baker 2020). In New South Wales, it occurs along the coast and is also frequently recorded in the Murray-Darling Basin, notably in floodplain wetlands of the Murray, Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers (TSSC 2019). The Barmah-Millewa wetland complex of Victoria and NSW is considered Australia's most important site (Herring *et al.* 2019).

The Australian population can be divided into two sub-populations, the south-eastern and south-western sub-populations. The Australasian Bittern also occurs in New Zealand and New Caledonia (Marchant & Higgins 1990).

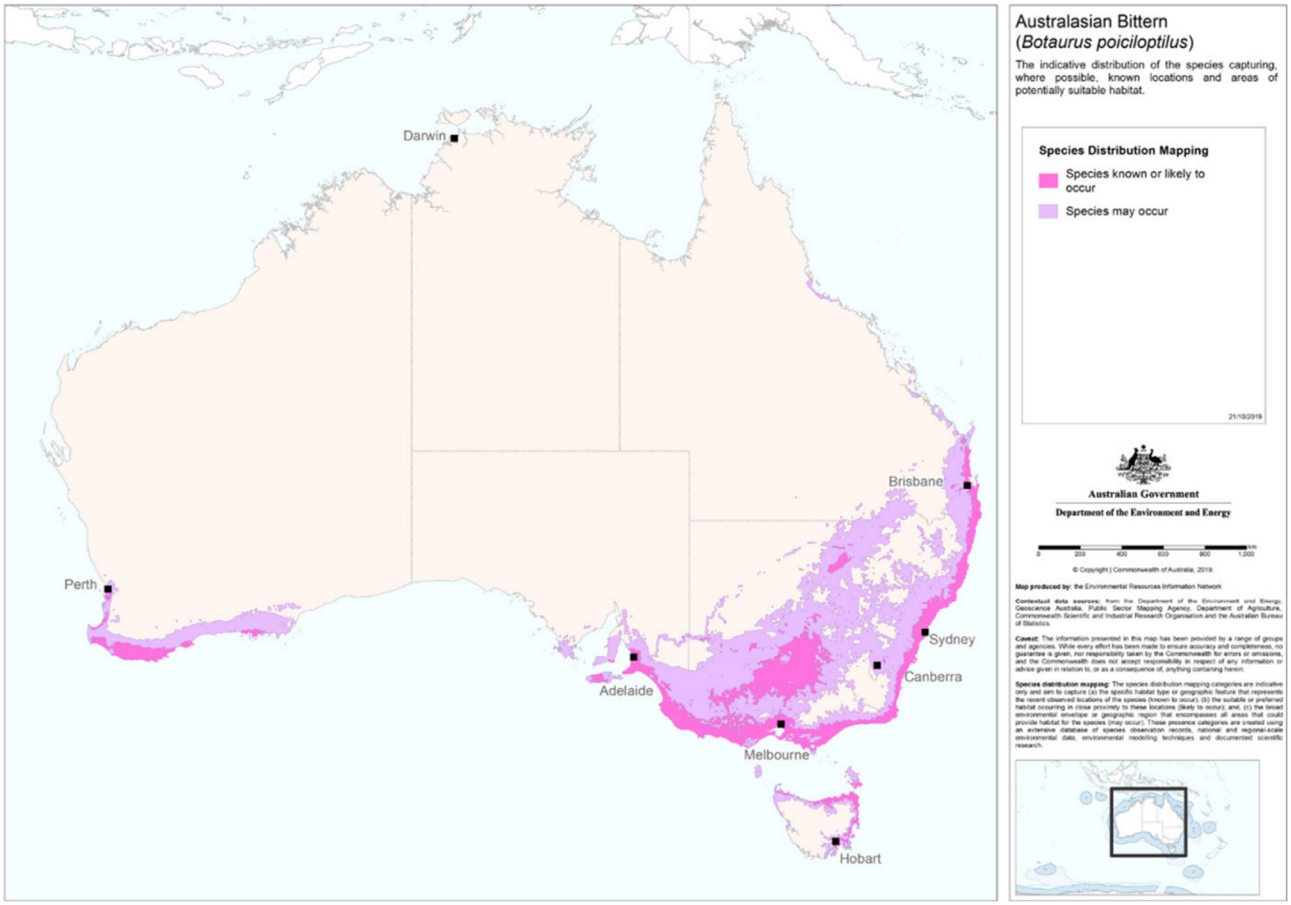



**Figure 2: Distribution map for the Australasian Bittern *Botaurus poiciloptilus* within Australia (DCCEEW 2022)**

## 3.4. Habitat

The Australasian Bittern inhabits shallow water with medium to low density vegetation for foraging and deeper water with medium to high density vegetation for nesting (Pickering 2013). The diet of the Australasian Bittern includes aquatic animals such as small fish, frogs, freshwater crayfish, spiders, insects, small reptiles, on occasions they can feed away from water bodies such as grasslands or crop stubble, particularly during rodent plagues (TSSC 2019, Garnett & Baker 2020).

## 3.5. Breeding

In south-eastern Australia, including Tasmania, the Australasian Bittern breeds from October to February. There is thought to be fewer than 30 natural wetlands that support breeding in most years, or support more than one booming male (a breeding male, called a “booming” male as they make booming calls to set up and defend a breeding territory), with the number substantially lower in drought years. The rice fields of the NSW Riverina support a further 50 – 1130 km$^2$ of suitable breeding habitat (Garnett & Baker 2020). They breed in solitary pairs, however sometimes several nests may be placed in close proximity to each other (Marchant & Higgins 1990). The species nests adjacent to relatively deep, densely vegetated freshwater swamps and pools, building its nests under dense cover over shallow water (Marchant & Higgins 1990). It prefers to nest in vegetation that is up to 2.5 m tall and the nests are

placed about 30 cm above the water level (Marchant & Higgins 1990). If population densities are high, it may nest in open wetlands, such as in stunted *Acacia* swamps (Marchant & Higgins 1990).

## 3.6. Movements

Very little is known about the movements of the Australasian Bittern. It is thought that around 950 birds within the eastern mainland population inhabit the Murray-Darling Basin, of which half move to the coast in winter where another 200 live year-round (Garnett & Baker 2020). A recent study of five satellite tagged individuals breeding in the rice fields of the NSW Riverina showed that birds from the Riverina dispersed to coastal wetlands in Victoria, South Australia and New South Wales and to wetlands in northern Victoria (Herring *et al*. 2019).

## 3.7. Conservation Status

Australasian Bitterns are listed as “Endangered” on the Commonwealth *Environment Protection and Biodiversity Act 1999* (EPBC Act). They are also listed as “Endangered” in the NSW *Biodiversity Conservation Act 2016* (Department of Environment, Parks and Water Security 2021). Its’ distribution in Australia has shrunk by seventy percent between 1977 and 2008. These declines are considered to have led to a comparable decline in the size of the adult population. The declines are primarily linked to the clearing and drainage of permanent and ephemeral swamps for agriculture or urban development and the diversion of water for irrigation (Kingsford 2000).

# 4. Detailed Spatial Ecology Review

## 4.1. Breeding Period

The breeding season of the species varies depending on the type of breeding habitat used, as well as differing climatic conditions between years. In most natural wetlands used for breeding, the breeding season is from October-February (Marchant and Higgins 1990, Bitterns in Rice Project 2016).

The breeding period within rice crops in the Riverina region is perhaps the best-understood, and an estimated 59% of the national population breeds within this habitat (Herring et al. 2019). Birds using rice crops as breeding habitat typically commence their breeding season about 2-3 months later than other individuals (that are presumably using natural wetlands) (Herring 2022). In such environments, breeding usually commences in December, roughly 77 days on average after rice crop is flooded (Herring 2022). Incubation of eggs takes roughly 25 days, and chicks fledge roughly 88 days after breeding commences (i.e., late February - late March), although they leave the nest and begin exploring within two weeks of hatching (Herring 2022). Departure of all individuals from breeding grounds in rice crop coincides with crop harvest 165-171 days after the crops are flooded (i.e., in late March to early April) (Herring 2022).

## 4.2. Habitat Features

### *4.2.1. Permanent Wetlands*

#### *General Habitat Requirements*

Australasian Bitterns primarily use freshwater wetlands, although estuarine or tidal wetlands are occasionally used (Marchant and Higgins 1990). Preferred wetlands are typically the largest within the landscape, with little or no tree cover (Herring 2022). Within these environments, these birds prefer mosaics of dense emergent and/or fringing aquatic vegetation and more open areas, with vegetation being from 0.5-3.5 metres high (although heights of 0.8-2 metres are preferred) (Herring 2022). Typical habitat for this species, particularly within the Riverina, is dominated by sedges (e.g. Tall Spike-Rush *Eleocharis sphaecelata,* Common Spike-Rush *Eleocharis acuta*, , March Club-Rush *Bulboschoenus caldwellii* and species in genera including *Scirpus* and *Baumea*), reeds (e.g. Common Reed *Phragmites australis*)rushes (e.g. Giant Rush *Juncus ingens,* Cumbungi/Bulrush *Typha domingensis/orientalis*),Canegrass *Eragrostris australasica,* and Cutting-Grass *Gahnia grandis*, usually growing in a muddy or peaty substrate (Corrick and Norman 1980, Gosper 1981, Jaensch et al. 1988, Herring 2022). Where Cumbungi and Common Reed dominate a site, they can develop large amounts of rank growth and prevent Australasian Bitterns from using the site (Herring 2022).

Individuals within the Murray-Darling Basin also occur in floodplain swamps, many of them along the Murrumbidgee, Lachlan, Murray, Macquarie and Gwydir Rivers. These may have lignum shrubs (*Duma florulenta*) within sedge or reed beds (DCCEEW 2022).

Wetlands with vegetation communities suitable for Australasian Bitterns generally grow in water that is 0.1-1 m deep (Herring 2022).

The species was historically threatened by habitat loss, as diversion of water from watercourses for irrigation has resulted in the loss of many wetlands (including within the Murray-Darling Basin, a core part of the species' range) (Kingsford 2000, Jaensch 2005, DCCEEW 2022), although most permanent wetlands used by the species are now protected (Garnett and Baker 2020). This was exacerbated by changes in water regulation in the 1950s and has also made major flooding events much more uncommon in the MDB (DCCEEW 2022).

### *Foraging Habitat Requirements*

Within permanent wetlands, Australasian Bitterns forage by carefully watching for nearby aquatic animals, waiting for them to swim or move close enough for them to be captured by the bird striking or pouncing (Howard 1963, Falla 1963, Herring 2022). There are two main ways in which this species goes about doing this; either by wading through and waiting in still, shallow water up to 30 cm deep, often at the edges of pools or waterways, or by perching and hunting from platforms or mats of vegetation (often flattened reeds) over deep water, where remains of prey have been found (Bright 1935, Whiteside 1989, Serventy and Whittell 1976, DCCEEW 2022, Herring 2022). This species is known to use grass to bait fish (Onians 1933).

Since Australasian Bitterns hunt visually, they require clear water to forage, and although they rely on dense vegetation for shelter, roosting and nesting, they find it difficult to locate and access prey within it (Herring 2022). For this reason, they typically hunt at the edges of such vegetation rather than entirely within it and find it more difficult to forage in highly turbid water (Herring 2022). This may explain why they prefer mosaics of open and densely vegetated areas within wetlands – in areas where the cover of vegetation is too tall, thick and extensive, bitterns cannot locate and hunt prey efficiently (Herring 2022). Patchy burns are a mechanism capable of creating the mosaics of vegetation and open areas favoured by the species, and grazing outside the breeding season can also help prevent rank growth (e.g. from Cumbungi, Common Reed) from making a site unusable for them (Herring 2022).

Australasian Bitterns primarily feed on medium-sized aquatic animals, such as eels, frogs, and freshwater crayfish (Marchant and Higgins 1990). Prey is subdued by swallowing whole or shaking and battering (Potter 1950, Whiteside 1989, Herring 2022). Most activity (including feeding) occurs around dawn, early morning, late afternoon and dusk (Herring 2022).

Known prey items of Australasian Bitterns include spiders (Whiteside 1989), crustaceans (including freshwater crayfish) (Serventy and Whittell 1976), insects (including orthopterans/grasshoppers and weevils) (Cleland et al. 1918, Whiteside 1989), and fish (Cleland et al. 1918, Onians 1933). In New Zealand, they have been observed taking eels (up to 60 cm in length) (Potter 1950). Frogs (Wheeler 1950, Serventy and Whittell 1976), snakes (*Pseudechis nuchalis*) (Hobbs 1979), lizards (Marchant and Higgins 1990), other birds (including Silvereye *Zosterops lateralis*) (Buller 1888), rats and mice (Marchant and Higgins 1990), leaves (Marchant and Higgins 1990), and fruit (Cleland et al. 1918) are also known food items.

### *Nesting Habitat Requirements*

Although a fairly broad variety of wetlands are used by this species, breeding activity is only known from a small proportion of them (DCCEEW 2022). It is currently thought that fewer than 30 natural wetlands support breeding, or more than one “booming”/breeding male in most years, with substantially fewer in drought years (Garnett and Baker 2020). The Barmah-Millewa Ramsar Wetlands along the Murray River are considered the most important site for the species, particularly in terms of breeding activity, with up to 73 booming (breeding and territorial) males occurring there (Herring et al. 2019). The Bool-Hacks Lagoon System in South Australia is another very significant breeding site (possibly the second-most significant), with up to 20 booming males known from there (Herring et al. 2019, Herring 2022). Other particularly important wetlands for the species include the Lowbidgee Wetlands and Fivebough-Tuckerbil Wetlands from NSW (the latter of which had the largest group known, a loose aggregation of 34 individuals in 2015), and the Hirds-Johnson Swamp in Victoria (Herring 2022).

Breeding sites within permanent wetlands are typically located in wetlands that have densely vegetated areas (TSSC 2019). Males call (“boom”) from specific “booming” platforms of flattened emergent and/or

fringing aquatic vegetation early in the breeding season, to set up and defend breeding territories (Herring 2022). Within rushland, the species appears to avoid nesting in the densest areas (Bright 1935), and in reedbeds, small patches seem to be preferred over large, continuous areas covered by reeds (DCCEEW 2022). When population densities are high, Australasian Bitterns have been known to nest in more open wetlands, like stunted *Acacia* spp. swamps, and have also been known to use stunted bushes and trees in areas of short (30 cm) grass (Hobbs 1961).

Nests are normally built in dense vegetation up to 2.5 m tall, over shallow water adjacent to deep areas, placed roughly 30 cm above the water level (although water levels may recede over the course of the breeding season, leaving the nest higher above the water) (Marchant and Higgins 1990, TSSC 2019). Stable water levels are ideal during the nesting season (Herring 2022). If water levels fluctuate too much in the nesting season, they can flood nests or cause abandonment (Herring 2022). Nests are well-constructed flat saucers of flat pieces of reeds or rushes broken off by the bird and laid across and across, at about 35-40 cm in diameter and 20-22 cm thick (Marchant and Higgins 1990). Some nests are protected by stems of growing weeds being interwoven above the nest (Marchant and Higgins 1990).

### *4.2.2. Rice Crops and Associated Irrigation*

#### *General Habitat Requirements*

Within the Murray-Darling Basin and the NSW Riverina, the Australasian Bittern is known to occur and breed within commercial rice-fields (Marchant and Higgins 1990, DCCEEW 2022). Although artificial, these are effectively seasonal freshwater wetlands, and they support the largest-known population of Australasian Bitterns (see Section 3.3.2.). Rice fields provide 50-1130 km$^2$ of breeding habitat for this species – this amount is quite variable (over an order of magnitude variation) as the extent of rice-growing is determined by year-to-year water availability (Garnett and Baker 2020).

Rice fields are typically flooded from October-April, with the rice growing to a maximum of 1.1 metres high, and with water depths usually around 15-25 cm (DCCEEW 2022). After the rice is harvested, between rice-growing seasons, Australasian Bitterns move from the crop fields. Many of them (approximately 50% of birds in the Murray-Darling Basin) do not move very far and use the irrigation structures typically surrounding rice (e.g., vegetated channels, recycle dams) until the rice fields are ready to support them again (Garnett and Baker 2020, DCCEEW 2022). Storage dams (at least several hectares in size) and stock dams (with large overflow areas) can provide useful habitat for bitterns if they have extensive aquatic vegetation and shallow water (Herring 2022). As previously discussed, irrigation infrastructure, farm dams, and constructed wetlands can support the species outside the breeding season but will not if there is a lack of shallow water areas for foraging and aquatic emergent vegetation providing cover (Herring 2022).

Grassy (esp. Barnyard Grass *Echinochloa* spp.), vegetated banks adjacent to rice fields can provide additional bittern habitat in the form of cover from predators (Corrick and Norman 1980, Herring 2022).

#### *Foraging Habitat Requirements*

Within the Riverina, particularly important and heavily-used sources of food for adults include the noxious Common Carp *Cyprinus carpio* and the threatened Growling Grass Frog *Litoria raniformis* (Herring 2022, DCCEEW 2022). Chicks are fed smaller prey items (e.g., dragonfly larvae, tadpoles), although sometimes they can be fed larger items (they have been observed consuming fish approx. 20 cm long) (Herring 2022, DCCEEW 2022). Tadpoles and dragonfly larvae require time to hatch and build up in numbers within seasonal wetlands like rice fields (unlike other prey items like frogs and fish, which may move in as soon as or very soon after the rice is flooded). The time delay in the availability of the prey items typically fed

to chicks may be (at least partially) responsible for the lag between the flooding of rice crop and the initiation of Australasian Bittern breeding activity within it (DCCEEW 2022).

*Nesting Habitat Requirements*

Within rice fields, Australasian Bitterns commence nesting around December-January, once the rice has grown enough to provide sufficient cover, and sufficient numbers of aquatic prey animals have moved into and bred up within the rice fields (DCCEEW 2022). In "early permanent water" crops, flooding consistently occurs from October-April, which is a sufficiently long period to give chicks of the species a relatively high chance of fledging prior to harvest (beyond which, the rice fields become unsuitable habitat) (Herring 2022, DCCEEW 2022). In "delayed permanent water" crops (e.g., shorter-season varieties), as well as areas where mid-season drainage is practiced, the flooding period is reduced, and this reduces the chances of successful breeding (DCCEEW 2022).

### *4.2.3. Other Ephemeral Wetlands*

*General Habitat Requirements*

Australasian Bitterns are known to use ephemeral wetlands, including those that fill infrequently during exceptionally wet years (Garnett et al. 2011) – monitoring data has shown that seasonal movements (including into such habitats) occurs, and that the species is responsive to favourable conditions (e.g. flooding) at particular wetlands, gathering there in relatively high densities at these times (Garnett et al. 2011). The species also uses temporary wetlands when dispersing from drying areas (Garnett et al. 2011).

The species was historically threatened by habitat loss, as diversion of water from watercourses for irrigation has resulted in the loss of many wetlands (including within the Murray-Darling Basin, a core part of the species range) (Kingsford 2000, Jaensch 2005, DCCEEW 2022), although most permanent wetlands used by the species are now protected (Garnett and Baker 2020). This was exacerbated by changes in water regulation in the 1950s and has also made major flooding events much more uncommon in the MDB (DCCEEW 2022).

*Foraging Habitat Requirements*

The ephemeral wetlands created by flooding during exceptionally wet years are often highly productive habitats, accompanied by intense bursts of breeding and growth activity by animals and plants (DoEE 2016), and by subsequent irruptive increases in the population densities of prey items at these locations. Therefore, it is likely that the Australasian Bittern's heavy use of such environments during substantial floods (Garnett et al. 2011) occurs in order to take advantage of the rich foraging opportunities they present.

Australasian Bitterns are also known to use dry areas, such as grasslands and crop-stubble, for foraging, particularly during rodent plagues when they feed on rats and mice (TSSC 2019, Garnett and Baker 2021). These may provide a food source for birds that (presumably temporarily) remain in certain ephemerally-flooded areas once floodwaters recede, as the rich plant growth that follows flooding (DoEE 2016) can fuel heavy population increases in these prey items.

*Nesting Habitat Requirements*

Although it is well-established that Australasian Bitterns may forage from and even undertake substantial movements to take advantage of the rich food sources that accompany the flooding of ephemeral wetlands, it is unclear whether they use such areas for breeding. Although the species breeds in rice fields, which are temporarily flooded from October-April (Marchant and Higgins 1990, DCCEEW 2022), there is typically just enough time for chicks to fledge and to be able to disperse from these crops before they are drained and harvested (Herring 2022), so any ephemeral wetland that Australasian Bitterns use

for breeding would need to be flooded for at least as long, and need to flood between September and March (Herring 2022).

Presumably, the structure and location of any Australasian Bittern nests in ephemeral wetlands will be similar to those in permanent wetlands – circular platforms of reeds and rushes (Marchant and Higgins 1990) within (usually small patches or mosaics of) dense emergent and fringing aquatic vegetation over shallow (approx. 30 cm) water (Marchant and Higgins 1990, DCCEEW 2022), although nests in other locations (e.g. within stunted *Acacia* spp. shrubs within open swamps) are possible (Hobbs 1961).

## 4.3. Population Information and Movements

Creating population estimates for the Australasian Bittern in any environment is challenging for several reasons. First, such estimates make heavy use of skewed citizen science records, and although some statistical methods can at least partially address this, there remains the risk of bias (or at least, imprecise estimates) (DCCEEW 2022). Furthermore, substantial uncertainty over population trends across the range of the species exists (DCCEEW 2022). Both of these issues are at least partly driven by the swampy (and therefore often inaccessible) habitat of the species as well as its secretive nature, although a number of studies within the last two decades have produced improvements in the knowledge and estimates of occurrence and numbers (Herring et al. 2016, 2019). Finally, immature Nankeen Night Herons (*Nycticorax caledonicus*) and Australian Little Bitterns (*Ixobrychus dubius*) can be misidentified as Australasian Bitterns by inexperienced observers, which adds further uncertainty to the data used to generate population estimates (DCCEEW 2022).

### *4.3.1. Permanent Wetlands*

*Population Size (incl. change over time within and between years)*

Australasian Bittern populations within permanent wetlands are likely to change within (and possibly between) years, although they probably fluctuate less than in other environments. This is because the populations within these environments are likely composed of sedentary, breeding resident birds, as well as (during the non-breeding season) migratory individuals that move in during the non-breeding season from nearby and distant ephemeral wetlands (Garnett and Baker 2020).

There are likely 1300 mature individuals within the Australian population of the Australasian Bittern, and <2000 mature individuals worldwide (Garnett and Baker 2020). Garnett and Baker (2020) state that approximately 200 individuals are thought to be permanent residents in (presumably permanent) coastal wetlands within south-eastern Australia. Of the 950 birds in the Murray-Darling Basin, 750 are thought to breed in the rice fields of the Riverina (Garnett and Baker 2020, Herring 2022), so if it is assumed the remaining 200 individuals are all sedentary breeding residents of permanent inland wetlands (this is likely an overestimate but gives an upper limit), there are unlikely to be more than 400 individuals that are sedentary breeding residents of permanent wetlands.

The number of Australasian Bitterns in permanent wetlands may increase during the non-breeding season, as more individuals are likely to occur in permanent wetlands during the non-breeding season. Garnett and Baker (2020) state that, of the approximately 950 birds that occur (and presumably breed) in the Murray-Darling Basin, about half of them (approx. 475 birds) migrate to (presumably permanent) coastal wetlands in winter. For example, at monthly-monitored wetlands near Melbourne, an increase in the number of individuals present occurs in the non-breeding season (April-October), with numbers peaking in August (DCCEEW 2022). Such movements would increase the number of birds in coastal (and presumably permanent) wetlands to likely no less than 675 birds in winter (this is probably an underestimate, as birds dispersing to inland permanent wetlands are not considered), with another (up to) 200 sedentary residents in permanent inland wetlands and an unknown number of birds that disperse to them in the non-breeding season.

*Social Structures and Population Densities*

Within permanent wetlands, Australasian Bitterns breed either in solitary pairs, or in polygamous groups with up to three females per booming (breeding, territorial) male, each with their own nest (although these can be relatively close to each other) (Hobbs 1961, Bitterns in Rice Project 2016). Usually, 4-5 eggs are laid, but 3-6 eggs are possible (Serventy and Whittell 1976, Marchant and Higgins 1990). Outside the breeding season, dispersed aggregations of up to 34 birds are known from at least one permanent wetland that acts as a non-breeding season refuge (the Fivebough-Tuckerbil Wetlands) (Herring 2022).

Very little data exists on critical ages in the life history of the Australasian Bittern. Based on figures from the closely-related and ecologically similar Eurasian Bittern (*Botaurus stellaris*), the age of maturity is estimated to be one year, the life expectancy is estimated to be 11 years, and the generation length of the species is estimated to be 5.5 years (BirdLife International 2019).

### *4.3.2. Rice Crops and Associated Irrigation*

*Population Size (incl. change over time within and between years)*

There are likely 1300 mature individuals within the Australian population of the Australasian Bittern, and <2000 mature individuals worldwide (Garnett and Baker 2020). The majority of the Australasian Bittern population (estimated 750, possibly 500-1000 mature adults most years; 59%) and the largest known population (39% of the global population), is thought to breed within the rice fields of the Riverina (Herring et al. 2019). Occupancy models using data from 2013-17 from the NSW Riverina produced estimates of 368-409 individuals within “early permanent water” rice crops in the Murrumbidgee and Coleambally Irrigation Areas, so the total population estimate for the species within the Riverina rice fields includes both this figure and conservative estimates for the numbers within “delayed permanent water” crops and the unsurveyed Murray Irrigation Area (Herring et al. 2019). More broadly, across the Murray-Darling Basin, approximately 950 individuals are thought to occur, with about half of them (approx. 475 individuals) remaining in the Basin year-round (Garnett and Baker 2020).

Reporting rates have decreased by 63% in the Riverina from 1977-2008 (Birds Australia 2010; Garnett et al. 2011), with a national long-term rate of decline estimated at 20-30% over two generations (11 years in total). Several agricultural trends in the region, such as lower water allocations due to droughts, the increasing prevalence of cotton crops and other uses of irrigation water unfavourable to bitterns, and a decreasing prevalence of “early permanent water” rice crops that Australasian Bitterns prefer, suggest that the population of the species in the rice fields of the Riverina is likely to decline in future (Herring et al. 2019).

The population of the Australasian Bittern within rice crops is also likely to change substantially across the seasons within a year. This is because rice crops are seasonal and are only good breeding habitat for the species after they have been flooded for roughly 77 days – the period between this point and when the rice crops are drained and harvested is when the species breeds in this habitat (Herring 2022). For much of the year, after the rice has been harvested and before the next crop has been planted and flooded for a sufficient period, the areas where rice is grown are not suitable habitat and often dry, forcing individuals using rice crops as habitat are to move (Herring 2022). About 50% of individuals are thought to remain relatively close (Garnett and Baker 2020), within irrigation structures related to the growing of rice (e.g. vegetated channels, recycle dams), as well as nearby permanent wetlands (DCCEEW 2022), but the other 50% of individuals migrate long distances (400-600 km) to coastal wetlands in South Australia, Victoria and NSW (and are therefore absent from the Riverina rice regions at this time of year), before returning when the rice fields are suitable habitat once more (Bitterns in Rice Project 2019).

*Social Structures and Population Densities*

Similarly to within permanent wetlands, Australasian Bitterns occurring in rice fields breed either in solitary pairs, or in polygamous groups with up to three females per booming (breeding, territorial) male, each with their own nest (although these can be relatively close to each other) (Bitterns in Rice Project 2016). Usually, 4-5 eggs are laid, but 3-6 eggs are possible (Serventy and Whittell 1976, Marchant and Higgins 1990). Large gatherings are unlikely to occur within rice fields themselves, as these are breeding grounds where males are typically more territorial (Herring 2022). Such gatherings could occur in nearby irrigation structures that provide permanent habitat, but this is perhaps less likely than in permanent wetlands as the habitat quality in these structures can vary substantially, with many not supporting bitterns due to a lack of shallow water areas and aquatic vegetation (Herring 2022).

Very little data exists on critical ages in the life history of the Australasian Bittern. Based on figures from the closely-related and ecologically similar Eurasian Bittern (*Botaurus stellaris*), the age of maturity is estimated to be one year, the life expectancy is estimated to be 11 years, and the generation length of the species is estimated to be 5.5 years (BirdLife International 2019).

### *4.3.3. Other Ephemeral Wetlands*

#### *Population Size (incl. change over time within and between years)*

The size of the Australasian Bittern population breeding in or otherwise inhabiting ephemeral wetlands is likely to fluctuate significantly within and between years, depending on the type of ephemeral wetland. Seasonal wetlands that regularly flood for sufficient periods at the right time of year (slightly over five consecutive months between September-March – Herring 2022) may be used for breeding in a similar way to rice crops and may be subject to similar population dynamics where individuals arrive to breed, and subsequently disperse to nearby or distant permanent wetlands once they have dried (Bitterns in Rice Project 2019). It is difficult to estimate precisely how many individuals breed within ephemeral wetlands other than rice fields within Australia. There are approximately 950 individuals that breed within the Murray-Darling Basin, and 750 of them are thought to breed within rice fields in the Riverina (Herring 2022). On the assumption that the remaining individuals all breed in other ephemeral/seasonal wetlands in the Basin, a maximum of 200 individuals breed in such locations, although some of them are likely to be sedentary residents of permanent inland wetlands instead.

Ephemeral wetlands that are flooded infrequently, in exceptionally wet years, often provide rich food resources due to the intense bursts of growth (for aquatic plants), breeding activity and high densities (for prey species, e.g., fish, frogs, dragonflies) that often occur in these environments under these circumstances (DoEE 2016, Herring 2022). This can attract many individual birds to them, resulting in large increases to the local population (Marchant and Higgins 1990, Garnett et al. 2011). Conversely, once the floodwaters recede and the ephemeral wetlands dry, individuals exploiting the rich temporary food resources are likely to disperse, causing the local population to decrease substantially.

#### *Social Structures and Population Densities*

Australasian Bitterns have been known to occur and gather in high densities within ephemeral wetlands after they flood significantly (Garnett et al. 2011). However, because the occurrence of these wetlands depends on exceptional flooding, and is therefore rather erratic in occurrence and duration, they may not necessarily support bittern breeding activity. This is because they may not occur for sufficiently long periods of time to permit chicks to fledge and disperse before they dry out (Herring 2022).

Lack of breeding activity within infrequently-flooded ephemeral wetlands may partially explain the high densities of Australasian Bitterns sometimes observed in them, as when breeding the species becomes more territorial (Bitterns in Rice Project 2019, Herring 2022) – conversely, lack of breeding means individuals are more tolerant of each other and may gather in higher numbers and densities. The high

densities of prey that may be found in such environments when flooded significantly are another potential contributing factor to the high densities seen in such wetlands (DoEE 2016).

#### *4.3.4. Movements*

Broadly speaking, the Australasian Bittern tends to move between permanent wetlands, rice fields and other similar seasonal wetlands, and other (possibly infrequently flooded) ephemeral wetlands as follows:

Individuals that breed within permanent wetlands are likely permanent, sedentary breeding residents that may be found there year-round (Garnett and Baker 2020).

Individuals that breed in rice fields and other similar seasonal wetlands will occur in these environments during their breeding season (approx. October-February; approx. December-March/April in rice fields), and disperse to permanent wetland environments (or analogous artificial environments, such as irrigation structures including vegetated channels and recycle dams) outside the breeding season (approx. March/April-October) (Garnett and Baker 2020, DCCEEW 2022, Herring 2022). These permanent natural or artificial wetland environments can occur in the local area (this is particularly the case for irrigation structures) or can be very large distances (400-600 km) away (Herring et al. 2019, Herring 2022). The latter distances are typically travelled by individuals that breed inland within rice fields or other seasonal wetlands within the Murray-Darling Basin and disperse to permanent wetlands in coastal environments in South Australia, Victoria and NSW outside the breeding season (Herring et al. 2019).

During exceptionally wet years (i.e. on a less-than-annual basis), infrequently-flooded ephemeral wetlands may fill, providing an intense and temporary burst of foraging opportunities due to the high densities of frogs, fish, dragonflies and other aquatic organisms exploiting these conditions (DoEE 2016). Many Australasian Bitterns will journey to such wetlands to take advantage of this, and because of the high densities of prey and the lack of breeding behaviour in the species in these conditions (as the floodwaters are unlikely to last long enough), the bitterns can gather in high densities (Garnett et al. 2011). These types of wetlands typically occur inland, and many individuals may move there from other inland areas, and possibly also coastal areas, in order to exploit them (Bitterns in Rice Project 2019). Individuals that are already actively breeding may be less inclined to move (Herring 2022), as this may involve abandoning their eggs, or abandoning chicks before they leave the nest or fledge.

Only a handful of individuals so far have been tracked migrating between breeding areas in the Murray-Darling Basin and coastal wetlands (Bitterns in Rice Project 2019, Herring et al. 2019), so insufficient information exists to determine whether particular migration routes or corridors are used.

### 4.4. Flight Behaviour

#### *4.4.1. Flight Heights*

Australasian Bitterns are typically a low-flying species, particularly when flying over water or reeds (Jaensch 1982). However, they have been observed circling up to 300 m high (Hodgkin 1949), and therefore are known to fly at RSA height (at the bare minimum, they must fly at RSA heights on ascent to and descent from circling flights). Otherwise, very little is known about their flight heights.

#### *4.4.2. Local Flight Behaviour*

Male “booming” Australasian Bitterns have breeding ranges of 5-30 ha, within which one or several females nest (so far, up to three have been documented within a single male territory) (Herring 2022). However, in some territories of “booming males”, no nesting occurs, or no females are attracted to the area. Wetlands housing breeding territories vary in size and are known from wetlands 5-10 ha to 300 ha in size (Marchant and Higgins 1990).

Little else is known about the local flight behaviour of the Australasian Bittern. It may therefore be instructive to examine the flight behaviour of their better-studied close relative, the Eurasian Bittern, as it is reasonably likely that the flight patterns of these two taxonomically and ecologically similar species will be comparable.

Within a wetland, Eurasian Bitterns have been observed chasing each other, and this can be an element of their breeding and social behaviours (White, Purps and Alsbury 2006). The males usually forage near their booming platforms, and females typically from near their own nests (including directly from the nest, but also up to 30-300 metres from it, foraging diurnally although nests are left before dawn). Outside the breeding season, individuals appear to use particular roosts, leaving them at dawn to forage and returning at dusk (White, Purps and Alsbury 2006).

### *4.4.3. Long Range Flight Behaviours*

Satellite-tracking studies as well as regular seasonal fluctuations in numbers of Australasian Bitterns at certain sites have demonstrated that a proportion of the population of this species completes seasonal migratory movements between breeding and non-breeding habitats (Bitterns in Rice Project 2019, Herring et al. 2019, DCCEEW 2022). Individuals within this proportion of the population typically disperse into low densities and are scattered across breeding sites during the breeding season (Bitterns in Rice Project 2019), before gathering into permanent wetland habitats alongside resident individuals outside the breeding season (Bitterns in Rice Project 2019, Herring et al. 2019). In particular, juveniles and adult males have been satellite-tracked moving 400-600 km from breeding grounds in rice-growing areas within the Riverina, to wetlands in coastal South Australia e.g., Pick Swamp), Victoria (e.g., Tootgarook Wetlands in Mornington Peninsula) and NSW (e.g., Coomonderry Swamp near Shoalhaven Heads) after the breeding season (Bitterns in Rice Project 2019, Herring 2022). Post-breeding movements from rice and other ephemeral wetlands into permanent inland wetland systems, such as the Barmah-Millewa wetlands, have also been documented (Herring 2022).

It is unknown whether flights between breeding and non-breeding areas are usually done as single birds, pairs, or larger groups. Based on satellite-tracking data, some of these potentially long-distance movements occur at night (Bitterns in Rice Project 2019).

Movements into flooded ephemeral wetlands to exploit rich foraging opportunities may also occur (DoEE 2016, Herring 2022). It is unclear whether such behaviour is mainly confined to birds that migrate between breeding and non-breeding habitat, or if many resident birds at permanent wetlands also move to such habitats in these circumstances. Due to the erratic nature of major floods, such movements may not occur every year, or at the same time or same duration in years where it does occur. However, it is such movements can result in relatively high densities of the species occurring in flooded ephemeral wetlands (Garnett et al. 2011).

### *4.4.4. Risk Flight Behaviours*

Bittern species outside Australia have been known to collide with transmission lines (Rubolini et al. 2005) and although no collisions with wind turbines are known, flight heights for Australasian Bittern are poorly understood (although some flights at RSA height must occur – Hodgkin 1949), and they are known to fly in low light conditions which may impede their ability to avoid turbines (Bitterns in Rice Project 2019). Additionally, this species is known to make regional movements and may not necessarily confine themselves to local habitats (Bitterns in Rice Project 2019, Herring et al. 2019), and may therefore potentially fly through the proposed Junction Rivers Wind Project even if no suitable habitat is present within or near the wind farm footprint.

Since Australasian Bitterns are known to undertake long-distance flights at night (Bitterns in Rice Project 2019). They also fly regularly in low-light conditions, as they can undertake daily commuting flights

between roost and foraging areas and are most active around dawn and dusk (but also in the early morning and late afternoon (Herring 2022). Hence, it may potentially be difficult for them to see wind turbines and take evasive action accordingly when they fly in these low-light or night-time periods.

Australasian Bitterns must make at least some flights at RSA height (Hodgkin 1949), and the type of flight being made in this record was likely a circling display. Other types of flights they could make that are potentially at or above RSA height are flights moving from one wetland to another, with seasonal long-distance flights perhaps likeliest to involve flying high.

Long-distance flights between breeding and non-breeding habitat are likely to occur on a seasonal basis, at least twice a year (accounting for flights to and from ephemeral breeding grounds) (Bitterns in Rice Project 2019, Herring et al. 2019). More frequent long-distance flights are possible if floodwaters create large ephemeral wetlands that attract many individuals from significant distances away, and potentially also if wetlands that are normally permanent dry out during severe drought conditions and birds are forced to gather into drought refugia (Herring 2022).

It is unknown whether Australasian Bitterns make long-distance flights as individuals, pairs, or groups, and therefore what the risk of hitting relatively large numbers simultaneously or in short succession would be. The largest known gathering of the species was a loose aggregation of 34 individuals (Herring 2022), which suggests travelling flocks are unlikely to be larger than this. If travelling flocks larger than this were detected it would represent record-breaking gatherings of the species.

No more than approximately 475 individuals in total are thought to migrate between the Murray-Darling Basin and permanent coastal wetlands (Garnett and Baker 2020), which means this may effectively be considered the relevant regional population size of the species. The species has not been detected flying more than 600 km between inland and coastal habitats (so flight routes shorter than this that pass through the study area appear much likelier to occur than those that are longer) (Bitterns in Rice Project 2019, Herring et al. 2019).

# 5. Application: Analysis of nearby records

## 5.1. Literature

All satellite tagged Australian Bitterns were shown to move from their breeding habitat to the coast or central-northern Victoria (Bitterns in Rice Project 2019, Herring et al. 2019). All recorded movement paths were to the south and east of the study area. The closest dispersing individual was recorded in wetlands between Moulamein and Dilpurra NSW, approximately 40 km south-east of the proposed Junction Rivers Wind Project (Bitterns in Rice Project 2019).

## 5.2. Analysis of on-site habitat and regional records

Australian Bitterns have been recorded at very low densities in the vicinity of the study area (Thirty-two records in the last 30 years within 50km) (ALA 2023). Within the study area, there is normally no suitable habitat for Australasian Bittern (Nature Advisory 2023). However, in December 2022, a large lake (so called 'Condoulpe Lake') in the north-east of the study area was observed to have flooded (Schipper pers. comm.), and it was still flooded in late February-early March (Thomas pers. comm). This lake likely has brackish water, was observed to have some patches of dense emergent and fringing vegetation and is thought to be no more than 30-40 cm deep, with many areas likely shallower (Schipper pers. comm.). This falls within the parameters of foraging habitat for the Australasian Bittern, and this habitat was flooded for a sufficient duration in the breeding season for breeding to potentially have occurred (Herring 2022).

Conversely, however, although it is an ephemeral wetland, because it flooded during the breeding season of the species, it is unlikely to attract Australasian Bitterns in high numbers or densities – to move in from elsewhere and exploit the foraging resource presented by the lake, bitterns would need to abandon their breeding attempts at this time of year since they are closely tied to their breeding wetlands at this time (Herring 2022), and any birds breeding in the lake will be territorial (Herring 2022), which will limit the numbers and densities of bitterns found there. Additionally, any bitterns breeding in the lake are likely to confine their activities to the lake and not fly elsewhere until breeding activity has ceased (Herring 2022), and the species generally flies low over water and reeds (Jaensch 1982), significantly limiting their potential to collide with turbines.

A 400 m buffer around wetlands and watercourses is thought to be a buffer large enough to prevent most collisions between waterbirds using them and wind turbines (Lane pers. comm., Islam et al. 2022, Everaert date unknown). This is because, when moving between wetlands, many waterbirds typically fly at very high heights, and then circle down when directly above the wetland they are travelling to (Doughty pers. comm.). They are thought to fly at RSA height primarily during their ascent from and descent to wetlands, and not more than 400 m from the wetlands (Doughty pers. comm.). If a 400 m buffer is established around any such areas within the study area then it decreases the risk of collision further, as long as Australasian Bitterns fly in this way that is typical of most waterbirds (although this is largely unknown).

The risk to Australasian Bitterns colliding with turbines when making local flights is ultimately unlikely because the habitat in the study area flood due to a three-year back-to-back La Niña event, which is unlikely to occur more than once every 50 years or so (ARC Centre of Excellence for Climate Extremes 2022); therefore, there is a roughly 50% chance it would ever flood in a similar way over the entire lifespan of the proposed windfarm, and it is highly unlikely that it would happen more than once. This means that risk of the species colliding with wind turbines due to local flights would be unlikely to be above negligible for more than one breeding season over the lifespan of the proposed windfarm. Additionally, if suitable buffers are implemented and Australasian Bitterns fly in a similar way to most waterbirds for which the buffers were designed, the risk of mortality even during such a local flooding and breeding event can be

minimised effectively (Lane pers. comm.). Despite (cumulatively) over a decade of mortality monitoring at various wind farms in Victoria and NSW (Moloney et al. 2019, Symbolix 2020), the species has never been detected as a mortality at a wind farm. Furthermore, similar measures have prevented the Brolga, another large waterbird species thought to be more vulnerable to turbine collision, from having been detected as a mortality at the same wind farms discussed earlier (Moloney et al. 2019, Symbolix 2020,), despite Brolgas being even larger and far more conspicuous (and therefore very easy for mortality-monitoring observers to detect if present dead under turbines).

The other way an Australian Bittern could interact with the study area would be while travelling between major wetland complexes or watercourses (including initial flights to and final flights from the potential habitat in the study area). It is not known at what height Australian Bitterns fly at while undertaking these movements, but most waterbirds fly above RSA height, only flying at RSA height during ascent or descent on long-distance flights between wetlands, and even then, it is usually circling down within 400 m of wetlands (Doughty pers. comm.). If Australasian Bitterns fly in a similar way, they are unlikely to collide with turbines even if they do fly over the study area on long-distance flights.

If a conservative assumption is made that the species regularly flies at RSA height during long-distance flights (which, based on the behaviour of other waterbirds, seems unlikely), then assessing the risk of turbine collisions to Australasian Bitterns making long-range movements is more complex. It is considered below:

The Australasian Bittern records in the region surrounding the proposed Junction Rivers Wind Project fall into four main clusters, with the other records largely scattered and isolated across the region (Fig. 3):

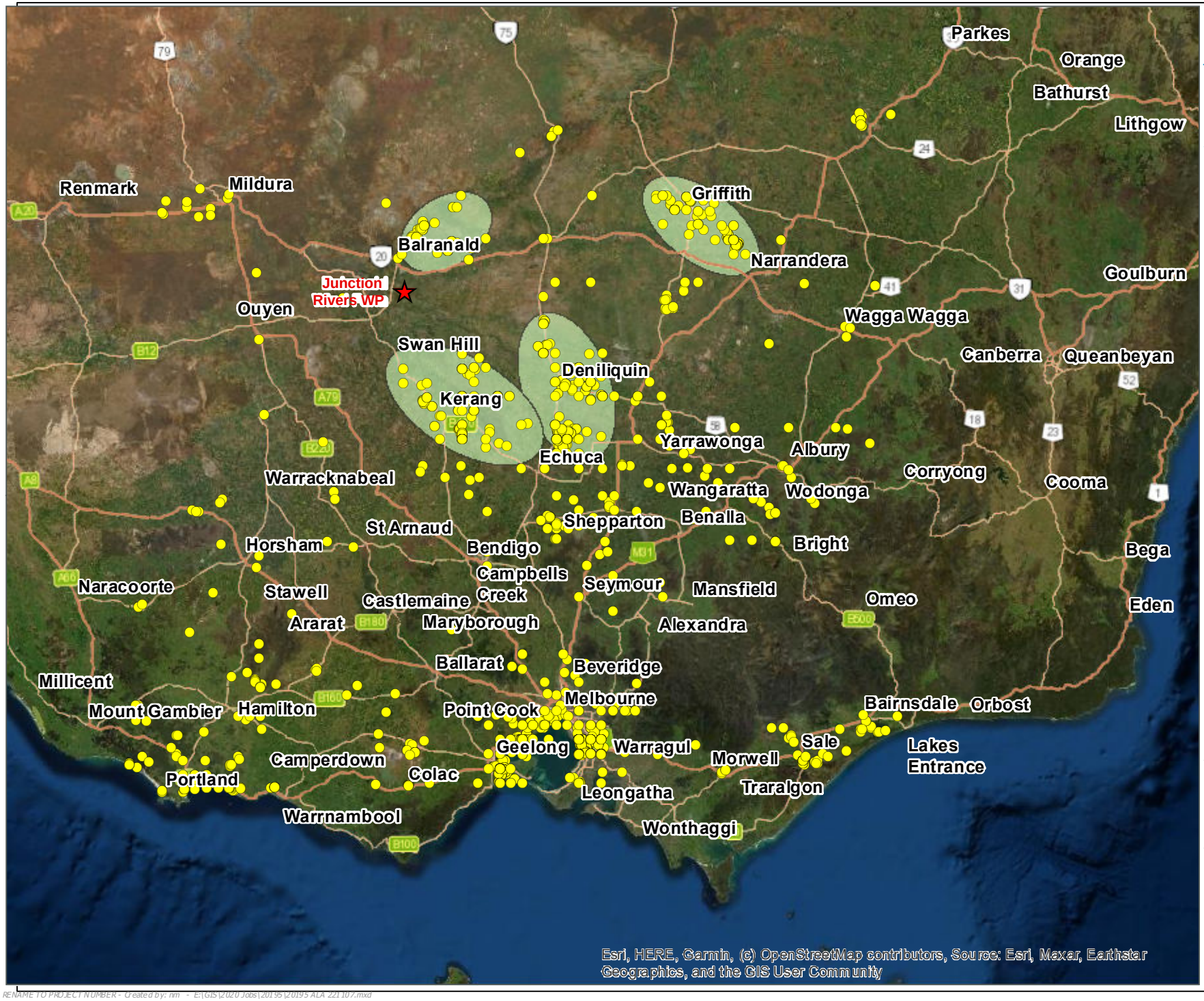



**Figure 1:** Australian Bittern Records (Scale 1:4,000,000)

**Project:** Junction Rivers Wind Project
**Client :** Windlab Pty Ltd
**Date :** 22/02/2024

Junction Rivers Wind Project

Australian Bittern records (last 30 years)

Distribution clusters

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- The closest cluster (Cluster 1) is associated with the wetlands around Murrumbidgee Valley National Park, and the closest edge of this cluster is approximately 11.3 km north-northeast of the proposed windfarm.
- The second-closest cluster (Cluster 2) is associated with a series of lakes and rivers in the Riverina roughly centred on an axis from Swan Hill to Moama, and the closest edge of this cluster is approximately 32 km south of the proposed windfarm. This cluster includes the Hirds-Johnson Swamp near Kerang.
- The second-farthest cluster (Cluster 3) extends along an axis from halfway between Deniliquin and Hay south to the Barmah-Millewa Ramsar wetland complex, and the closest edge of this cluster is approximately 86 km southeast of the proposed windfarm.
- The farthest cluster (Cluster 4) extends along an axis from near Narrandera to about 40 km northwest of Griffith. The closest edge of this cluster is approximately 189 km north-east of the proposed windfarm. This cluster includes Campbell's Wetland and the Fivebough-Tuckerbil Wetlands Ramsar site.

A scenario where Australasian Bitterns fly through the study area could occur in three ways; movements of individuals between the four clusters above, between the clusters and breeding grounds where the clusters represent records in non-breeding habitat, and between the clusters and large permanent inland and coastal wetlands where the clusters represent records in breeding habitat. Because the clusters contain both seasonal and permanent breeding wetlands, some overlap between these three categories can occur.

For the purposes of this analysis, all flights within approximately 10 km of the proposed Junction Rivers Wind Project boundary were considered as potentially passing through it.

### *5.2.1. Flights Between Clusters*

Flights between the clusters would only ever have a possibility of crossing through the study area if they occurred between the western half of Cluster 1 and the western third of Cluster 2, or between the southwestern edge of Cluster 1 and the Barmah-Millewa wetlands in Cluster 3. No flights between any other pair of clusters would cross into the study area.

### *5.2.2. Flights Between Clusters and Significant Permanent Wetlands*

Flights between Cluster 4 and the Hattah-Kulkyne Lakes Ramsar wetlands would have a possibility of crossing through the study area. Flights between Cluster 2 and the Riverlands Ramsar wetlands could also cross through the study area, as could flights between Cluster 1 and the wetlands at the SA-Victorian border. Flights between Cluster 4 (particularly from near the Fivebough-Tuckerbil Wetlands Ramsar site) and the Coorong, Lakes Alexandrina and Albert Ramsar wetlands could also cross through the study area, but the distance separating these two clusters along a line of travel that passes through or close to the study area exceeds (by approx. 50 km) the distance Australasian Bitterns are known to make long-distance movements over (600 km) (Herring et al. 2019).

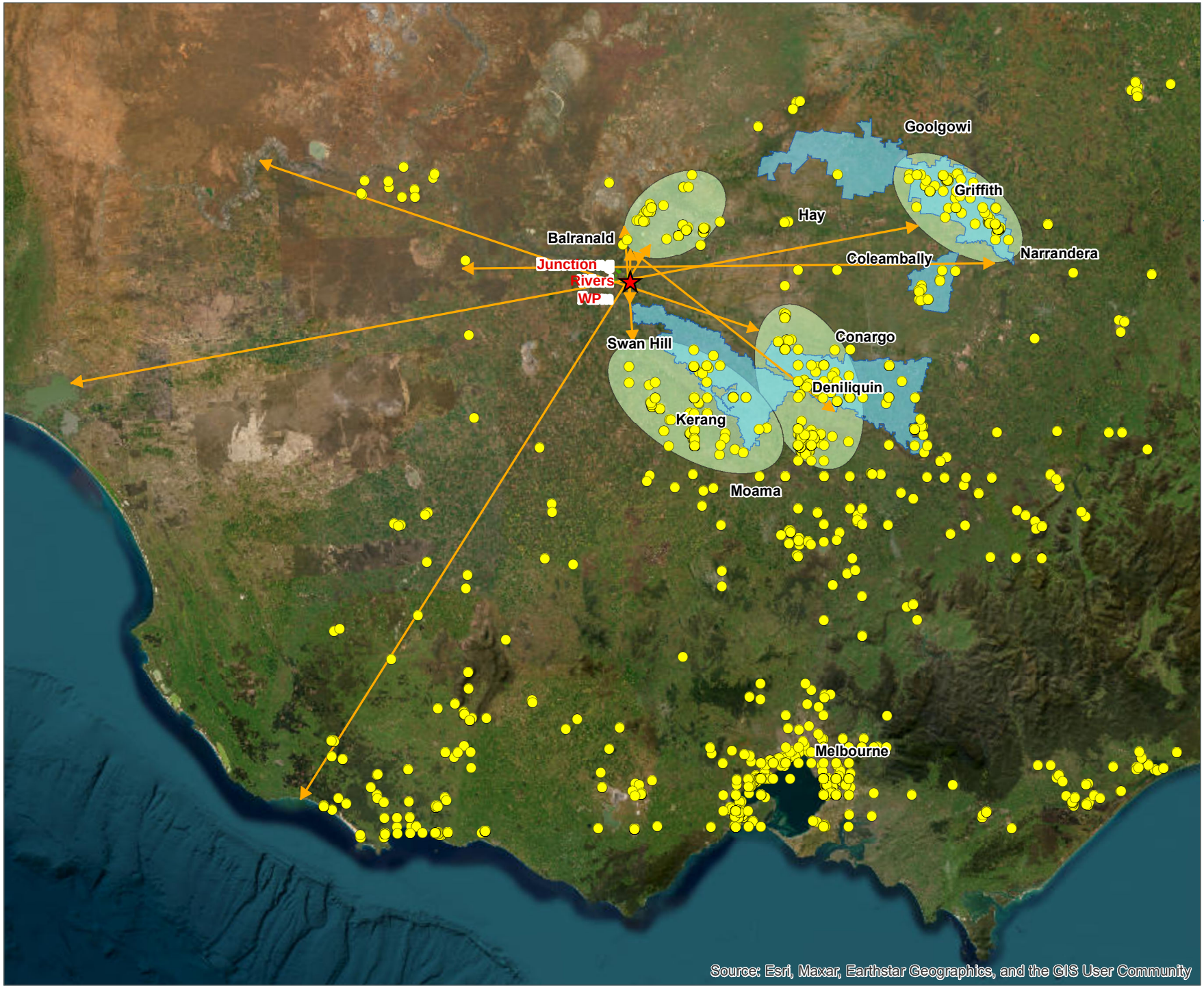
### *5.2.3. Flights Between Clusters and Seasonal Breeding Grounds*

Within the Riverina and lower Murray-Darling Basin, rice is primarily grown in the Murrumbidgee Irrigation Area, the Coleambally Irrigation Area and the Murray Irrigation District (Marsden Jacobs Associates 2020). Rice fields represent the primary seasonal breeding grounds of the Australasian Bittern (79% of the Murray-Darling Basin population, breeds in rice) (Garnett and Baker 2020). Therefore, movement between the clusters of Australasian Bittern records in Figure 3 and between seasonal breeding grounds is primarily between the clusters and the rice-growing areas specified above (shown in Fig. 4).The

Murrumbidgee Irrigation Area (Fig. 4) is located north of the Murrumbidgee River, beginning from Narrandera at its eastern end, extending north-west to Tabbita and Goolgowi, and west along Mirrool Creek to approximately halfway between Griffith and Balranald, just north of Hay. No flights between any of the clusters and the Murrumbidgee Irrigation Area would pass through the study area.

The Coleambally Irrigation Area (Fig. 4) is located just south of the Murrumbidgee River. Coleambally is located in its north-west corner, and the area extends south-east about halfway from Coleambally to Urana, its eastern edge extends north to near the Murrumbidgee River, and the south-western corner extends to about one third of the way between the Murrumbidgee and Murray Rivers. No flights between any of the clusters and the Coleambally Irrigation Area would pass through the study area.

The Murray Irrigation District (Fig. 4) is located just north of the Murray River. It extends from Mulwala in the east along and north of the Murray River, westwards to approximately halfway between Swan Hill and Balranald, and north almost to Conargo. Only flights between the western edge of Cluster 1 and the western tip of the Murray Irrigation District would pass through the study area.




# Figure 4: Major rice-growing areas in the NSW Riverina, and flight routes between record clusters and other sites

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 2202/2024

- Junction Rivers Wind Project
- Distribution clusters
- Major rice growing areas (irrigation areas)
- Australasian Bittern records (last 30 years)
- Long-distance risk flights

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### *5.2.4. Worst-case and Likely Scenarios*

Currently, only 10 Australasian Bitterns have been satellite-tracked, and none of them have been mature females (Bitterns in Rice Project 2019), so existing understanding of the long-distance movements of the species are incomplete. Nevertheless, none of the risk flights outlined in Sections 4.2.1. to 4.2.3. (Fig. 4) have ever been documented (Bitterns in Rice Project 2019).

Of the discussed significant permanent wetlands outside the clusters, Australasian Bitterns have been recorded at the:

- Hattah-Kulkyne Lakes Ramsar wetlands but the site has been assessed as unlikely to support the species (Butcher and Hale 2011).
- Riverlands Ramsar wetlands (Newall et al. 2009)
- wetlands at the SA-Victorian border (e.g. Long Swamp, Pick Swamp), with the Bool-Hacks Lagoon System noted as being particularly important for the species (Herring et al. 2019, Herring 2022)
- Coorong, Lakes Alexandrina and Albert Ramsar wetlands (DEWNR 2013), but this site is more than 600km away from Cluster 4, which is above the maximum distance between breeding and non-breeding habitat the species has been recorded travelling (Herring et al. 2019).

There is therefore some basis for thinking that flights could occur between these particular wetlands (except for the Hattah-Kulkyne wetlands) and the clusters of Australasian Bittern records in the region surrounding the study area.

All clusters of Australasian Bittern records have potential, straight-line flight routes to and from significant permanent wetlands and seasonal breeding grounds that could pass through the study area. Some of the flight routes between clusters, significant permanent wetlands and seasonal breeding grounds are the same aand there is some overlap between these areas. Cluster 1 has eight different flight routes (including flights both to and from Cluster 1) that could pass through the study area. Cluster 2 has four such flight routes, Cluster 3 has two such flight routes, and Cluster 4 has two such flight routes (Fig.4). Almost all these flight routes (apart from that between Cluster 4 and the Coorong, Lakes Alexandrina and Albert Ramsar wetland, as previously described), are less than 600 km in length, and therefore within the known long-distance flight range for the species (Herring et al. 2019).

In all clusters, a large majority of Australasian Bittern records occur during the breeding season of the species (approximately October-February), with Cluster 1 having practically no records outside this period (ALA 2023). This could indicate that the clusters largely represent seasonal breeding habitat for the species (most likely rice, as Clusters 2-4 overlap with major rice-growing areas), with a relatively small proportion of permanent wetland habitat in Clusters 2-4. According to this line of reasoning, flights between the clusters are therefore less likely than flights to large permanent wetlands beyond the region surrounding the study area, in which the clusters are located. This is further substantiated by the fact that none of the clusters have a corresponding increase in records when there is a decrease in records in other clusters (which is what would be expected if large-scale movements between the clusters occurred) (ALA 2023).

Of the large permanent wetlands discussed, there are few records of Australasian Bittern from the Hattah-Kulkyne Lakes and Riverlands Ramsar wetland sites, which could suggest flights to these areas are unlikely (ALA 2023). In contrast, there are many more records (including direct satellite-tracking of birds) in permanent coastal wetlands of known significance, such as Long Swamp, Pick Swamp, and the Bool-Hacks Lagoon System near the SA-Victorian border, Tootgarook, the Port Phillip Bay and Western Port Ramsar wetland sites near Melbourne, and along the Shoalhaven River and Shoalhaven Heads in NSW (Herring et al. 2019). Additionally, 50% of the Australasian Bittern population in the Murray-Darling Basin is thought to migrate to such permanent coastal wetlands after the breeding season (Garnett and Baker

2020). Therefore, flights between clusters and permanent coastal wetlands are more likely. This would mean that the likeliest long-distance flight routes to pass through the study area are the following:

- Flights between Cluster 1 and wetlands near the SA-Victorian border (Fig. 4).

- Flights between Cluster 1 and the Barmah-Millewa Ramsar wetland complex (Fig. 4). Notably, this is an inland rather than a coastal site, and only birds flying to or from the southwestern edge of Cluster 1 would pass through the study area, but this route is on this list as this site is thought to be the most important for the species.

- Flights between Cluster 4 (particularly the Fivebough-Tuckerbil Wetlands Ramsar site) and the Coorong, Lakes Alexandrina and Albert Ramsar wetlands near Adelaide (Fig. 4). Notably, however, only birds flying to or from the southern half of Cluster 4 (which includes the Fivebough-Tuckerbil Wetlands) would pass through the study area, and the distance between the cluster and this site exceeds 600 km (minimum distance 645 km), which is the current upper limit of known migratory movement in the Australasian Bittern (Herring et al. 2019).

Therefore, if Australasian Bitterns were to fly through the study area, it would most likely be axes running north-northeast and south-southwest of the study area, north-northwest and southeast of the study area, and east-northeast and west of the study area. Such flights would likely occur from September-early December (with individuals breeding rice generally arriving relatively late), and from late February-early April (with individuals that bred/were hatched in rice generally leaving relatively late) (Herring 2022). Since the species is known to fly through RSA height (Hodgkin 1949) and flight heights during long-distance flights are currently unknown, it should be presumed that at least some individuals that could fly through the study area may be doing so at RSA height. The size of groups undertaking long-distance flights is also unknown – the largest known group of individuals was a loose aggregation of 34 at the Fivebough-Tuckerbil Wetlands Ramsar site in Cluster 4 in the non-breeding season in 2015, so a group this size is theoretically possible. However, given that the species usually occurs in low densities and can be territorial, flocks (if any) are very likely to be much smaller than this, although multiple flocks could fly across the study area during the migration windows. Finally, the species is known to fly in low-light conditions, being active at dawn and the early morning, in the late afternoon and dusk (Herring 2022) and is known to make long-distance flights at night (Bitterns in Rice Project 2019). In these low-light conditions, individuals could have greater difficulty detecting and therefore evading obstacles (such as wind turbines and powerlines) than birds flying during the day, an idea supported by the fact that their close relatives in Europe are known to collide with powerlines (Rubolini et al. 2005).

Based on the above, it should be considered possible that a handful of individuals could collide with wind turbines or powerlines of the proposed windfarm in the study area in both spring-early summer, and late summer-early autumn. 475 individuals are thought to currently inhabit the Murray-Darling Basin and migrate to permanent coastal wetlands outside the breeding season, and if this number is assumed to represent the relevant regional population of the species (this is likely an underestimate but gives a lower limiting figure since some of the remaining 475 birds will also move long distances but to permanent inland wetlands) up to 25% of this population could be lost due to collision with wind turbines over the approximately 20-year lifespan of the proposed wind farm, which is likely to have long-term significantly detrimental impacts to the population. However, this represents a worst-case scenario. To begin with, many waterbirds fly above RSA height when making long-distance movements, and it is entirely conceivable that this applies to the Australasian Bittern as well, which would make any collision with turbines on such flights highly unlikely. Additionally, Australasian Bitterns have never been detected as mortalities at a number of wind farms that (cumulatively) have been monitored for bird and bat mortalities

for over a decade (Moloney et al. 2019, Symbolix 2020), indicating their behaviour generally does not make them susceptible to turbine strike. Furthermore, in the majority of wind farms in the country, practically no species normally reach this level of mortality (with the possible exceptions of the Wedge-tailed Eagle, White-striped Freetail Bat and Gould's Wattled Bat) Careful management and planning, including the implementation of 400-metre buffer zones around wetland areas, have meant that other large waterbirds thought to be more susceptible to collision with turbines (e.g. Brolga) than the Australasian Bittern have never been detected as a mortality at wind farms across Australia either (Moloney et al. 2019, Symbolix 2020). It is much more likely that at most, a handful of individuals will collide with turbines over the entire roughly 20-year lifespan of the wind farm, rather than each year it is operational.

## 5.3. Limitations of analysis

The above analysis is subject to the following limitations:

- The dip in Australasian Bittern records in the four clusters in the non-breeding months (ALA 2023) may not necessarily be entirely driven by individuals departing from seasonal breeding grounds and making long-distance movements to other wetlands. This species is very cryptic, and one of the best ways to detect it is by listening for the distinctive "booming" calls of males attempting to breed during the breeding season (Herring 2022) – in fact, this is the most key aspect of targeted surveys for this species, which aim to maximise the probability of detecting it. Furthermore, many of the records in the clusters in the breeding season likely come from rice fields where observers are likely to be present somewhat regularly, whereas outside the breeding season, most remaining individuals will be in permanent wetland habitats where observer presence is less likely. Therefore, outside the breeding season, Australasian Bitterns are very likely to be significantly more difficult to detect and observe. This decrease in the detectability of the species outside its breeding season could be at least partially responsible for the lower numbers of records in the four clusters outside the breeding season. If this is the case, the clusters could contain a much larger component of permanent wetland breeding areas than has been considered here, which would make flights between clusters and seasonal breeding grounds (especially rice fields) more likely. In this scenario, the most likely flight route to pass through the study area would be flights between Cluster 1 north of the study area and the Murray Irrigation District south and southeast of it. The lower number of flight routes going through the wind farm would lead to a corresponding decrease in the risk of Australasian Bitterns being hit by turbines, with up to 10% of the migratory Murray-Darling Basin population being lost in some of the worst scenarios, less than what is currently considered a theoretical possibility.

- The coastal wetlands considered are thought to be areas where birds using seasonal breeding grounds disperse to at the conclusion of the breeding season (Herring et al. 2019, ALA 2023). However, only the habitats in the vicinity of Melbourne show an actual increase in the number of records during the non-breeding season (ALA 2023). The non-breeding months at other coastal wetlands considered still have similar or lower (but with a smaller difference than the clusters) numbers of records compared to the breeding months (ALA 2023). As previously stated, the species is more detectable during the breeding season, and this may be responsible for the lack of difference or slightly smaller number of records in non-breeding compared to breeding months in the other coastal wetlands.

- There were few observations of Australasian Bitterns in the Hattah-Kulkyne Lakes and Riverlands Ramsar wetland sites (ALA 2023), and the Hattah-Kulkyne Lakes Ramsar wetlands have been assessed as unlikely to support the species (Butcher and Hale 2011). However, in the case of the Riverlands Ramsar wetland, rather than this being due to the species being present only occasionally or in small numbers in these wetlands, this may be due to low observer effort. This wetland is the most remote of all the wetlands that have been considered in this report, and since Australasian Bitterns are normally difficult birds to observe at the best of times, the poorer accessibility of this site could have really depressed the number of records coming from their relative to other wetlands considered. If this area is more important to the species than was assumed in Section 4.2.4., there could be a reasonable chance of flights occurring between it and Cluster 3. These largely east-west running flights pass through the study area and would provide an additional (if small) opportunity for individuals to collide with turbines during the migration windows of the species (Fig. 4).

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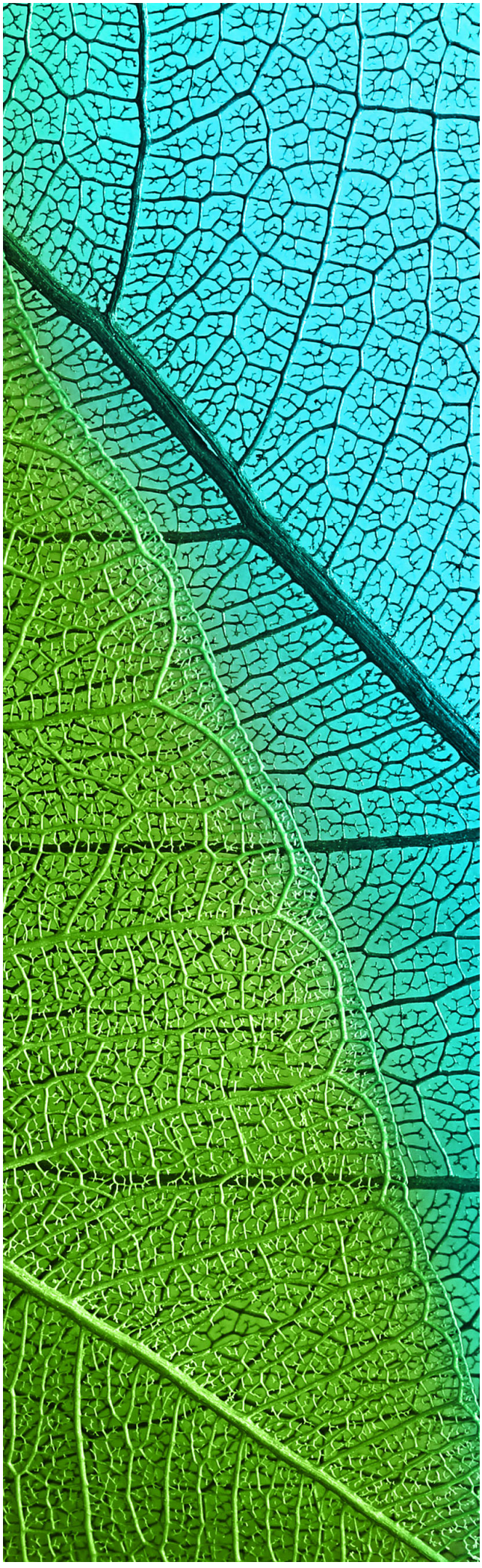
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# Junction Rivers Wind Project

## Regent Parrot Targeted Assessment Report

**Prepared for Windlab Pty Ltd**

February 2024
Report No. 20195.06 (1.2)

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# 1. Executive summary

Nature Advisory Pty Ltd undertook a targeted assessment Regent Parrot (eastern subspecies (*Polytelis anthopeplus monarchoides*)) at the proposed Junction Rivers Wind Project. This investigation was commissioned by Windlab Pty Ltd (Windlab) to provide detailed information on the utilisation of the study area by the Regent Parrot for the purposes of decision-making by Windlab regarding the layout and design of turbines at the proposed windfarm. Nature Advisory aim to provide guidance to Windlab to avoid and mitigate potential impacts on this species and it's habitat by recommending strategies to reduce or eliminate the risk of a turbine strike occurring. Guidance is also provided to avoid and reduce the potential impact to foraging and roosting habitat of the Regent Parrot.

Previous studies by Nature Advisory have shown that the Regent Parrot utilises the study area as foraging habitat and commutes between patches of remanent mallee within the study area. It also commutes between the study area and remanent mallee outside of the study area. Areas of breeding habitat are likely to occur outside the study area along the Murrumbidgee and Edwards Rivers. Daily commutes to and from these areas would result in Regent Parrot movements along the western boundary of the proposed windfarm.

Potential impacts from the project on the species includes:

- Potential removal of suitable foraging and roosting habitat.
- Barrier effects resulting from the potential removal of foraging and roosting habitat along established movement corridors.
- The planned location of turbines.
- Collision with operating turbines.

Design recommendations include the following:

- Ensure a 100-metre turbine free buffer (including all parts of the structure and blades) is established surrounding areas identified as suitable foraging and roosting habitat and along known movement corridors.
- Ensure all suitable roosting and foraging habitat (mallee woodland) is identified and mapped within the development corridor to ensure this habitat is not removed during construction in areas where this habitat is likely to provide a movement corridor for the species.
- Design to avoid the removal of mallee woodland identified as suitable habitat for foraging and roosting in other areas of the subject site where possible.

A referral under the *Environment Protection and Biodiversity Conservation Act 1999* is recommended for the project.

# 2. Introduction

Windlab engaged Nature Advisory to conduct a targeted assessment for Regent Parrot at the proposed Junction Rivers Wind Project (JRWP). Nature Advisory designed survey methodology that aimed to capture in detail how and where the Regent Parrot is currently utilizing the windfarm study area. As a result of the assessment Nature Advisory will outline any implications under various national, state and local legislation and policy resulting for the survey results.

Specifically, the scope of the targeted assessment included the following.

- A review and background of the Regent Parrot at the proposed Junction Rivers Wind Project.
- Habitat mapping for the Regent Parrot at the JRWP including:
    - Mapping all foraging and roosting habitat within the proposed windfarm study area in areas identified during the targeted assessment.
    - Identify and map if any breeding habitat occurs within or immediately adjacent to the study area.

Roaming and transect surveys were undertaken in all identified habitat. The observer conducted vehicle-based and walked roaming surveys and point-count surveys.

This report presents the findings of the targeted assessment, identifies relevant issues and provides recommendations and mitigation options, and is divided into the sections described below.

**Section 3** presents the sources of information and biology of the Regent Parrot.

**Section 4** presents the methods of the surveys.

**Section 5** presents the results of the targeted assessment.

**Section 6** presents the regulatory implications.

**Section 7** presents the conclusions and recommendations.

This investigation was undertaken by a team from Nature Advisory, comprising Gavin Thomas (Senior Ecologist), Philip Allen (Zoologist), Clint Schipper (Zoologist), Nhung Thi Hong Nguyen (Senior GIS Analyst), Curtis Doughty (Senior Zoologist) and Bernard O'Callaghan (Director).

# 3. Regent Parrot biology

## 3.1. Description

The Regent Parrot is a slim medium-sized parrot (37 to 42cm) with a long narrow tail and pointed backswept wings. It is mostly yellow with contrasting blue-black wings and tail, and prominent yellow shoulder patch and red patches in the wings and under the tail. The female's plumage is duller and greener than the male. It is often first detected in flight by its distinctive call, describe as a harsh rolling 'carrack-carrack'.

## 3.2. Habitat

This species breeds in riverine forests of River Red Gum (*Eucalyptus camaldulensis*) and forages widely in mallee and agricultural landscapes (Menkhorst *et al*. 2017). It will use remnant woodlands along roadsides or in farm paddocks for movement and occasionally foraging; rarely use more extensively cleared areas (Webster & Leslie 1997; Higgins 1999IN). Relatively little is known about the habitat utilised by Regent Parrot during the non-breeding season, though they are known to remain within the Murray-Darling Basin all year round. Some birds appear to move away from their riverine breeding areas and will use mallee woodlands for foraging up to 100 kilometres from the river (Joseph 1978; Burbidge 1985; Baker-Gabb 1997).

## 3.3. Distribution

The eastern subspecies of the Regent Parrot *Polytelis anthopeplus monarchoides* is restricted to a single population, occurring inland south-eastern Australia, in the lower Murray-Darling basin region of South Australia, New South Wales and Victoria. Within this range, the Regent Parrot occurs in riverine and mallee woodlands and forests.

## 3.4. Threats

The eastern subspecies Regent Parrot has suffered a decline in range and abundance over the last 100 years. Major threats include clearing and degradation of nesting and foraging habitat, disturbance around nesting sites, competition for nest hollows, deliberate killing of birds, road kills and accidental poisoning.

## 3.5. Legislative protection

The eastern subspecies of the Regent Parrot is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Endangered under the New South Wales state *Biodiversity Conservation Act 2016* (BC Act).

# 4. Methods

## 4.1. Existing information

Existing species records and information regarding the potential occurrence of listed matters of national environmental significance were obtained from an area termed the 'search region', defined here as an area with a radius of 10 kilometres boundary of the proposed windfarm study area boundary. A list of records was obtained from NSW Bionet Atlas search (DPIE 2023). These records are mapped in Figure 1. Information from previous Nature Advisory studies was reviewed prior to undertaking the targeted assessment, this information is contained in the following report:

- Junction Rivers Wind Project – Bird and Bat Baseline Report (Nature Advisory 2023).

## 4.2. Habitat assessment

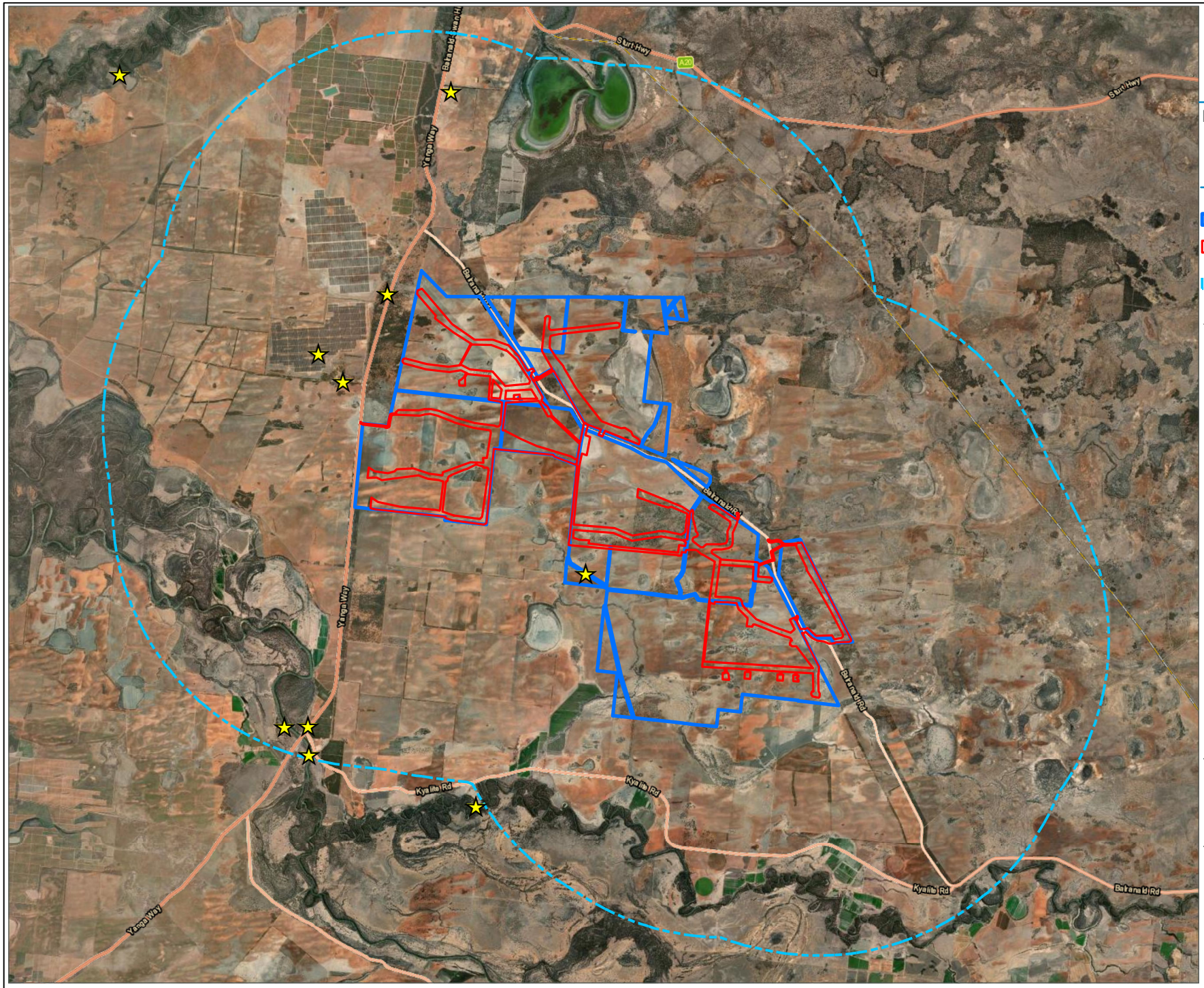
While traversing across the study area, potential roosting and foraging habitat for Regent Parrot was identified and this was used as the basis from which to carry out the targeted assessment. Any areas of breeding habitat within or directly adjacent to the study area including riverine habitats dominated by River Red Gum were also mapped where identified by Nature Advisory staff.

## 4.3. Field methodology

Roaming surveys were undertaken between 6am and 9pm, moving between designated point count locations, as indicated in Figure 2. The observer spent a minimum of 15 minutes at a location. If the Regent Parrot was recorded at a specific location, the observer remained longer than the 15 minutes. When birds were sighted the observer would remain stationary recording all flight details until they lost sight of the individual or flock, before moving on to the next location. Total survey effort tallied to approximately 50 hours over four days. The Regent Parrot survey was undertaken using methods consistent with the Commonwealth survey guidelines for Australia's threatened birds (DEWHA 2010). When an individual or flock was observed, their location and/or flight paths, number of individuals, flight height (first observed, min and max), and distance from observer were recorded using the ArcGIS Fieldmaps application. Any notes on the habitat were also made. Other significant bird species were recorded during the survey as incidentals (raptors and waterbirds).

## 4.4. Limitations of field assessment

The timing of the Regent Parrot survey, duration and weather conditions under which surveying was undertaken were considered suitable for detecting and surveying the species (Appendix 2).




# Figure 1: Regent Parrot (eastern subspecies) records from Bionet

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

- Wind Farm Boundary
- Development corridor
- Search region (10km buffer from wind farm)
- Regent Parrot records (Bionet)

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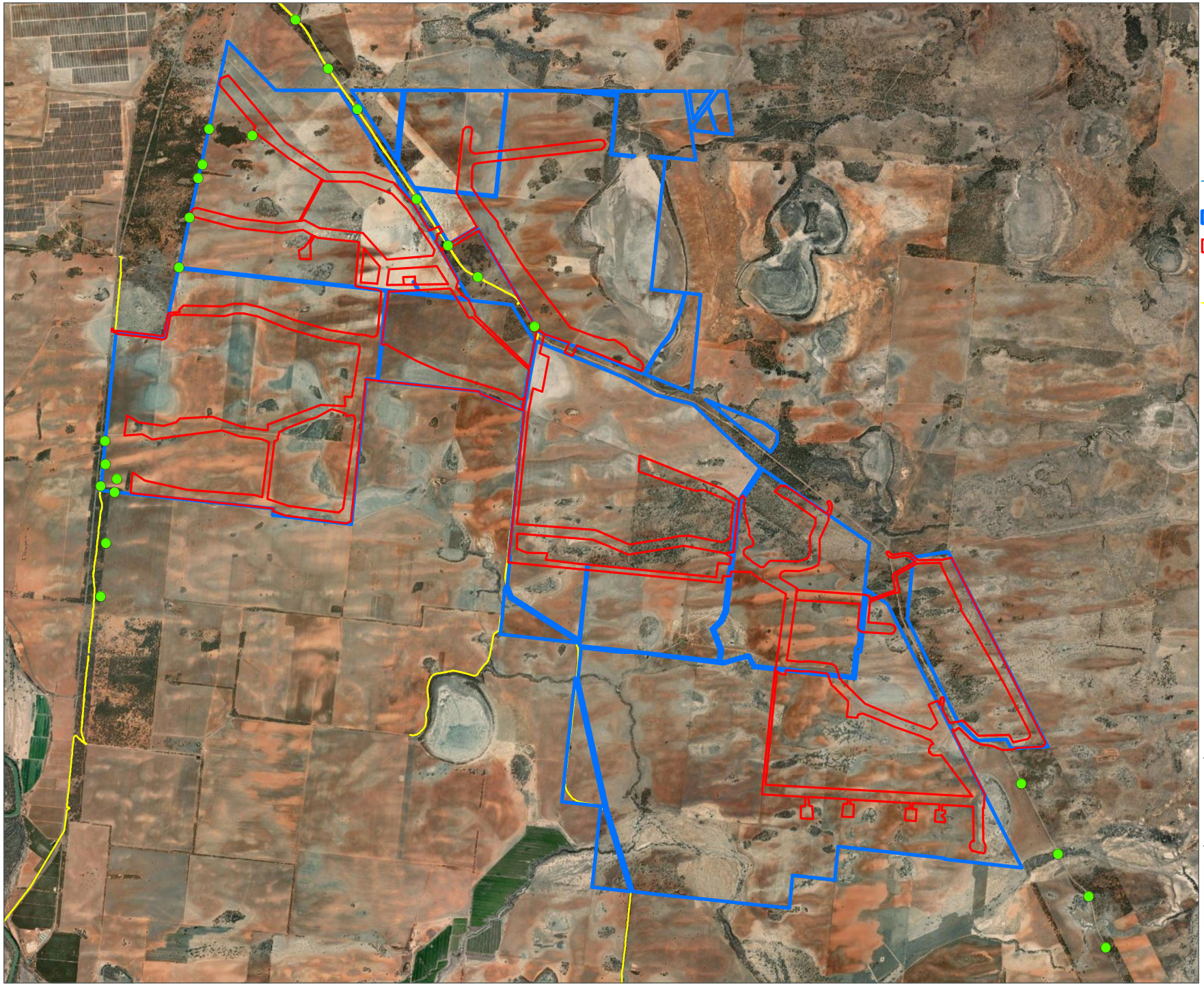
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# 5. Results

## 5.1. Existing information

NSW Bionet holds 45 records of Regent Parrot within 10 kilometres of the study area, dated between 1985 and 2019 (Appendix 1). Figure 1 shows the location of records on and surrounding the windfarm study area. The species was recorded mostly to the west of the proposed JRWP along Yanga Way, between Kyalite and Yanga Lake. Historic records occur in (assumed) breeding habitat on the Murrumbidgee near Balranald, and Edward River (a tributary of the Murray River), just south of Kyalite Road. One record exists along Arundel Road, along the southern boundary of the proposed JRWP. There are five records in this dataset with no record of number of individuals, merely recording presence close to the township of Kyalite.

A total of 117 Regent Parrots were observed during the collection of baseline data over two years (2021-2022), 102 during formal bird utilisation surveys (BUS) and 15 incidental records (Figures 3a & b). Incidental observations occurred along roads (Yanga Way) and at the northwest tip of the study area where mallee woodland occurs along the Balranald Road and intersects with Yanga Way. No observations of Regent Parrot were made flying within Rotor Swept Area height (RSA) of 51 to 300 meters during formal BUS surveys or during the targeted assessment.



## Figure 2: Regent Parrot survey locations and roaming surveys

**Project**: Junction Rivers Wind Project
**Client**: Windlab Pty Ltd
**Date**: 22/02/2024

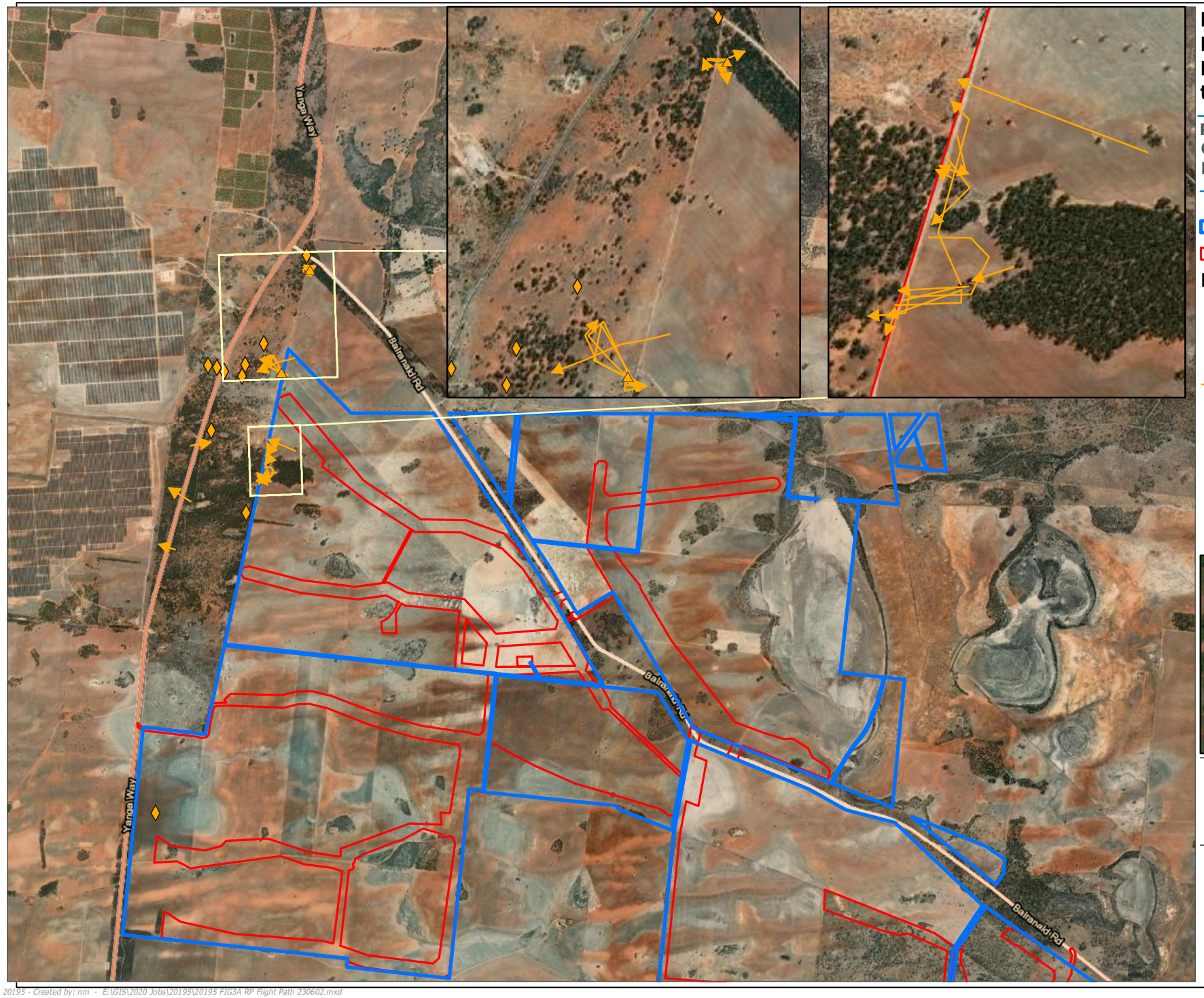
- Wind Farm Boundary
- Development corridor
- Survey location
- Roaming survey tracks

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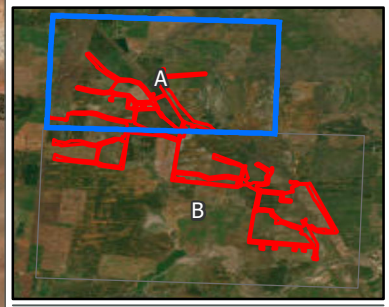

# Figure 3-A: Regent Parrot recorded by Nature Advisory during two years of monitoring

**Project**: Junction Rivers Wind Project
**Client**: Windlab Pty Ltd
**Date**: 22/02/2024

Wind Farm Boundary
Development corridor

**BUS/Incidental survey**

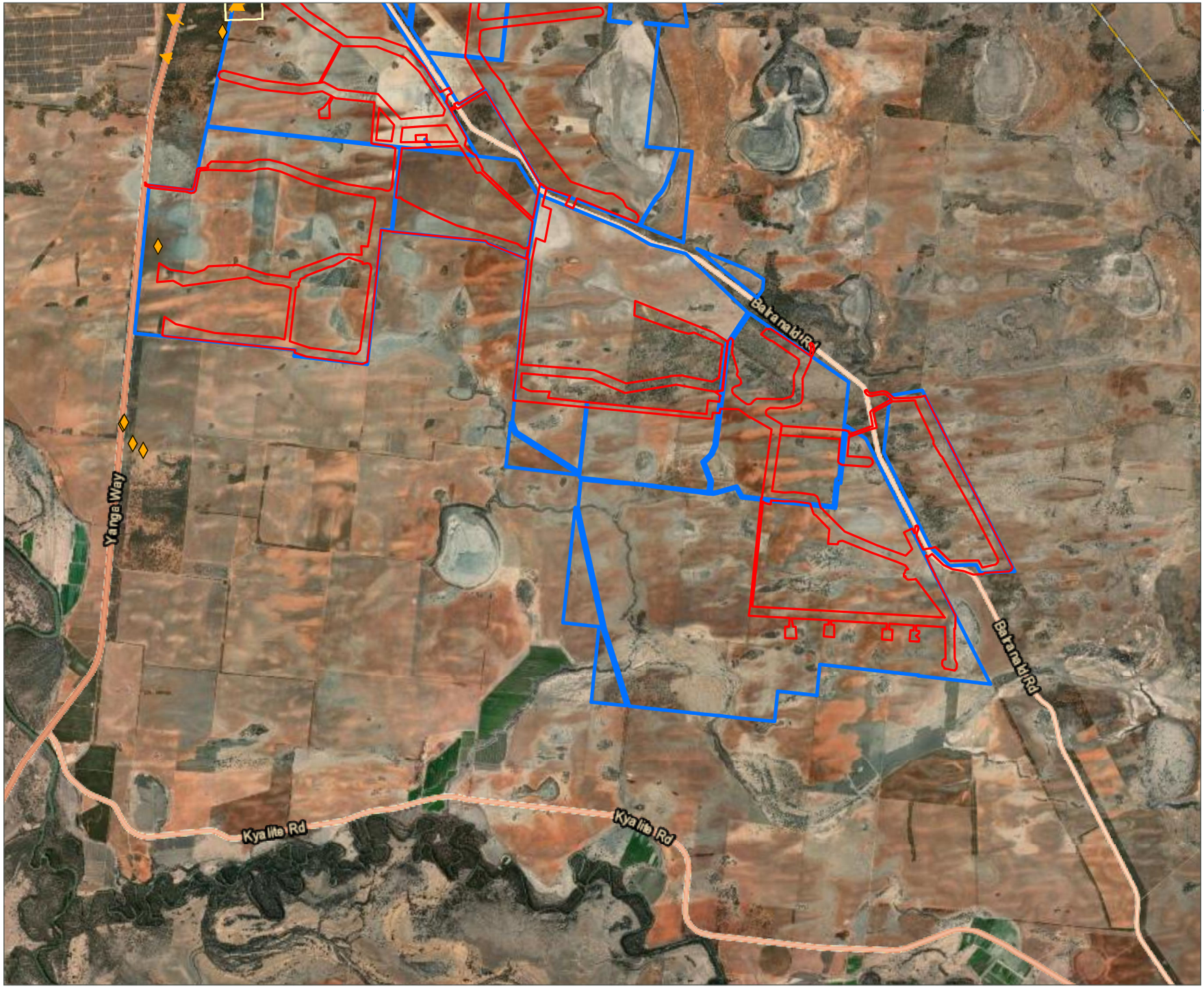
Regent Parrot (Perched/Ground)
Regent Parrot record
Regent Parrot flight path




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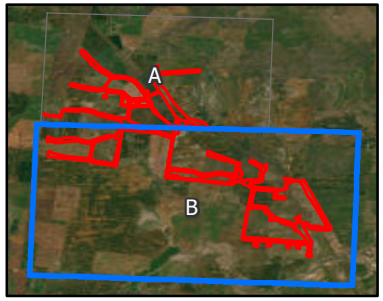

# Figure 3-B: Regent Parrot recorded by Nature Advisory during two years of monitoring

**Project:** Junction Rivers Wind Project
**Client:** Windlab Pty Ltd
**Date:** 22/02/2024

Wind Farm Boundary
Development corridor

**BUS/Incidental survey**

Regent Parrot (Perched/Ground)
Regent Parrot record
Regent Parrot flight path




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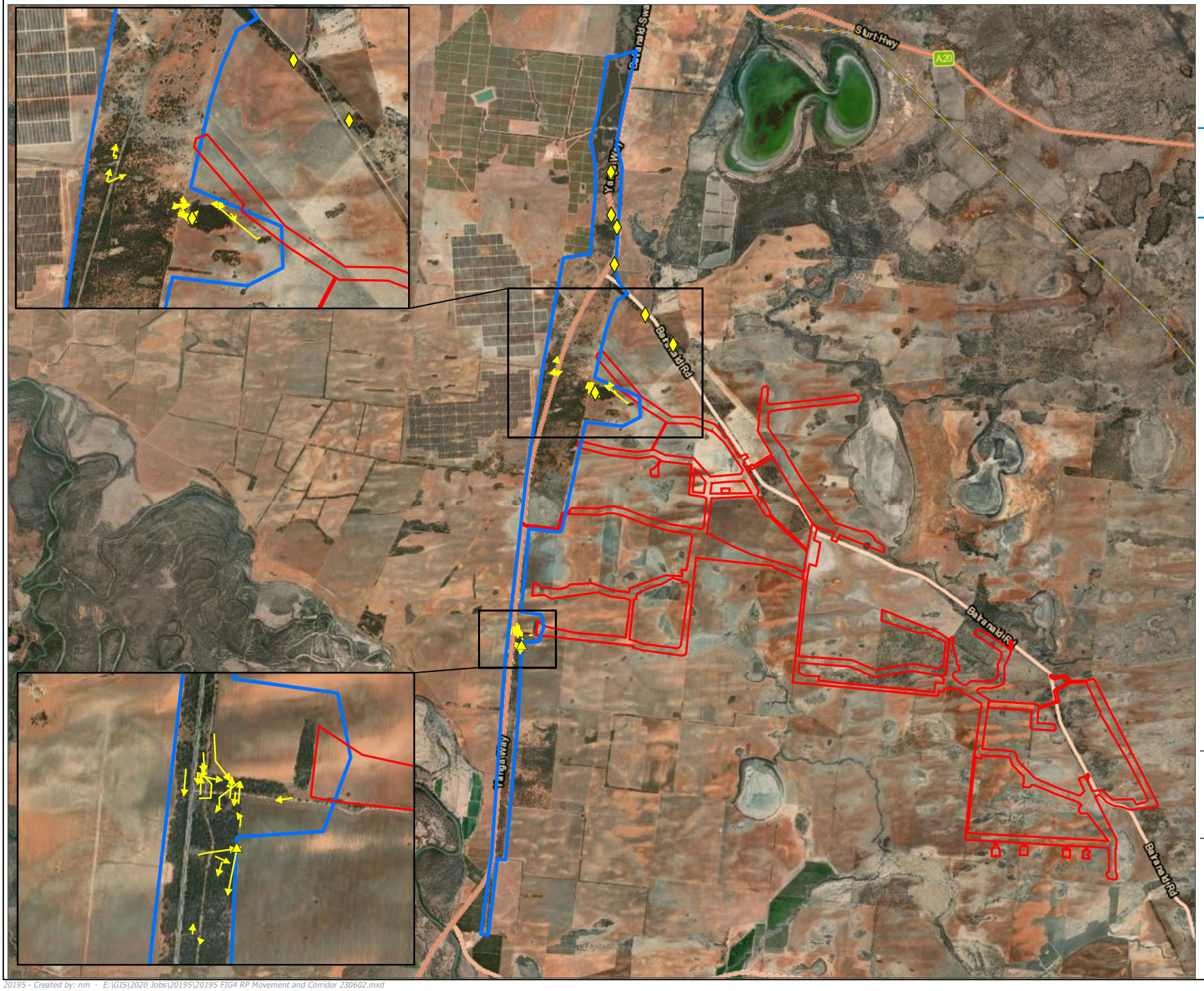
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## 5.2. Habitat assessment

The Regent Parrot was observed travelling and foraging within Mallee woodland (DEE 2017) in and adjacent to the study area. On the western boundary of the proposed JRWP, remnant Mallee woodland provides a corridor between the northern and southern ends of the proposed windfarm (Figure 4), this vegetated corridor follows Yanga Way from the south near Kyalite, extending north to Balranald. (henceforth referred to by Nature Advisory as the Yanga Corridor). Mallee woodland is more prevalent in the north and west of the study area with some patches extending to the eastern or southern boundaries of the proposed windfarm. The Yanga Corridor provides forging opportunities and cover for movement. Adjacent to the Yanga Corridor cereal cropping takes place and this was noted to provide some foraging opportunities for the Regent Parrot during the targeted assessment.

The Murrumbidgee River to the north, and the Edward River to the south, intersect the broader search region and there is likely River Red Gum (*Eucalyptus camaldulensis*) providing nesting habitat within daily foraging range of the proposed windfarm. Nature Advisory have not identified any breeding habitat within or immediately adjacent to the study area.




# Figure 4: Movement and foraging corridor for Regent Parrot including flight observations at BWF

**Project**: Junction Rivers Wind Project
**Client**: Windlab Pty Ltd
**Date**: 22/02/2024

Wind Farm boundary

Movement and foraging corridor for Regent Parrot

**Targeted survey**

Regent Parrot (Perched/Ground)

Regent Parrot record

Regent Parrot flight path

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## 5.3. Survey results

A total of 216 Regent Parrots were recorded within the study area during the targeted assessment. The Regent Parrot was recorded along the western and northern regions of the study area (Figure 4)

The Yanga Corridor is important habitat for the Regent Parrot. It provides foraging resources and a movement corridor where the parrots can safely travel to and from breeding sites along the Edward and Murrumbidgee Rivers. Mallee woodland habitats that adjoin the Yanga corridor provide foraging and roosting opportunities.

Approximately 97% of observations of Regent Parrot were within 100 metres of suitable habitat. Regent Parrot was observed to stay within suitable habitat (Mallee woodland) in 71% of all occurrences (Figure 5). When the remaining 29% left habitat cover, most flew less than 100 metres from suitable habitat. There were 3% of occurrences that flew beyond this, moving between areas of suitable habitat patches across open cropping paddocks.

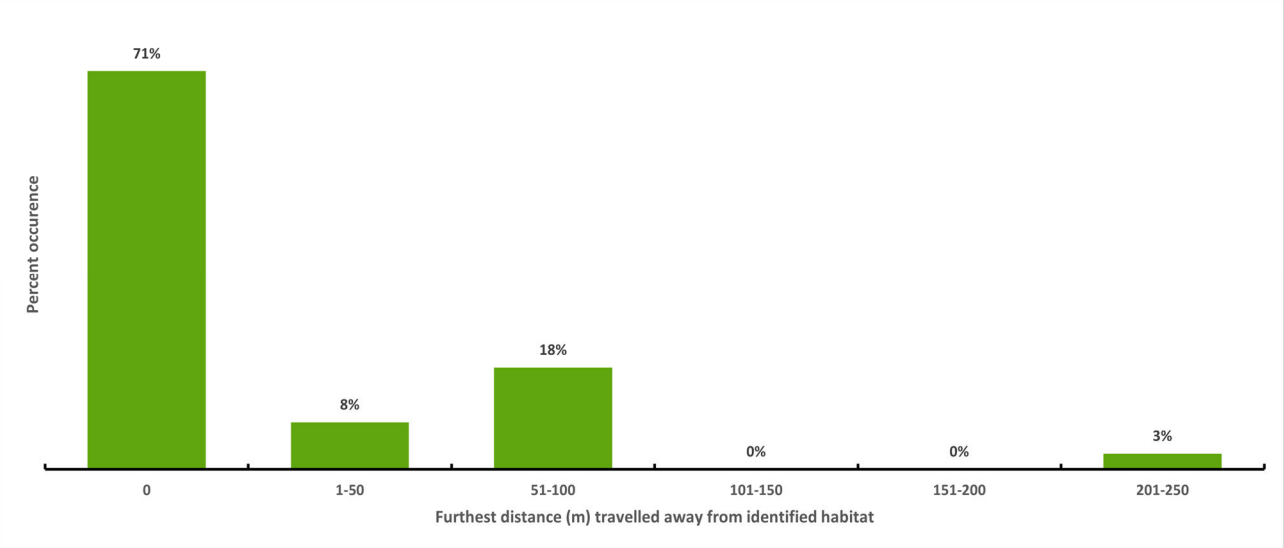



**Figure 5: Percent occurrence of distance (m) Regent Parrots were observed away from suitable habitat.**

All recorded flight heights were below the proposed RSA of 50 metres. Most observations were below 20 metres (64%), with a smaller proportion flying below 30 metres (29%) (Figure 6). It should be noted that the 1% of birds that flew at 30 metres (observed at 30m) were actively avoiding raptor predation.

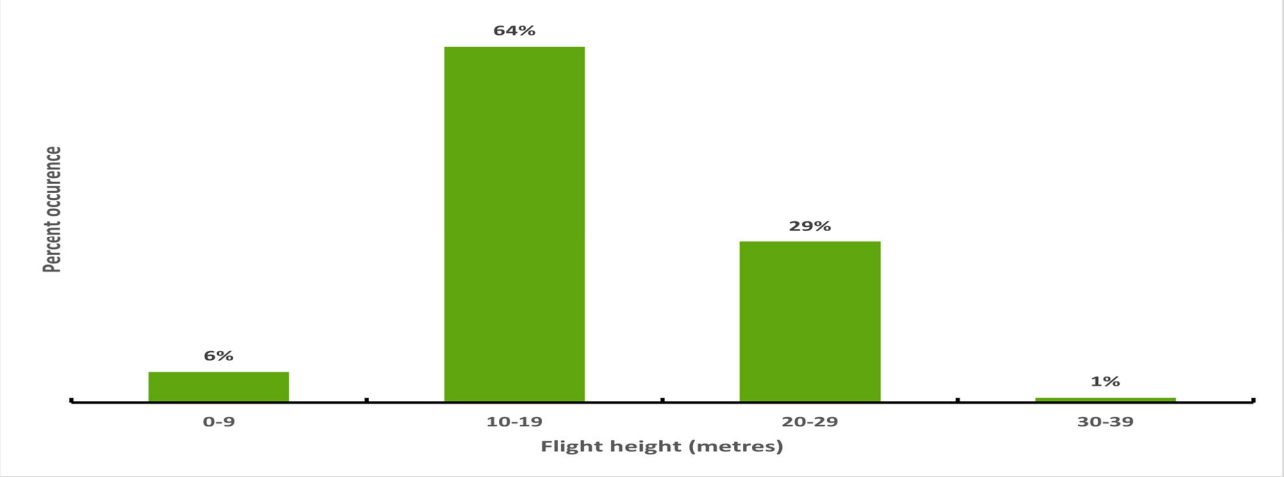



**Figure 6: Percent occurrence of observed flight heights of Regent Parrot**

# 6. Assessment of impacts

The Regent Parrot was confirmed as occurring within the study area during BUS and the targeted assessment, conducted during December 2022. A targeted Regent Parrot assessment was undertaken using best-practice methods to determine whether the species or associated habitat was present in areas potentially impacted upon by the proposed JRWP. A total of 216 Regent Parrots were detected during the targeted assessment.

The Regent Parrot exists within a very restricted range, requiring both Mallee woodland and shrubland for foraging opportunities and River Red Gum for nesting. The species concentrates in colonies to breed, has an absolute requirement for mallee foraging areas within 20 kilometres (usually 5–10km) from nest sites, and requires vegetated corridors between breeding and feeding areas (Baker-Gabb and Hurley 2011). The Murrumbidgee River to the north and Edward River (a tributary of the Murray River) to the south would likely be providing nesting sites, and the Yanga Corridor (Mallee woodland) provides an area of relative safety against predation risks and anthropomorphic destruction (landholders shooting), as well as providing foraging opportunities.

A survey conducted in April 2008 in NSW recorded large numbers of birds roosting in mallee near the Murray River and then returning to River Red Gum habitats for most of the day, for feeding and inspecting prospective nest hollows. Importantly, the birds used the same flight paths that had been utilised during the breeding season (Webster & Belcher 2008). There is considerable evidence to show eastern Regent Parrots use these flyways to commute between nest sites and feeding grounds several times a day during the breeding season (Webster 1991, 2005; Sluiter 2006; Hurley 2009, Robertson and Hurley 2010). One study in particular (Sluiter 2006) illustrated changes in flight path following the destruction of part of one of these corridors and a reluctance on the part of eastern Regent Parrots to cross gaps or open areas greater than 200 metres.

## 6.1. Proposed development

The current proposal will involve the construction of turbines, access tracks and associated windfarm infrastructure. Once construction is completed the windfarm will be operational for the time of the lease agreement.

The proposed development footprint has been overlaid with areas of suitable Regent Parrot habitat that were mapped as part of this assessment.

Potential impacts on the Regent Parrot that may be result from the construction of the windfarm include the following.

- Potential removal of suitable foraging and roosting habitat
- Barrier effects if foraging and roosting habitat along established movement corridors is removed
- Collision with operating turbines.

## 6.2. Design recommendations

To maximise the effectiveness of mitigation measures to avoid impacts to the threatened Regent Parrot, Nature Advisory have proposed the following:

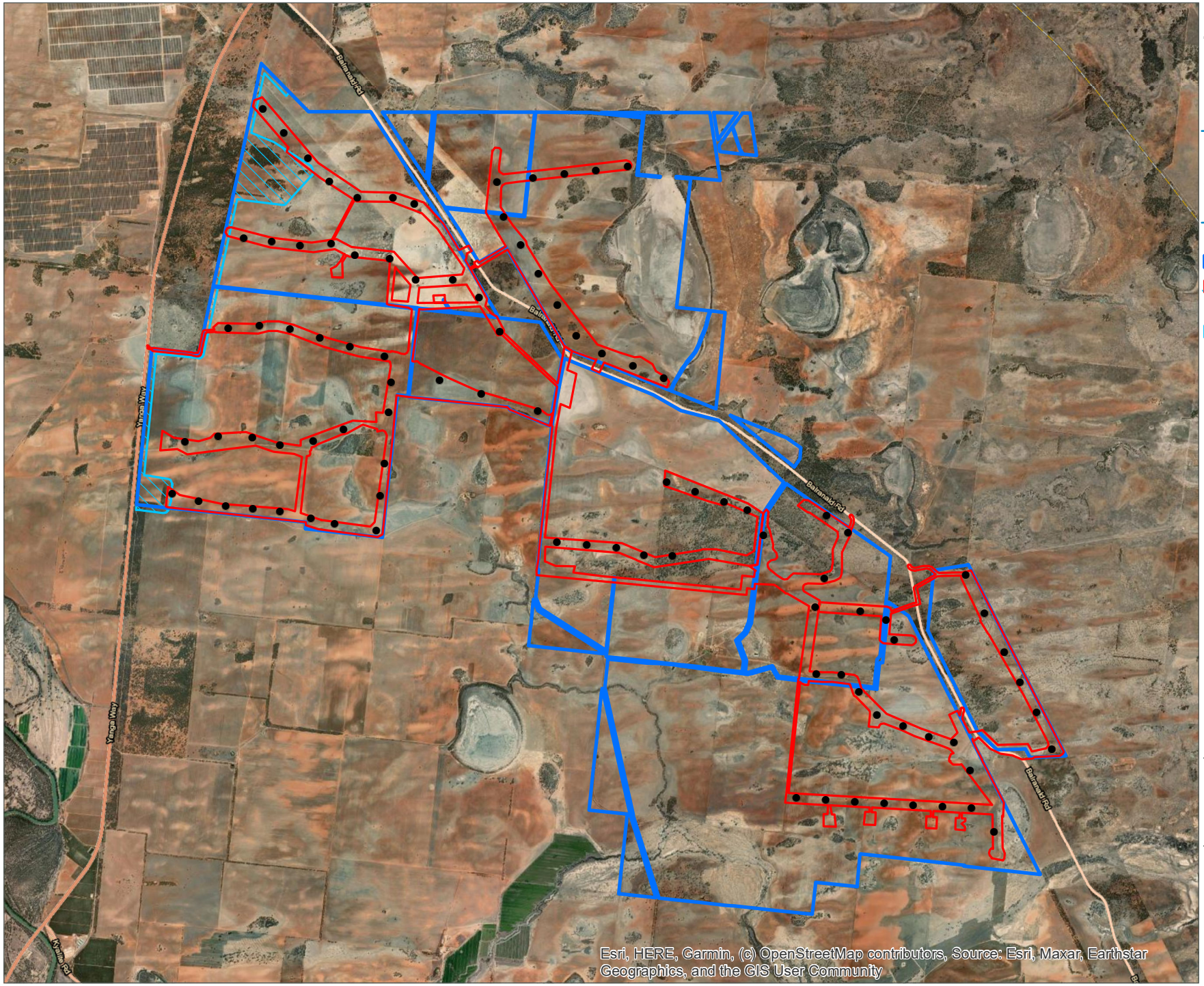
- Enact the 100-metre turbine free buffer as proposed by Nature Advisory in this document
- Avoid the removal of suitable foraging and roosting habitat for the Regent Parrot

- Ensure a 100-metre turbine free buffer (from blade tip) around all areas of suitable foraging and roosting habitat (Mallee woodland) present within the study area and along the western boundary of the study area is maintained (Figure 7)
- Nature Advisory advises that habitat surveys be undertaken to identify all possible areas of important roosting and foraging habitat (not identified by Nature Advisory) to ensure these areas are not impacted during construction or subject too ongoing disturbance
- A Bird and Bat Adaptive Management Plan will need to be developed and a monitoring program designed and implemented to monitor impacts on the Regent Parrot.

### 6.3. Impacts of proposed development

Nature Advisory has drawn the following conclusions following completion of the Regent Parrot assessment and upon review of data provided by Windlab:

- The investigation identified that the Regent Parrot could be impacted by the proposed windfarm development in the study area
- The finalised turbine layout adheres to Nature Advisory's recommendation of placing all turbines outside of a 100-metre turbine free buffer where Regent Parrot roosting and foraging habitat has been identified by Nature Advisory
- Micro-siting of individual turbines should be planned to avoid impinging on this buffer – this includes all parts of the turbine structure and blades
- The current design layout impinges on this turbine free buffer at several points potentially leading to short-term disturbance (Figure 7) and depending on eventual positioning of individual turbines this may be avoided.




# Figure 7: 100m buffer from identified Regent Parrot foraging and roosting habitat

**Project**: Junction Rivers Wind Project
**Client**: Windlab Pty Ltd
**Date**: 22/02/2024

- Wind Farm Boundary
- Development corridor
- 100m buffer zone from identified areas of important habitat
- Proposed turbines

N

Metres
0 1,400

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# 7. Regulatory implications

## 7.1. EPBC Act

The EPBC Act lists threatened species and ecological communities of national conservation significance. Any impacts to these species considered significant require the approval of the Australian Minister for the Environment. If a significant impact on nationally threatened species or community, or listed migratory species may be possible, a Referral under the EPBC Act should be considered. After 20 business days, the Minister will decide whether the project will be a 'controlled action' under the EPBC Act, in which case the project cannot be undertaken without the approval of the Minister. This approval depends on a further assessment and approval process (lasting between three and nine months, depending on the level of assessment).

The Regent Parrot is listed as vulnerable under the EPBC Act and was observed during the current assessment.

Through this assessment Nature Advisory has outlined mechanisms that aim to avoid and mitigate possible impacts to Regent Parrot within the proposed Junction Rivers Wind Project. Nature Advisory has identified areas of suitable foraging and roosting habitat within and surrounding the proposed windfarm and has proposed a turbine free buffer around these areas. Nature Advisory has not identified or mapped all possible suitable foraging and roosting habitat within the subject site for this species. This habitat may be identified through other mechanisms such as through plant community type (PCT) mapping carried out within the development corridor. Referral under the EPBC Act is recommended.

## 7.2. BC Act

The Regent Parrot is listed as Endangered under the BC Act. Therefore, the responsible authority will consider this species under the provisions of this legislation.

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## Appendix 1: NSW Bionet historical records of Regent Parrot

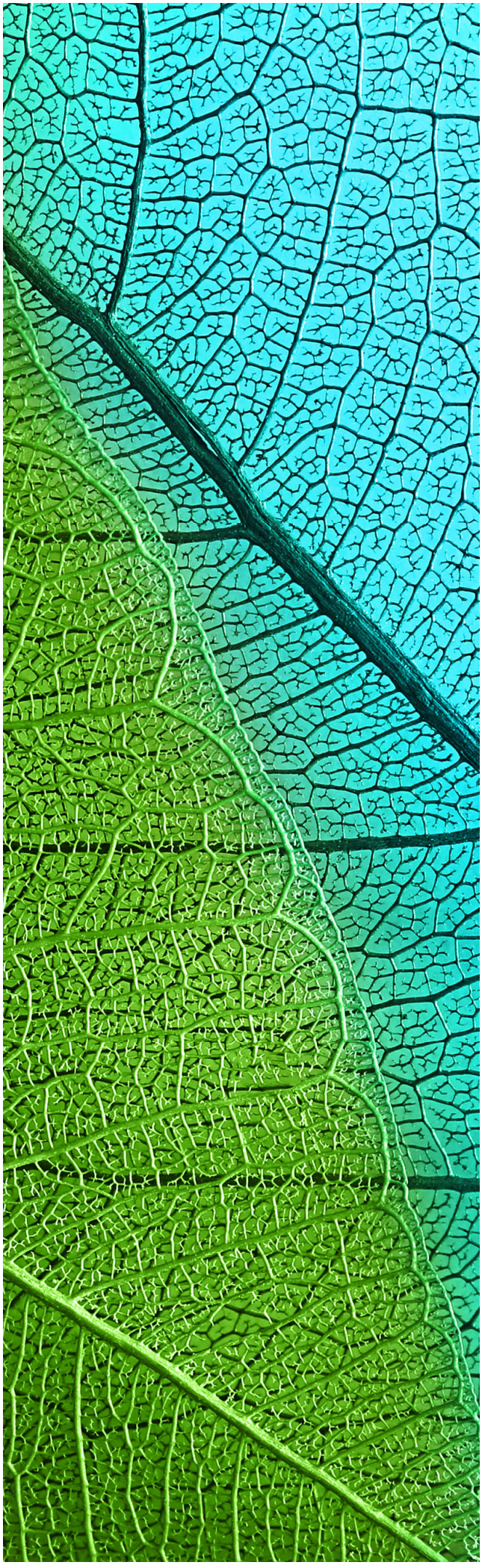
| Dataset Name | Sighting Key | Species Code | Scientific Name | NSW Status | Comm Status | Sensitivity Class | Profile ID | Date First | Date Last | Number Individuals | Estimate Type Code | Observation Type | Status | Latitude GDA94 | Longitude GDA94 | Zone | Accuracy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPIE Data from Scientific Licences dataset | SJJSI0324405 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 1/11/2016 | 1/11/2016 | | | OW | Valid and accepted without modification | -34.79 | 143.52 | 54 | 1 |
| DPIE Data from Scientific Licences dataset | SJJSI0324461 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 1/11/2016 | 1/11/2016 | | | OW | Valid and accepted without modification | -34.79 | 143.52 | 54 | 1 |
| DPIE Data from Scientific Licences dataset | SJJSI0324463 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 1/11/2016 | 1/11/2016 | | | OW | Valid and accepted without modification | -34.82 | 143.5 | 54 | 1 |
| DPIE Data from Scientific Licences dataset | SJJSI0327095 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 1/11/2016 | 1/11/2016 | | | O | Valid and accepted without modification | -34.81 | 143.49 | 54 | 2000 |
| DPIE Data from Scientific Licences dataset | SPJGI7048012 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 7/12/2020 | 7/12/2020 | | | O | Valid and accepted without modification | -34.89 | 143.6 | 54 | 11924.53 |
| DPIE Default Sightings | 101263-035 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 3/09/1985 | 3/09/1985 | 2 | | O | Valid and accepted without modification | -34.95 | 143.48 | 54 | 1000 |
| DPIE Default Sightings | 4-LD | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 11/06/1994 | 11/06/1994 | 30 | | R | Valid and accepted without modification | -34.72 | 143.55 | 54 | 1000 |
| DPIE Default Sightings | SMIT18031200 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 18/11/2017 | 24/11/2017 | 1 | + | O | Valid and accepted without modification | -34.97 | 143.55 | 54 | 100 |
| DPIE Default Sightings | SMIT2009080Q | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 18/07/2019 | 18/07/2019 | 4 | X | O | Valid and accepted without modification | -34.94 | 143.47 | 54 | 10 |

| Dataset Name | Sighting Key | Species Code | Scientific Name | NSW Status | Comm Status | Sensitivity Class | Profile ID | Date First | Date Last | Number Individuals | Estimate Type Code | Observation Type | Status | Latitude GDA94 | Longitude GDA94 | Zone | Accuracy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DPIE Default Sightings | SPXE12112100 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 23/09/2012 | 23/09/2012 | 2 | | O | Valid and accepted without modification | -34.94 | 143.48 | 54 | 1500 |
| State Forests Biodata | SF-1093896 | 709 | Polytelis anthopeplus monarchoides | E1,P,3 | V | 3^^ | 10644 | 18/02/2011 | 18/02/2011 | 1 | | O | Valid and accepted without modification | -34.71 | 143.41 | 54 | 10 |

## Appendix 2: Weather conditions during the targeted Regent Parrot survey.

| Survey Point | Date | Time | Regent Parrot Observed | Temperature | Wind | Wind Direction | Cloud Cover % | Notes |
|---|---|---|---|---|---|---|---|---|
| RP | 1/12/2022 | 5:53 | No | 12 | Gentle | S | 0 | 10 minutes |
| RP1 | 1/12/2022 | 7:46 | No | 12 | Fresh | S | 0 | 15 minutes |
| RP10 | 30/11/2022 | 18:51 | Yes | 27 | Gentle | S | 0 | |
| RP11 | 1/12/2022 | 18:25 | Yes | 26 | Fresh | S | 0 | 105 minutes |
| RP2 | 1/12/2022 | 7:06 | Yes | 13 | Fresh | S | 0 | |
| RP3 | 2/12/2022 | 6:15 | Yes | 11 | Nil | NA | 0 | 51 minutes |
| RP4 | 2/12/2022 | 17:50 | Yes | 29 | Gentle | NE | 0 | 160 minutes |
| RP5 | 1/12/2022 | 6:40 | Yes | 13 | Gentle | S | 0 | |
| RP5 | 2/12/2022 | 9:05 | No | 15 | Gentle | SE | 5 | |
| RP6 | 2/12/2022 | 7:15 | Yes | 12 | Nil | NA | 0 | |
| RP7 | 30/11/2022 | 8:15 | No | 14 | Strong | S | 0 | |
| RP7A | 30/11/2022 | 18:00 | No | 26 | Gentle | S | 0 | |
| RP8 | 30/11/2022 | 18:27 | No | 27 | Gentle | S | 0 | |
| RP9 | 2/12/2022 | 8:05 | No | 15 | Gentle | S | 5 | |
| RPB1 | 29/11/2022 | 6:55 | Yes (1) | 13 | Gentle | SW | 40 | |
| RPB1 | 2/12/2022 | 8:45 | No | 15 | Fresh | SE | 5 | |
| RPB10 | 30/11/2022 | 9:25 | No | 16 | Gentle | S | 0 | |

| Survey Point | Date | Time | Regent Parrot Observed | Temperature | Wind | Wind Direction | Cloud Cover % | Notes |
|---|---|---|---|---|---|---|---|---|
| RPB11 | 30/11/2022 | 7:30 | No | 14 | Gentle | SE | 0 | |
| RPB2 | 29/11/2022 | 7:37 | Yes (1) | 14 | Gentle | SW | 40 | |
| RPB3 | 29/11/2022 | 8:05 | No | 14 | Fresh | W | 60 | |
| RPB4 | 29/11/2022 | 16:49 | No | 24 | Gentle | W | 0 | |
| RPB5 | 29/11/2022 | 17:17 | No | 25 | Gentle | W | 0 | |
| RPB6 | 29/11/2022 | 17:43 | No | 24 | Gentle | W | 0 | |
| RPB7 | 29/11/2022 | 18:12 | No | 24 | Gentle | W | 0 | |
| RPB8 | 30/11/2022 | 10:20 | No | 17 | Gentle | S | 0 | |
| RPB9 | 30/11/2022 | 9:55 | No | 16 | Gentle | S | 0 | |



# Junction Rivers Wind Project

## Regional Review of Waterbirds in the Riverina

**Prepared for Windlab Pty Ltd**

February 2024
Report No. 20195.07 (2.1)

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# 1. Executive summary

This literature review of the ecology of Riverina waterbirds, with reference to the proposed Junction Rivers Wind Project (JRWP) near Balranald in NSW, found the following key facts with regards to the likely risk of collision or otherwise associated with groups or species known to occur within the region and this is presented detail below.

## 1.1. Cormorants

Overall, whilst cormorants do occasionally fly at RSA height, they seem likely to fly below it most of the time and are unlikely to regularly occur in the JRWP. At worst, some may pass through the airspace of the proposed JRWP, occasionally, in large flocks, but even when this occurs, most flights seem likely to be below RSA height. Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. Given every species in this group of waterbirds is considered widespread and secure, they appear unlikely to be heavily impacted by turbine collision at the proposed JRWP.

## 1.2. Waterfowl

Overall, whilst ducks and geese, on rare occasions, fly at RSA height, they seem likely to fly below or above it most of the time and are unlikely to regularly occur in JRWP area. At worst, some may pass through the airspace of the proposed JRWP occasionally in large flocks, but even when this occurs, most flights seem likely to be below or (particularly for long-distance movements) above RSA height. Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude and are unlikely to be those of listed species. The possible exceptions to this would be:

- Fledglings of the Blue-billed Duck (*Oxyura australis*) at Yanga Lake – there is a reasonable possibility that they could periodically disperse through the airspace of the proposed JRWP.
- Grey Teal (*Anus gracilis*) – discussed here due to the (limited) potential for large-scale mortality even though it is not listed. Individuals, small flocks or large flocks may occasionally use habitat in or near the proposed JRWP on the rare (less than annual, possibly decadal or less) occasions floods produce suitable habitat there. Substantially more likely is that the species could fly through the airspace of the proposed JRWP (potentially in large numbers), and this could happen occasionally and sporadically depending on rainfall and water levels in the wider region.

However, even in these instances, these species would be making long-distance movements and based on the behaviour of other waterfowl, they would most likely be doing so well-above RSA height.

## 1.3. Shorebirds

Overall, whilst shorebirds do fly at RSA height, they fly below or above it for the overwhelming majority of the time and are unlikely to regularly occur in the proposed JRWP. At worst, some may pass through the airspace of the proposed JRWP occasionally in large flocks, but even when this occurs, most flights seem likely to be below or (particularly for long-distance movements) above RSA height. Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude and are unlikely to be those of listed species. The possible exceptions to this would be:

- Sharp-tailed Sandpiper (*Calidris acuminata*)– individuals, small flocks, or at times large flocks could potentially, very occasionally fly through the airspace of the proposed JRWP, or use habitat in or near the proposed JRWP on the rare (less than annual, possibly multi-decade, or less) occasions that floods produce suitable habitat there.
- Red-necked Avocet (*Recurvirostra novaehollandiae*) – large flocks could potentially and occasionally fly through the airspace of the proposed JRWP or use habitat in or near the proposed

JRWP on the rare (less than possibly multi-decade, or less) occasions that floods produce suitable habitat there.

- Pied Stilt (*Himantopus Himantopus*) – moderately large flocks could potentially and occasionally fly through the airspace of the proposed JRWP or use habitat in or near the proposed JRWP on the rare (less than possibly multi-decade, or less) occasions that floods produce suitable habitat there.

However, even in these instances, these species would be making long-distance movements (unless they are using the study area), and based on the behaviour of other shorebirds, they would most likely be doing so well-above RSA height for long-distance movements, or below it for short-range movements.

## 1.4. Terns

Terns are generally high-flying, aerial birds that are likely to spend considerable amounts of time at RSA height. The Caspian Tern (*Hydroprogne caspia*) and the Whiskered Tern (*Chlidonias hybrida*) both have specifically been recorded flying at RSA height, including when making long-distance movements, and in tight groups performing aerial displays. The proportion of flights made at RSA heights is unknown for each species, but the known flight behaviour of these species suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat in the proposed JRWP near turbines could pose a risk to these species, as they may fly at RSA height in this context. However, such habitat is not expected to appear in the vicinity of the proposed JRWP very often at all (less than annually, possibly decadal or less frequent). They may also fly at RSA height when travelling relatively long distances as they move between drying, ephemeral wetlands and floodwaters, so it is possible that flocks of these species, including large flocks in the Whiskered Tern, could fly through the study area at RSA height and potentially collide with turbines. It is difficult to comment on the frequency and magnitude of such events given the variable flock sizes of terns and how they track ephemeral wetlands across the landscape (which is driven by stochastic phenomena like rainfall), but for Whiskered Tern in particular, large flocks flying through the airspace of the proposed JRWP at RSA height are possible, even if, based on the available records, this is probably an uncommon occurrence.

## 1.5. Large Waterbirds

Brolga (*Grus rubicunda*), White-bellied Sea-eagle (*Haliaeetus leucogaster*), Australian Pelican (*Pelecanus conspicillatus*) and Straw-necked Ibis *(Threskiornis molucca)* are known or expected to fly at RSA height. The proportion of flights made at RSA height is unknown for most of these species, although White-bellied Sea-eagles have been recorded making 70% of their flights between 30-120m, so they likely spend considerable time at RSA height. Each species will be considered separately from this point.

Brolgas are not thought to occur frequently, or in high numbers in the search region, and there are no records from within the search region. They are a very large, relatively conspicuous bird of considerable ornithological interest and are readily identifiable, even to the casual observer. At wind energy facilities in Victoria buffers of 400 m have been enacted around wetlands along with other conventional measures to prevent waterbird collisions with turbines have been sufficient to prevent Brolga collisions. Inn more than a decade of monitoring no mortalities have been observed. This species is considered unlikely to collide with turbines, regardless of its regular flight heights.

For White-bellied Sea-eagles -on the assumption that a handful of breeding pairs are or were scattered among Yanga Lake, the Murrumbidgee River and the Wakool River in the search region - a worst-case scenario would involve six – eight locally bred fledglings annually colliding with wind turbines at the proposed JRWP as they dispersed. The species has been declining in NSW, particularly south-west NSW, and so the collisions could potentially have an unacceptable impact on the local or regional populations of the species. However, this is a worst-case scenario – it assumes maximum reproductive output and

perfect survivorship and fledging among the offspring produced by local pairs every year, and every one of those fledglings or immature birds colliding with turbines at the proposed JRWP every year, which is unlikely. Furthermore, the species generally follows watercourses when making movements in inland areas, which would direct dispersing immature birds away from the proposed JRWP. Nevertheless, it is conceivable that 1-2 mortalities could occur each year (although collisions every few years instead are perhaps more likely), and this could still have a smaller but detrimental impact on the local population.

Australian Pelicans could use any suitable habitat within the proposed JRWP footprint, and if they did, it would most likely be due to floodwaters creating temporary wetlands (even very small ones) in or near the proposed JRWP for them to forage from, although even the creation or existence of a small farm dam could potentially attract some individuals to the area. In extreme instances, large areas of suitable habitat created by flooding and inundation could create opportunities for breeding in the vicinity of the proposed JRWP, but this is unlikely to occur frequently at all (less than annually, possibly decadal or even less frequent). However, because the species can breed in very large colonies, if this does occur it could create many opportunities for collision with turbines in quick succession, although most of the birds would probably stay very close to the wetland habitats and if so, would generally be unlikely to encounter turbines if they were situated more than 400 m away. A more realistic scenario is of flocks (potentially including large flocks) flying through the proposed JRWP airspace as the species moves between areas of ephemeral wetland. Since this movement is dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be, but it could potentially include relatively large groups passing through the proposed JRWP.

Straw-necked Ibis could use any suitable habitat within the proposed JRWP footprint, and if they did, it would most likely be due to floodwaters creating temporary wetlands (even very small ones) in or near the proposed JRWP for them to forage from, although they could also forage from dry habitats such as dry grassland in the study area. In extreme instances, large areas of suitable habitat created by flooding and inundation could create opportunities for breeding in the vicinity of the proposed JRWP, but this is unlikely to occur frequently or at all (less than annually, possibly decadal or even less frequent). However, because the species can breed in large colonies, if this does occur it could create many opportunities for collision with turbines in quick succession, although most of the birds would probably stay relatively close to the wetland habitats and if so, would be unlikely to encounter turbines if they were situated more than 400 m away. A more realistic scenario is of flocks (potentially including large flocks) flying through the proposed JRWP airspace as the species moves between areas of ephemeral wetland and other habitat patches in the landscape. Since this movement is partially dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be, but it could potentially include relatively large groups passing through the proposed JRWP.

# 2. Introduction

Nature Advisory has been retained by Windlab Pty Ltd to do a review of the ecological literature and previous records concerning waterbirds in the Riverina in the region surrounding the proposed Junction Rivers Wind Project, south of Balranald NSW, and consider the risk to these species of collision with wind turbines there. This document is to be considered as fulfilling all these requirements.

This investigation was conducted by Michael Sebastian (Zoologist), Gavin Thomas (Senior Ecologist – NSW Team Leader) and Bernard O'Callaghan (Managing Director).

# 3. Methods

## 3.1. Existing Information

Records of all bird species belonging to the bird orders listed below within 20 km of a point (co-ordinates: -34.784440, 143.566585) within the approximate location of Junction Rivers Wind Project (JRWP) were extracted from the Atlas of Living Australia (ALA) (ALA 2023). These bird orders were selected as they are or contain the major Australian waterbird lineages.

Bird orders considered:

- Anseriformes
- Charadriiformes
- Gruiformes
- Pelecaniformes
- Suliformes

Additionally, the White-bellied Sea-eagle was included in the search for records.

## 3.2. Screening for analysis

Many waterbird species were recorded as occurring within 20 km of the proposed Junction Rivers Wind Project. However, not all of them are likely to be significantly impacted by this project via turbine collision. Turbine collision results in some level of avian mortality at wind farms, but impacts typically become problematic through one of two pathways:

1. A species that is listed as threatened at either a state and/or federal level under the Biodiversity Conservation [BC] Act 2016 (NSW) and/or the Environmental Protection and Biodiversity Conservation [EPBC] Act 1999 (Federal) is found to have collided with wind turbines. This typically triggers an investigation into whether the impact is unacceptable and/or likely to re-occur.
2. A species that is not listed as threatened at either a state or federal level is found to have collided with wind turbines in relatively high numbers within a relatively short period of time. This typically triggers an investigation into whether the impact is unacceptable and/or likely to re-occur.

Additionally and noting the above, species were also included for consideration in this review if they met either of the two criteria below:

1. The species is in one of the bird orders being considered (see Section 3.1.), is listed as threatened at a state (NSW – BC Act) or federal (EPBC Act) level, and either had records in the ALA within 20 km of the point within the proposed JRWP or could be considered as potentially occurring there. The latter is a discretionary measure that has been implemented because many waterbirds are highly nomadic and dispersive in Australia and may be absent from areas for long periods of time but use them intensely when conditions are suitable.
2. The species is in one of the bird orders being considered (see Section 3.1.), and if not listed as threatened at a state (NSW – BC Act) or federal (EPBC Act) level, had over 100 records in the ALA within 20 km of the point within the proposed JRWP. Some species were included in a discretionary manner as they were found to have large numbers of individuals (at least over 100) associated with certain records.

Species selected for consideration were sorted into five main groups, based on common taxonomy and/or ecological traits:

1. Cormorants and Darters
2. Waterfowl (ducks, geese and swans)

3. Shorebirds
4. Terns
5. Large waterbirds (Straw-necked Ibis, Australian Pelican, White-bellied Sea-eagle, Brolga)

## 3.3. Analysis

For each group, their basic ecological information (description, diet, distribution, habitat, breeding, movements, social behaviour and conservation status) was researched and presented. Subsequently, records of each species within the group were considered within the 20 km radius search region, and a spatiotemporal analysis of the records, including a consideration of their likelihood to occur at the proposed the proposed JRWP, was completed. Finally, the flight behaviour of the species or group was considered, together with information on movement patterns of the species or group, to assess the risk of collision with turbines.

# 4. Group 1: Cormorants and Darters

This group of waterbirds includes the following:

- Great Cormorant *Phalacrocorax carbo*
- Little Pied Cormorant *Microcarbo melanoleucos*
- Little Black Cormorant *Phalacrocorax sulcirostris*
- Black-and-white Shag (Pied Cormorant) *Phalacrocorax varius*
- Australasian Darter (Arrgarrg) *Anhinga novaehollandiae*

## 4.1. Cormorants and Darters - overview of species biology and ecology

### *4.1.1. Description*

Cormorants are waterbirds that vary in size between species. In the context of the environment surrounding the proposed Junction Rivers Wind Project, the Little Black Cormorant sits at the smaller end of the scale, being a medium-sized bird about 55-65 cm long (Morcombe 2021), whereas the Great Cormorant is at the large end of scale, being a large bird about 80-85 cm long (Morcombe 2021). Cormorants have long necks (although they often fold them up, giving a short-necked appearance), a medium-long hooked beak, webbed feet, and relatively broad wings. Colours and plumage vary between species and between breeding and non-breeding seasons, but the species discussed have plumage that is either entirely black or counter-shaded (Morcombe 2021). The beak is usually either black, white or yellow, and facial colours and markings may be present in some species (Morcombe 2021).

Australasian Darter looks a little like a cormorant but there are substantial differences. They are longer and larger (85-90 cm long) (Morcombe 2021), but slenderer, with longer, thinner necks and beaks, and their beaks are not hooked (Birds in Backyards 2023). Additionally, they are not as strongly counter-shaded, having a great deal of pale streaking on their otherwise grey-black dorsal surface (Morcombe 2021).

### *4.1.2. Diet*

Cormorants and darters are active hunters of fish although they will consume other small animals like frogs and insects opportunistically (Pizzey and Knight 2013, Morcombe 2021). They dive and swim underwater to pursue fish and use their long necks and hooked beaks to grab them (Pizzey and Knight 2013, Commonwealth of Australia 2020), with darters also striking and spearing their prey from both above and underwater (Morcombe 2021). Unlike most waterbirds, their feathers are not waterproof, in order to facilitate their hunting technique of swimming underwater – waterproof feathers would cause them to float and not allow them to submerge. Consequently, cormorants and darters have to spend time spreading and drying their feathers out in the sun in order to get dry, and in order to be able to fly (Pizzey and Knight 2013).

### *4.1.3. Distribution and Population*

All four species of cormorants and the Australasian Darter that may occur around the planned Junction Rivers Wind Project are common and widespread species that are considered secure. All have distributions that extend beyond Australia and cover large swathes of the world and are thought to be increasing globally (BirdLife International 2023). Within Australia, all five species are also considered common, widespread and secure, being found across most of the country, absent only from very dry and arid regions (particularly the Great Sandy Desert and the Nullarbor Plain in central and southern Western Australia (WA) and western South Australia (SA)) (Morcombe 2021).

### 4.1.4. Habitat

Cormorants will use a variety of aquatic and marine habitats to forage, from relatively small, freshwater farm dams in inland Australia to large harbours and bays along the coast (Morcombe 2021). Within inland areas, the larger cormorant species and the Australasian Darter are typically associated with relatively large waterbodies, such as deep rivers, lakes and swamps (with the latter found only in wetlands 50 cm deep or more), whereas the smaller species can also be found in small farm dams and billabongs (Morcombe 2021). Little Pied and Great Cormorants in particular appear to take advantage of floodwaters when they occur (Morcombe 2021).

Cormorants and the Australasian Darter are diurnal, and when roosting at night, or when resting from foraging, will make use of a variety of roosting sites, such as trees (particularly those standing in water), rocky areas like cliffs, or structures isolated from other areas by water (e.g., channel markers, fishing piers) (Pizzey and Knight 2013). Sunny, open roost sites near water are preferred for daytime use, to allow the birds to dry their feathers in the sun (Pizzey and Knight 2013).

### 4.1.5. Breeding

Cormorants and Australasian Darters can breed both in coastal and inland areas (Pizzey and Knight 2013, Morcombe 2021). When breeding in inland areas, most of these species usually use well-vegetated freshwater swamps, wetlands and lakes, and typically nest in (often tall) trees overhanging or standing in water (Pizzey and Knight 2013, Morcombe 2021). Nests are platforms usually built from sticks, bark and stems (including reeds), and often lined with leaves, feathers, or other relatively soft materials (Pizzey and Knight 2013, Morcombe 2021). Most species have clutches of 3-5 eggs, with the Black-and-white Shag having slightly smaller clutches (2-4 eggs) (Morcombe 2021).

The Great Cormorant differs from the other species in that it uses a wider variety of nesting sites apart from trees, such as rocks, ledges, shrubs, the ground and anthropogenic structures (Morcombe 2021). However, like the other species, nests are a platform of sticks lined with softer debris (Morcombe 2021).

Most cormorant species and the Australasian Darter will breed at any time of year when local conditions are favourable (high enough water levels and food supplies) (Pizzey and Knight 2013, Morcombe 2021). However, different species tend to have peak breeding activity at different times of year – in the context of inland regions in southeast Australia (such as near the proposed Junction Rivers Wind Project) Little Black and Little Pied Cormorants and the Australasian Darter (in southern Australia) usually have peak breeding in the spring-summer months, whereas Great Cormorants can have peak breeding in autumn (or less often, spring) (Morcombe 2021). Black-and-white Shags are unusual in that, in the context of breeding in inland areas, they appear to confine breeding activity to the autumn months (Morcombe 2021).

All cormorant species discussed and the Australasian Darter breed in pairs, typically within colonies of varying size, often with a variety of species present (other cormorants, herons, ibis, spoonbills, egrets) (Pizzey and Knight 2013, Morcombe 2021). Little Pied Cormorants and Australasian Darters do not breed in very large colonies (the latter can breed in solitary pairs), whereas the breeding colonies of the other species can consist of a considerable number of individuals (Morcombe 2021).

### 4.1.6. Movements

Both the Little Pied Cormorant and Black-and-white Shag are largely sedentary (although individuals may move relatively small distances away from breeding colonies in the non-breeding season), but juveniles can be highly dispersive (Pizzey and Knight 2013, BirdLife Australia 2023, Birds in Backyards 2023). Some movement from the coast to inland regions during floods may occur in the Little Pied Cormorant (Morcombe 2021). In contrast, both the Little Black and Great Cormorants are usually nomadic and

dispersive in Australia, in response to cycles of flooding and drought, moving to flooded inland areas in order to take advantage of the good conditions to breed, before moving away towards the coast during drought conditions (Pizzey and Knight 2013, Birds in Backyards 2023). Localised artificial floods are also known to initiate breeding in cormorants, not just large-scale, natural flood events (Llewellyn 1983).

This Great Cormorant is particularly dispersive – many individuals from natal colonies in the lower Murray River move upstream, so occasional large influxes of individuals into the permanent, cooler waters of the eastern, upper region of the Murray-Darling system occur, and these influxes can be forecast to some degree (Llewellyn 1983). When these influxes occur, it is expected that the remaining populations in the lower Murray will be correspondingly smaller. Two-way movements between Australia and New Zealand are also known from this species (Birds of the World 2023).

Australasian Darters are also relatively mobile birds, but their movement patterns differ from the cormorants discussed. This species can move very long distances when not breeding but returns to breeding grounds within its range to breed during the breeding season, acting in a somewhat similar way to Australasian Bittern (Marchant and Higgins 1990, Herring 2022, Birds in Backyards 2023).

#### *4.1.7. Social Behaviour*

All cormorant species discussed, and the Australasian Darter will breed in pairs, typically (but not always, particularly in the case of the Australasian Darter) within mixed-species colonies of varying size and composition, as outlined in Section 4.1.5. Outside the breeding season, the Australasian Darter, Great Cormorant, Little Pied Cormorant and Black-and-white Shag can be found in groups of varying size, from individuals to small groups, (and in the case of Black-and-white Shags, groups numbering in the thousands) (Morcombe 2021). The Little Pied Cormorant usually fishes alone but flies in flocks (Pizzey and Knight 2013). In contrast to all the other species, the Little Black Cormorant is reliably gregarious (but is especially so in autumn-winter), occurring in large flocks that hunt fish co-operatively (Pizzey and Knight 2013, Morcombe 2021).

The structure of flying flocks varies between species, but all except the Little Pied Cormorants are known to adopt a V-shaped flock structure when flying, with the Little Black Cormorant also flying in undulating strings, and the Great Cormorant also flying in lines (Morcombe 2021). Flock structure in flying Little Pied Cormorants appears to be random (Morcombe 2021).

#### *4.1.8. Conservation Status*

None of the cormorant species discussed or the Australasian Darter have any conservation status and are considered widespread and secure species in every state and territory on mainland Australia.

### 4.2. Local abundance analysis

#### *4.2.1. Great Cormorant*

There were 165 point records of this species within 20 km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 1000 individuals, although most records had far fewer individuals (the next-highest number of individuals at a record was 176, and the median number of individuals at a record is three). The majority of the records were clustered around Yanga Lake and the Murrumbidgee River, and the vast majority of records were from 2010-2019, and are therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions (e.g., from during the Millennium Drought) making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, the lowest number of records were from May-September, with the period from October-April having substantially more records. It is unclear why there would be fewer observations from May-September, but for some reason the species was observed less during these cooler months. The pattern is not strong.

There were a handful of records with substantial spatial uncertainty but still likely to be located from land within the planned JRWP even after accounting for this. Since these records are relatively far from large water sources, they may represent birds travelling between such water sources, including between the Murrumbidgee River or Yanga Lake to the north of the proposed JRWP and the Wakool River to the south.

Nature Advisory's own avifauna surveys in the study area have included observations of this species (Nature Advisory 2023). A flock of 30 individuals was observed flying at RSA height at Reference Point 1 during bird utilisation surveys, and two flocks of 18 and five birds were seen flying under RSA height at Impact Points 1 and 3 in the summer and spring 2021-22 surveys respectively.

On the basis of this data and known information about the species, Great Cormorant occasionally use habitat within the proposed JRWP footprint (likely in relatively small numbers) or fly through the proposed JRWP airspace (potentially in large flocks), likely during flood conditions that attract them to forage and breed in the area, although these are likely to be rare events (less than annual, potentially decadal or more infrequent) (ARC Centre of Excellence for Climate Extremes 2022). If they breed in the areas surrounding the proposed JRWP, they may do so in considerable numbers, and fledglings may potentially disperse through the proposed JRWP, particularly eastwards towards the upper reaches of the Murray-Darling basin.

### *4.2.2. Black-and-white Shag*

There were 139 records of this species within 20 km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 130 (median: Seven). All records were clustered around Yanga Lake, the Murrumbidgee River and the Wakool River, with the majority being from 2010-2019, and therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions (e.g., from during the Millennium Drought) making the area unsuitable for this species. Since mature adults are largely sedentary, if there were truly higher numbers present during this decade, this may reflect juveniles that dispersed into the area or increased survival and breeding success of local populations.

Within each year, there are two peaks of observations, with most observations occurring from October-December or from February-April. Months outside of these periods (as well as November) have far fewer observations. The peaks of observations during late summer-autumn could be due to breeding efforts of the species, as the appearance of fledglings and juveniles would lead to a higher number of individuals in the landscape being observed prior to their dispersal. It is unclear what could be causing the peak of observations in late spring-summer.

Nature Advisory's own avifauna surveys of the study area did not include observations of this species (Nature Advisory 2023).

This species was never recorded far from the aforementioned three large water sources, despite being a large, conspicuous bird. Since it is also sedentary, adults are unlikely to use habitat in or fly through the airspace of the proposed JRWP, as the footprint is relatively far from these water bodies, although juveniles could occasionally disperse through its airspace.

### *4.2.3. Little Black Cormorant*

There were 143 records of this species within 20 km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 200 (median: three). Most records were

clustered around Yanga Lake, and the Murrumbidgee and Wakool Rivers, and the vast majority of records are from 2010-2019, and are therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions (e.g., from during the Millennium Drought) making the area unsuitable for this species, causing them to disperse away from the area during this time.

Within each year, the months of February, April, and October-December have the most observations. The peak of observations during the October-December period could be attributed to increased breeding efforts by this species at this time of year, with the resultant fledglings and juveniles contributing to the higher number of records at this time. It remains unclear why a peak of observations occurs in February and April, although a similar pattern occurs for the Black-and-white Shag.

Nature Advisory's own avifauna surveys of the study area did not include observations of this species (Nature Advisory 2023).

This species was recorded on a handful of occasions relatively far from large water sources, between the Murrumbidgee River and Yanga Lake to the north and the Wakool River to the south. Given that this species will use even moderately small water bodies for foraging habitat, these records could represent occurrences of the species at farm dams, ponds, or small wetlands. However, this species is also quite dispersive, and these records could also represent movement of flocks between the aforementioned large water sources, potentially through the airspace of the proposed JRWP. Overall, this species may make use of any suitable habitat, such as small farm dams, in or near the footprint of the proposed JRWP to forage, and may also fly through the airspace of the proposed JRWP in large flocks (particularly when floods attract them to breed and forage in the surrounding areas) to travel between the Murrumbidgee River and Yanga Lake to the north of the proposed JRWP and the Wakool River to the south..

### *4.2.4. Little Pied Cormorant*

There were 109 records of this species within 20 km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 117 (median: one and a half). As with the Black-and-white Shag, all records were clustered around Yanga Lake, and the Murrumbidgee and Wakool Rivers, although this species was clustered more loosely and could be found further from these water sources than the Black-and-white Shag. As with the other cormorant species, the vast majority of records are from 2010-2019, and therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions (e.g., from during the Millennium Drought) making the area unsuitable for this species. Since mature adults are largely sedentary, if there were truly higher numbers present during this decade, this may reflect juveniles that dispersed into the area or increased survival and breeding success of local populations.

Observations for this species peak in October and are generally uniform for the rest of the year (although there are lower numbers from mid-winter-early spring). It is unclear why there should be so many observations from October in particular. However, more broadly this species experiences breeding peaks in the spring-summer months, so this peak in observations could potentially be caused by increased breeding efforts at this time. The appearance of fledglings and juveniles would lead to a higher number of individuals in the landscape being observed prior to their dispersal.

Nature Advisory's own avifauna surveys of the study area did not include observations of this species (Nature Advisory 2023).

This species was largely recorded relatively close to the aforementioned three large water sources, despite being a large, conspicuous bird. Therefore, they are unlikely to use habitat in or fly through the airspace of the proposed JRWP, as the footprint is relatively far from these water bodies. A group of eight individuals was seen relatively far from Yanga Lake, and potentially in or the northern edge of the footprint

for the proposed JRWP. Therefore, small flocks of this species may infrequently pass near or along the northern edge of the proposed JRWP or may possibly utilise small patches of aquatic habitat such as farm dams in that area.

#### *4.2.5. Australasian Darter*

There were 122 records of this species within 20 km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 28 (median: two). Virtually all records were clustered around Yanga Lake, and the Murrumbidgee and Wakool Rivers, although there was one record old record located relatively far (approx. 11.4 km) from these water bodies and watercourses. As with the cormorant species, the vast majority (79%) of records are from 2010-2019, and therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions (e.g., from during the Millennium Drought) making the area unsuitable for this species.

Observations for this species peak in October, with smaller peaks in February and April, but are generally uniform for the rest of the year. It is unclear why there should be so many observations from these months in particular. However, more broadly this species experiences breeding peaks in the spring-summer months, so this peak in observations could potentially be caused by increased breeding efforts at this time. Additionally, the appearance of fledglings and juveniles would lead to a higher number of individuals in the landscape being observed prior to their dispersal, which could potentially explain the peak in observations in February. The peak of observations in April is particularly difficult to understand.

Nature Advisory's own avifauna surveys of the study area did not include observations of this species (Nature Advisory 2023).

This species was largely recorded relatively close to the aforementioned three large water sources, despite being a large, conspicuous bird. Furthermore, the species is known to be confined to wetlands that are above a certain size and depth, only being found in wetlands 50 cm deep or more. Therefore, they are unlikely to use habitat in or fly through the airspace of the proposed JRWP, as the footprint is relatively far from these water bodies and suitable habitat is unlikely to exist in or near it most of the time (although it could occur rarely after very intense flooding (ARC Centre of Excellence for Climate Extremes 2022). Even in this latter scenario, however, relatively few individuals are likely to occur in or near the proposed JRWP, or more generally fly through its airspace when travelling between breeding and non-breeding habitat, as this is a usually a relatively solitary species (Birds in Backyards 2023).

### 4.3. Flight height analysis/review

Black-and-white Shag, Little Pied Cormorant and Great Cormorant have all been recorded flying at RSA height (20-150m) (Matthews 1984, Beauchamp et al. 2009, Furness et al. 2013), and the Australasian Darter has been recorded at heights that are probably at or above RSA height (Straw 2013). No information exists for the Little Black Cormorant, but based on the behaviour of these closely related species they are likely to occasionally fly at RSA height as well.

The proportion of flights made at RSA heights is unknown for each species, except for the Great Cormorant, for which multiple estimates have been made (an average of 4% across studies – Furness et al. 2013). This is a very low proportion of flights, and there are theoretical aerodynamic reasons (supported by empirical evidence in the case of the Great Cormorant) for cormorants to largely fly low near to the ground or water surface (at least during foraging and commuting flights) (Finn et al. 2012). The presence and use of any aquatic habitat in the proposed JRWP and near turbines is unlikely to pose a risk to these species, as they are unlikely to fly at RSA height in this context.

Overall, whilst cormorants do occasionally fly at RSA height, they seem likely to fly below it most of the time and are unlikely to do so regularly at the proposed JRWP. It is unknown what proportions of flights made by Australasian Darters are at RSA height, but they are arguably even less likely to occur in the proposed JRWP than the cormorants. At worst, some cormorants or darters may pass through the airspace of the proposed JRWP occasionally (potentially in large flocks for the cormorants), but even when this occurs, most cormorant flights seem likely to be below RSA height and darters are unlikely to travel in large flocks. Therefore, occasional mortalities could occur but appear unlikely to be high in frequency or magnitude. Given every species in this group of waterbirds is considered widespread and secure, they appear unlikely to be heavily impacted by turbine collision at the proposed JRWP.

# 5. Group 2: Waterfowl (Ducks, Geese and Swans)

This group of waterbirds includes the following:

- Grey (Oceanic) Teal *Anas gracilis*
- Maned Duck (Australian Wood Duck) *Chenonetta jubata*
- Pink-eared Duck *Malacorhynchus membranaceus*
- Pacific Black Duck *Anas superciliosa*
- Black Swan *Cygnus atratus*
- Australasian Shoveler *Spatula rhynchotis*
- Freckled Duck *Stictonetta nervosa*
- Magpie Goose *Anseranas semipalmata*
- Blue-billed Duck *Oxyura australis*

## 5.1. Species biology and ecology

### *5.1.1. Description*

Ducks, geese and swans, collectively known as waterfowl, are a primarily aquatic order of birds. All members of the order are characterised by webbed feet, relatively short legs and a broad, flat bill. They are relatively large birds – even relatively small duck species like the Blue-billed Duck are medium-sized birds (roughly around the size of an Australian Magpie *Cracticus tibicen*), and the largest members of the order - the swans - are very large birds that regularly exceed a metre in length (Morcombe 2021). Ducks are smaller and have shorter necks than geese and swans. Colours can vary dramatically between species, and even within species between juveniles and adults, between males and females, and between the breeding and non- breeding season plumages (particularly for males) (Morcombe 2021).

### *5.1.2. Diet*

Ducks, geese and swans, including most of the species discussed here, are generally omnivorous birds, feeding on parts of aquatic and terrestrial vegetation including leaves and seeds but also incorporating some aquatic animals such as yabbies, fish and insects in their diet (Birds in Backyards 2023). However, some species (e.g., Magpie Goose, Black Swan) are strictly herbivorous (Birds in Backyards 2023). Additionally, some species (within the search region, Australasian Shoveler and Pink-eared Duck) are planktivorous and will filter-feed on microalgae and zooplankton from water (Pizzey and Knight 2013, Morcombe 2021).

### *5.1.3. Distribution and Population*

The nine species of waterfowl considered here (a combination of those frequently recorded in the search region and listed species that could feasibly occur in the search region) vary in distribution and abundance between species, with some being very common and others now relatively rare and listed as threatened at a state and/or federal level. All occur in south-eastern Australia, particularly in coastal areas and the moister upper areas of the Murray-Darling Basin, with most (apart from the Magpie Goose) also present along the relatively moist south-west coast of WA (Morcombe 2021). Among the listed species, Magpie Goose and Australasian Shoveler extend their distribution northwards to the tropics, with the Magpie Goose also present across the Top End (Morcombe 2021). In contrast, Freckled and Blue-billed Ducks are largely confined to south-west WA, the south-east coast and the Murray-Darling Basin, with scattered and infrequent records from elsewhere (Morcombe 2021).

The more common species, such as Grey Teal, Maned Duck, Pacific Black Duck, Black Swan and to a lesser extent Pink-eared Duck, are found (more patchily in drier parts) across almost the whole continent, but with all of them avoiding western SA and the interior of WA (and in the case of Maned Duck and Black

Swan, the Top End as well for the former and the Kimberley coast, tip of Cape York Peninsula and the western Gulf of Carpentaria for the latter) (Morcombe 2021).

### 5.1.4. Habitat

Ducks, geese and swans use a variety of aquatic freshwater, brackish, estuarine, saline and marine environments, depending on the species (Pizzey and Knight 2013, Morcombe 2021). Within inland areas, freshwater environments support the highest diversity of species, but species with more flexible habitat preferences (particularly Grey Teal, Pacific Black Duck and Black Swan) will also use brackish or saline wetlands (Pizzey and Knight 2013, Morcombe 2021).

Many species prefer relatively shallow, ephemeral wetlands (Pink-eared Duck, Freckled Duck and Magpie Goose are particularly inclined to), but they are never confined to them and will sometimes use permanent wetlands even if not forced to by dry conditions (Pizzey and Knight 2013, Morcombe 2021). In contrast, some species largely confine themselves to deep, permanent wetlands (of the species within the search region, this applies to Blue-billed Duck) (Pizzey and Knight 2013, Morcombe 2021).

Some species of waterfowl specialise in using open expanses of water, and others prefer to use areas with dense, extensive growth of aquatic vegetation, and still others make ready use of both (Pizzey and Knight 2013, Morcombe 2021). Most species in the search region use both open and heavily vegetated areas, but Freckled Ducks have a strong preference for areas of dense aquatic vegetation (Pizzey and Knight 2013, Morcombe 2021), and Black Swans require some open stretches of water (40 m long or more) to take off successfully (Birds in Backyards 2023).

Wetlands can get too deep for many species to use (including most of the species in the search region), because benthic food becomes too difficult to access (Birds in Backyards 2023). However, Maned Ducks often persist in such environments because they rely heavily on terrestrial vegetation for food and are relatively unaffected by this problem (Birds in Backyards 2023).

### 5.1.5. Breeding

Most ducks, geese and swans can breed in both coastal and inland wetlands, but Blue-billed Ducks and Freckled Ducks largely confine their breeding activities to inland wetlands, with Grey Teal and likely Pink-eared Duck displaying a preference for breeding in inland wetlands as well (Morcombe 2021, Birds in Backyards 2023).

When breeding in inland wetlands (such as in the search region and the study area), a variety of nesting locations are used depending on the species (Morcombe 2021). Some species, (in this case, Grey Teal), are very flexible with nest sites, and will nest on the ground, in rabbit burrows, and in tree hollows (Morcombe 2021, Birds in Backyards 2023). Many other species have more specific nesting requirements – tree hollows are the main nest site of choice for Maned Duck, and one of the main nest locations for Australasian Shoveler, Pacific Black Duck and Pink-eared Duck (the others being tree stumps, on the ground in dense vegetation, and in old nests of other birds) (Morcombe 2021, Birds in Backyards 2023). Magpie Goose, Black Swan and Blue-billed Duck are also particular about nesting requirements, making their nests on floating platforms of aquatic vegetation within reedbeds (although Magpie Geese, like Freckled Ducks, will also use trees, and Black Swans will also nest on islands) (Morcombe 2021). Nests may be built from leaves, twigs, grass and/or reeds, depending on the species, but will generally be lined with down (Morcombe 2021).

Clutch sizes vary between species but are generally relatively large. Most species considered here have a minimum clutch size of 5-7 but have maximum clutch sizes of 8 (Pink-eared Duck, Freckled Duck), 9 (Magpie Goose), 10 (Black Swan) or 12 (Grey Teal and Pacific Black Duck) (Morcombe 2021). Australasian Shovelers generally have larger clutch sizes, from 9-11 eggs (Morcombe 2021). Of the

species considered here, Blue-billed Ducks have the most variable clutch sizes, from 3-12 eggs (although 5-6 is most common) (Morcombe 2021). Pacific Black Ducks are known to raise two broods of ducklings in a single breeding season (Birds in Backyards 2023).

All species of ducks and geese discussed here depend heavily on rainfall patterns in any given year for the timing of their breeding and can breed at any time of year when conditions are right (typically after high rainfall and flooding) (Morcombe 2021). This particularly applies to Pink-eared Duck, Black Swan and Magpie Goose, as these are very dependent on floods for initiation of breeding (Morcombe 2021). However, other species still experience peaks of breeding activity in their populations, generally from late winter-late spring/early summer (September-December for Blue-billed Duck, July-November for Grey Teal, August-December for Freckled Duck, and August-November for Australasian Shoveler) (Morcombe 2021). The breeding season is unusually long for the Pacific Black Duck – this species breeds from June-January in southern Australia (Morcombe 2021).

Mating and chick-rearing systems differ between the duck and geese species discussed. Some, such as the Blue-billed Duck, and Freckled Duck are polygamous, and for such species females build the nest, incubate the eggs, and raise the young – males, if present at all after mating, hang around until shortly after the eggs are laid, during early incubation, and depart afterwards (Morcombe 2021, Birds in Backyards 2023) Pacific Black Ducks are similar in terms of parental care, but are monogamous (Birds in Backyards 2023). In contrast, the Black Swan, Maned Duck, Grey Teal and Pink-eared Duck form monogamous breeding pairs where the male shares some parental duties like helping to guard, brood or feed offspring (less so in the Grey Teal) (Morcombe 2021, Birds in Backyards 2023). The breeding system of the Australasian Shoveler is unknown, but it is thought to be monogamous (Birds in Backyards 2023). Magpie Geese are unusual in that they can be a polygamous species, but they breed in stable social groups where males share some parental duties – males' mate for life with 1-2 females, and these females may use the same nest, and all adults contribute to incubation and care of offspring (Morcombe 2021, Birds in Backyards 2023). The waterfowl species discussed are generally not colonial breeders, and breed alone or in pairs, but Magpie Geese breed in large colonies, large numbers of Grey Teal can congregate to breed in ideal locations, and Black Swans sometimes breed in small colonies (Morcombe 2021, Birds in Backyards 2023).

### *5.1.6. Movements*

Most of the waterfowl species discussed are nomadic and will move across landscapes and regions depending on rainfall and water levels in water bodies and watercourses (Morcombe 2021). This is particularly true of Grey Teal, Australasian Shoveler, Pacific Black Duck, Black Swan and Pink-eared Duck, which are or can be highly dispersive species that will move in large numbers across long distances to take advantage of the rich foraging opportunities provided by flooding in ephemeral wetlands (Morcombe 2021, Birds in Backyards 2023). Magpie Goose is also somewhat nomadic, as they concentrate in areas of permanent water when conditions are dry but disperse across floodplains to breed then they flood (Birds in Backyards 2023). Freckled Ducks are also prone to making long-distance movements – they breed inland in heavily vegetated ephemeral wetlands when conditions are suitable but move to the coast when conditions are dry (Birds in Backyards 2023). In contrast, Blue-billed Duck and Maned Duck are largely sedentary, although in the case of the former, young birds disperse from natal areas to the Murray River system and coastal wetlands in Victoria and South Australia (Morcombe 2021, Birds in Backyards 2023).

### *5.1.7. Social Behaviour*

The duck and goose species discussed display a variety of social behaviours, depending on the species and the time of year (breeding and non-breeding season behaviours).

Blue-billed Duck and Freckled Duck are polygamous, with the female alone building the nest, incubating the eggs and raising the young (Morcombe 2021, Birds in Backyards 2023). Grey Teal is monogamous, but the male does not usually assist in parental duties unless necessary (e.g., death of the female) (Morcombe 2021, Birds in Backyards 2023). Black Swan, Maned Duck and Pink-eared Duck form monogamous breeding pairs where both parents help guard, brood or feed offspring, and in Magpie Goose, males mate with 1-2 females but all adults assist with incubation and rearing of young (Morcombe 2021, Birds in Backyards 2023). The mating system of the Australasian Shoveler and Pacific Black Duck is thought to be monogamous, but the female incubates the eggs and broods the young on her own (Morcombe 2021, Birds in Backyards 2023).

Most of the duck and goose species described are not colonial breeders, and nest solitarily or in pairs (Morcombe 2021). The biggest exception to this trend is the Magpie Goose, which breeds in large colonies, and the Grey Teal, which can gather opportunistically in big numbers to breed in ideal areas, although Black Swans may also breed in small colonies (Morcombe 2021).

Social behaviour outside the breeding season also varies between species. Some species, such as Blue-billed Duck, Pink-eared Duck and Magpie Goose, gather in large flocks in deep, permanent freshwater wetlands (or for Pink-eared Ducks, relatively shallow, ephemeral wetlands where they forage co-operatively) outside the breeding season (especially in autumn or winter for the Blue-billed Duck) (Pizzey and Knight 2013, Morcombe 2021, Birds in Backyards 2023). Others, such as Maned Duck, are largely sedentary and always occur in small family groups consisting of a breeding pair and sometimes their offspring, although flocks are also known (Pizzey and Knight 2013, Birds in Backyards 2023). Many species sit between these two extremes – Grey Teal, Black Swans and Pacific Black Ducks can gather in small or (for the ducks) large flocks, depending on how foraging opportunities happen to be distributed across the landscape at a particular time (gathering in large flocks when foraging habitat is uncommon, or ideal in a small area), Freckled Ducks disperse to permanent, more open, coastal wetlands when conditions are dry (and may occur in larger numbers as they are concentrated in a smaller area), and Australasian Shovelers are often found in mixed flocks with other ducks (Pizzey and Knight 2013, Morcombe 2021, Birds in Backyards 2023).

When Pink-eared Duck flocks are disturbed, they generally do not fly far – the flock circles and lands again nearby (Morcombe 2021).

Black Swans will fly in flocks at night when undertaking long-range movements outside the breeding season, and rest during the day (Birds in Backyards 2023).

#### *5.1.8. Conservation Status*

Maned Duck, Pink-eared Duck, Pacific Black Duck, Black Swan and Grey Teal are considered widespread, common and secure species that are not listed as threatened in any Australian state or territory.

Australasian Shoveler is not listed as threatened in NSW or federally.

Blue-billed Duck, Magpie Goose and Freckled Duck are listed as “Vulnerable” in NSW under the Biodiversity Conservation Act 2016.

### 5.2. Local Abundance Analysis

#### *5.2.1. Grey Teal*

There were 277 records of this species within 20 km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 2000 individuals, although most records had far fewer individuals (the nest-highest number of individuals at a record was 1340, and the median number of individuals at a record is 10). Most of the records were clustered around Yanga

Lake, the Murrumbidgee River and the Wakool River. Roughly 68% of records occurred since 2010, with another 13% of records occurring from 2000-2009, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, there were generally a higher number of monthly records from October-February, with the period from March-September having fewer records. There is also a very large spike in number of records in October. It is unclear why this pattern of fewer records during the colder months exists, but it is reasonably (or in the case of the October spike, very) strong.

There were a handful of records with substantial spatial uncertainty but still likely to be located relatively far from large water sources. They may represent birds travelling between such water sources, such as between the Murrumbidgee River or Yanga Lake to the north of the proposed JRWP and the Wakool River to the south of it. Alternatively, these records may represent use of small, ephemeral patches of wetland in the landscape, as this species is highly opportunistic and particularly prone to using such habitat patches.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, Grey Teal may occasionally use habitat within the proposed JRWP footprint or fly through its airspace (potentially in large numbers), likely during flood conditions attracting them to forage and breed in or near the study area, although this is likely to be a very infrequent event (less than annual, potentially decadal or more infrequent) (ARC Centre of Excellence for Climate Extremes 2022). If they breed in the areas surrounding the proposed JRWP, they may do so in considerable numbers, and fledglings may potentially disperse through the proposed JRWP.

### *5.2.2. Maned Duck*

There were 222 records of this species within 20 km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 300 individuals, although most records had far fewer individuals (the median number of individuals at a record is six). Most of the records were clustered around Yanga Lake, the Murrumbidgee River and the Wakool River. Roughly 65% of records occurred since 2010, with another 9% of records occurring from 2000-2009, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times). A reasonable number of records came from 1970-79 (9%), although the reason for this is not clear.

Within each year, there was not a very clear pattern of occurrence across seasons – all months had broadly similar numbers of records, with perhaps slightly more in November and February. The big exception to this was a spike in records in October. The reason for this spike is not clear, but it is noted that a similar (but much stronger) spike exists in the Grey Teal occurrence data as well.

There were a handful of records with substantial spatial uncertainty but still likely to be located relatively far from large water sources. This species is sedentary, but these records may represent birds travelling between such water sources, such as between the Murrumbidgee River or Yanga Lake to the north of the proposed JRWP and the Wakool River to the south of it, during very dry years when such movements may be necessary. Alternatively, these records may represent use of small patches of wetland (including farm dams with little-no vegetation) in the landscape or represent feeding from terrestrial vegetation near such wetlands. Most of these records are relatively old, which indicates this species is generally unlikely to be found far from large water sources.

Nature Advisory's own avifauna surveys in the study area recorded this species once under RSA height, at Impact Point 6, during the 2021-22 winter surveys (Nature Advisory 2023). Seven individuals were seen (Nature Advisory 2023).

Based on this data and known information, Maned Duck could persistently use and breed in habitat within the proposed JRWP footprint or fly through its airspace, but this is uncertain as they were not observed frequently on site (Nature Advisory 2023). If they do so, it is unlikely to do so in large flocks, but rather in small groups. If they breed in the areas surrounding the proposed JRWP, a small number of fledglings could also potentially disperse through the proposed JRWP.

### 5.2.3. Pink-eared Duck

There were 37 records of this species within 20-km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 300 individuals, although most records had substantially fewer individuals (the nest-highest number of individuals at a record was 272, and the median number of individuals at a record is six). Most of the records were clustered around Yanga Lake, with several along the Murrumbidgee River near Balranald. Roughly 78% of records occurred since 2010, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, there were generally a higher number of monthly records from October-February, with the period from March-September having fewer records. There is a small peak in the number of records in October. It is unclear why this pattern of fewer records during the colder months exists, but it is reasonably strong.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Pink-eared Duck may occasionally use habitat within the proposed JRWP footprint or fly through its airspace (potentially in large numbers), likely during flood conditions attracting them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less.

### 5.2.4. Pacific Black Duck

There were 200 records of this species within 20 km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 140 individuals, although most records had far fewer individuals (the median number of individuals at a record is three). Most of the records were clustered around Yanga Lake, the Murrumbidgee River and the Wakool River. Roughly 65% of records occurred since 2010, with another 7% of records occurring from 2000-2009, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times). A reasonable number of records came from 1970-79 (10%), although the reason for this is not clear.

Within each year, there was not a very clear pattern of occurrence across seasons – all months had broadly similar numbers of records, with perhaps slightly more in February. The big exception to this was a spike in records in October. The reason for this spike is not clear, but it is noted that a similar spike exists in the Grey Teal occurrence data as well.

There were records with substantial spatial uncertainty but still likely to be located relatively far from large water sources. This species is sedentary, but these records may represent birds travelling between such water sources, such as between the Murrumbidgee River or Yanga Lake to the north of the proposed

JRWP and the Wakool River to the south of it, during very dry years when such movements may be necessary. Alternatively, these records may represent use of small patches of wetland (including farm dams with little-no vegetation) in the landscape or represent feeding from terrestrial vegetation near such wetlands. Most of these records are relatively old, which indicates this species is generally unlikely to be found far from large water sources.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, Pacific Black Duck may occasionally use habitat within the proposed JRWP footprint or fly through its airspace (although probably in relatively small numbers), likely during flood conditions attracting them to forage and breed in or near the study area, although this is likely to be a very infrequent event (less than annual, potentially decadal or more infrequent) (ARC Centre of Excellence for Climate Extremes 2022). If they breed in the areas surrounding the proposed JRWP, they would likely do so in relatively small-moderate numbers, although fledglings may potentially disperse through the proposed JRWP.

### *5.2.5. Black Swan*

There were 180 records of this species within 20 km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 79 individuals, although most records had far fewer individuals (the median number of individuals at a record is four). Most of the recorded locations were clustered around Yanga Lake, with a couple along or near the Murrumbidgee River and the Wakool River. Oddly, 91 old records (from the 60s) in the same location were somewhat distant (3.2 km) from a large water body or watercourse (the nearest is Yanga Lake), apparently after accounting for spatial uncertainty. Based on existing knowledge of the species, this is unlikely, and these records probably occurred at Yanga Lake. These peculiar records make up the bulk of the records in the search region (approx. 50%), giving this species the unusual status of being the only species discussed in this report that appears to have declined in the search region over time. However, these records came from a banding program, and it is likely that recording rates simply fell after the banding program was discontinued. If these banding records are ignored, roughly 48% of records occurred since 2010, with another 7% of records occurring from 2000-2009, meaning the bulk of the records (apart from the banding records) are relatively recent, although there was a relatively high number of observations from the 70s (20%). The reason for these patterns over time is not clear, and it is unknown whether the banding program was discontinued due to a drop in the population and the increased inefficiency of data collection as a result, or whether no drop in population occurred and the banding program was discontinued for other reasons. If the latter is in fact true, records of the species in the search probably represent the abundance of the species in a limited, imprecise and potentially inaccurate way.

Within each year, there was not a very clear pattern of occurrence across seasons – all months had broadly similar numbers of records, with a small peak in October. The big exception to this was an enormous spike in records in November. This spike is driven by the banding records, as all of those records are from the same date. When the November data is ignored, there is still largely no clear pattern of occurrence across seasons, apart from the small peak of records in October.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, Black Swan may rarely use habitat in or near the proposed JRWP footprint, likely during flood conditions attracting them to forage and breed in or near the study area, although this is likely to be a very infrequent event (less than annual, potentially decadal or more infrequent) (ARC Centre of Excellence for Climate Extremes 2022) and would involve a relatively small-moderate number of birds

although fledglings may potentially disperse through the proposed JRWP airspace. A more likely scenario is that some birds will fly through the airspace of the proposed JRWP on nomadic travels, flying between wetlands offering the best foraging and potentially breeding opportunities. However, although the species does fly in flocks, these flocks generally not large, so large numbers of individuals are unlikely to cross the airspace of the proposed JRWP simultaneously or in rapid succession.

### 5.2.6. Australasian Shoveler

There were 23 records of this species within 20 km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 108 individuals, although most records had substantially fewer individuals (the nest highest number was 66 individuals, and the median number of individuals at a record is three). Most of the records were clustered around Yanga Lake, with several along or relatively near the Murrumbidgee and Wakool Rivers. Roughly 52% of records occurred since 2010, with a further 22% from 2000-2009, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, there were generally a higher number of monthly records from August-December, with the period from January-July having very few records each month. The times when the species was observed more frequently in the search region approximately coincided with the most common breeding period of the species, although in semi-arid inland areas such as the search region, breeding can occur at any time and is largely dictated by rainfall patterns.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Australasian Shovelers would rarely use habitat within the proposed JRWP footprint, and if they ever did it would likely when flood conditions attract them to forage and breed in or near the study area, although this is likely to be a very infrequent event (less than annual, potentially decadal or more infrequent) (ARC Centre of Excellence for Climate Extremes 2022). However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less. It is likelier that individuals or possibly small flocks could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels. Because this species is highly nomadic and dispersive this is difficult to quantify, but being a relatively uncommon species, it is unlikely that such flights through the proposed JRWP would occur frequently.

### 5.2.7. Freckled Duck

There were two records of this species within 20 km of a point within the proposed Junction Rivers Wind Project. One record was of a single individual on Yanga Lake in 2018, and the other was of an unknown number of individuals very near the Wakool River in 1992. Possible explanations for the low number of records include a lack of observer effort, or the cryptic behaviour of the species (it often occurs in densely vegetated wetlands), but when compared to the much higher numbers of records of even other listed species in the search region (e.g. Australasian Shoveler), it indicates that occurrence of the species in the search region may be infrequent, of short duration, and/or in small numbers.

The Yanga Lake record occurred in September, and the Wakool River record occurred in June. Notably, the latter was outside the usual breeding season of the species (although depending on rainfall, breeding can occur at any time of year), and the former, although within the usual breeding season, was from a large, likely permanent lake during a dry year (which could indicate that the record was of a non-breeding bird using the lake as a drought refuge, as this is not normal breeding habitat – the species prefers

breeding in ephemeral, densely vegetated wetlands). It appears unlikely (but possible) that the species regularly breeds in the search region.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Freckled Ducks are unlikely to occur within the proposed JRWP footprint, due to a lack of suitable habitat. It is likelier that individuals could very occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels. This species generally moves between ephemeral inland breeding grounds and permanent coastal non-breeding grounds, so if breeding occurred annually such flights would occur in two main windows each year (usually around August and December). However, because breeding can occur at any time of year (or not at all) depending on the conditions, this is difficult to quantify. Being a relatively uncommon species, it is unlikely that such flights through the proposed JRWP would occur frequently.

### *5.2.8. Magpie Goose*

There were no records of this species within 20 km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023), and the species is included here as a precautionary measure as they are predicted to occur in or near the region on the NSW Threatened Species website (OEH 2018).

On the basis of this data, and the known habits of the species, Magpie Goose are unlikely to use habitat within the proposed JRWP footprint, and if they ever did it would likely when flood conditions attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a 50% chance of this occurring during the lifespan of the wind farm (ARC Centre of Excellence for Climate Extremes 2022), and even then, they have never been recorded in the search region despite being a large, conspicuous and gregarious bird. It is marginally likelier that large flocks could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels, but having never been recorded in the study area, it is unlikely that such flights through the proposed JRWP would occur frequently (if ever).

### *5.2.9. Blue-billed Duck*

There were four records of this species within 20 km of a point within the proposed Junction Rivers Wind Project. Three records were from Yanga Lake, and the other was halfway between Yanga Lake and the Murrumbidgee River. All records were from 2010 or 2021. Possible explanations for the low number of records include a lack of observer effort, but when compared to the much higher numbers of records of even other listed species in the search region (e.g. Australasian Shoveler), and the easily-observed behaviour of the species (it often uses open water) it indicates that occurrence of the species in the search region is in small numbers, and is likely confined to Yanga Lake and possibly nearby stretches of the Murrumbidgee River.

All records of the species occurred from November-February, which roughly coincides with the breeding season of the species (although breeding can occur at practically any time depending on rainfall and water levels). However, since the species is considered sedentary, it should be assumed present and potentially breeding year-round at Yanga Lake.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Blue-billed Ducks are highly unlikely to occur within the proposed JRWP footprint, due to a lack of suitable habitat. Because the species is

generally sedentary, it is also unlikely to fly through the airspace of the proposed JRWP. However, fledglings typically disperse from inland breeding grounds to coastal areas in SA and Victoria, so fledglings dispersing from any breeding events at Yanga Lake could potentially fly through the proposed JRWP on their way southwards towards the Victorian coast. Because breeding could occur at almost any time of year, it is difficult to determine when such an event could happen, but it is perhaps likelier from November-February. Because it is likely there are only a few breeding birds at Yanga Lake, fledglings are unlikely to fly through the proposed JRWP in large numbers – a worst-case scenario would be of multiple pairs having a maximum clutch size of 12, with perfect survivorship of offspring and all migrating through the proposed JRWP to the Victorian coast. Such a scenario could result in 24-36 fledglings flying through the proposed JRWP (but not necessarily in a single flock), but this is very unlikely, with a handful of fledglings flying through the proposed JRWP occasionally being a more realistic scenario.

## 5.3. Flight height analysis/review

Very little information exists on the flight heights of the species of ducks and geese discussed. Generally, waterfowl are thought to fly at relatively low heights when using particular water bodies or wetlands (particularly Maned Duck), and not venture very far from them, such that a 400 m buffer around wetlands and watercourses is generally large enough to prevent most collisions between waterbirds using them and wind turbines (Islam et al. 2022, Everaert date unknown). Furthermore, when undertaking relatively long-distance movements between wetlands, many waterfowl species fly at very high heights, well-above RSA height, and circle down when directly above the wetland they are travelling to (e.g., Yu and Si 2019). This would mean that flights at RSA height primarily occur during ascent from and descent to wetlands, and many waterfowl species (e.g., Australasian Shoveler, Grey Teal) have been noted to have steep flight trajectories (Morcombe 2021), which minimises the distance from wetlands where they fly at RSA height. If a 400 m buffer is established around any wetlands in the study area, it decreases the risk of collision further, as long as the species of waterfowl discussed fly in a similar way to most other waterfowl species in other parts of the world (although this is largely unknown).

Although a number of Australian waterfowl species (Pacific Black Duck, Grey Teal, Australian Shelduck, Maned Duck and Black Swan) are known to have collided with turbines (Moloney et al. 2019, Symbolix 2020), over cumulatively more than a decade of monitoring across various Victorian wind farms none were found to have collided with turbines more than 1-3 times across all the wind farms monitored over the entire period the mortality monitoring data was collected. One of these species, the Black Swan, is known to fly long distances in flocks at night (Birds in Backyards 2023), which can increase the risk of collision with turbines due to poor visibility and subsequent inability to take evasive action, so the low number of mortalities recorded at Victorian wind farms points to the effectiveness of buffers around wetlands and other measures typically taken to prevent waterfowl collisions with turbines.

Magpie Goose and Freckled Duck are thought not to occur in the search region at all, or only briefly and/or infrequently, which minimises or virtually eliminates their risk of colliding with turbines. Adult Blue-billed Ducks are thought to be largely confined to Yanga Lake, and being sedentary they are unlikely to enter the airspace of the proposed JRWP and so collide with turbines, although dispersing fledglings may.

Overall, whilst waterfowl, on relatively rare occasions, fly at RSA height and collide with turbines (Moloney et al. 2019, Symbolix 2020), they seem likely to fly below or above RSA height most of the time and are unlikely to regularly occur in the proposed JRWP. At worst, some may pass through the airspace of the proposed JRWP occasionally in large flocks, but even when this occurs, most flights seem likely to be below or (particularly for long-distance movements) above RSA height. Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude and are unlikely to be those of listed species. The possible exceptions to this would be:

- Fledglings of Blue-billed Ducks at Yanga Lake – there is a reasonable possibility that they could periodically disperse through the airspace of the proposed JRWP.
- Australasian Shoveler – individuals, small flocks, or at times large flocks could potentially, very occasionally fly through the airspace of the proposed JRWP or use habitat in or near the proposed JRWP on the rare (less than annual, possibly decadal or less) occasions that floods produce suitable habitat there.
- Grey Teal – discussed here due to the (limited) potential for large-scale mortality even though it is not listed. Individuals, small flocks or large flocks may occasionally use habitat in or near the proposed JRWP on the rare (less than annual, possibly decadal or less) occasions floods produce suitable habitat there. Substantially more likely is that the species could fly through the airspace of the proposed JRWP (potentially in large numbers), and this could happen occasionally and sporadically depending on rainfall and water levels in the wider region.

However, even in these instances, these species would be making long-distance movements (except for Australasian Shovelers using the study area), and based on the behaviour of other waterfowl, they would most likely be doing so well-above RSA height.

# 6. Group 3: Shorebirds (Migratory and Non-Migratory)

This group of waterbirds includes the following:

Migratory Shorebirds:

- Sharp-tailed Sandpiper *Calidris acuminata*
- Common Greenshank *Tringa nebularia*
- Curlew Sandpiper *Calidris ferruginea*
- Eastern Curlew *Numenius madagascariensis*
- Common Sandpiper *Actitis hypoleucos*
- Latham's Snipe *Gallinago hardwickii*
- Pectoral Sandpiper *Calidris melanotos*
- Marsh Sandpiper *Tringa stagnatilis*
- Black-tailed Godwit *Limosa limosa*
- Great Knot *Calidris tenuirostris*

Non-Migratory Shorebirds:

- Australian Painted-Snipe *Rostratula australis*
- Red-necked Avocet *Recurvirostra novaehollandiae*
- Pied Stilt *Himantopus himantopus*
- Masked Plover *Vanellus (Lobipluva) miles*

## 6.1. Species biology and ecology

### *6.1.1. Description*

Shorebirds are an aquatic and marine order of wading birds. All members of the order are characterised by relatively long, scaly and featherless legs (although some species have much longer legs than others) (Morcombe 2021). Many species (but not all) also have relatively long beaks which may be curved in some direction (usually upwards or downwards), and all have plumage that is coloured with a drab palate (typically brown, grey, white, cream or black) but can be patterned in a cryptic or striking way (often counter-shaded) (Morcombe 2021). All species have beaks that are specifically adapted to allow them to forage in particular ways, and most typically eat a variety of benthic aquatic and marine invertebrates and some small fish (DoEE 2017). Size in the order varies from the sparrow-sized Red-necked Stint to the large Eastern Curlew which can exceed 60 cm in length (Morcombe 2021), but there are no very large species among them.

### *6.1.2. Diet*

Shorebirds are mostly carnivorous, feeding on benthic aquatic and marine invertebrates from intertidal areas, as well as the edges of wetlands and lakes (DoEE 2017). Prey items are typically shellfish, worms and crustaceans, but also insects, insect larvae, earthworms, arachnids and small fish (DoEE 2017, Birds in Backyards 2023), with some (e.g. Masked Plover) preferring terrestrial invertebrates like insects and earthworms (Birds in Backyards 2023). However, some species (e.g. Pectoral Sandpiper, Sharp-tailed Sandpiper, Latham's Snipe, Australian Painted-Snipe, Black-tailed Godwit and Red-necked Avocet) are omnivorous, also consuming seeds, algae (Pectoral Sandpiper), rice and berries (Black-tailed Godwit), and other plant material (Latham's Snipe, Australian Painted-Snipe) (DCCEEW 2023a, Birds in Backyards 2023). They can feed at the edge of fresh, brackish, saline and marine water, and on a variety of hard and soft substrates (DoEE 2017).

### *6.1.3. Distribution and Population*

The thirteen species of shorebirds considered here (a combination of those frequently recorded in the search region, and listed species that could feasibly occur in the search region) vary widely in abundance between species, with some widespread, common and secure and some highly threatened and listed at a state and/or federal level, but most of them are migratory species that occur in and move along the East Asian – Australasian Flyway between their breeding grounds in the northern hemisphere and their over-wintering grounds in Australia (DoEE 2017).

The ten migratory shorebirds considered here vary between species in their distributions within Australia in the months they are present here (August/September-April/May). The Sharp-tailed Sandpiper, Curlew Sandpiper, Marsh Sandpiper and Common Greenshank all occur over most of the continent, including Tasmania, only avoiding the very dry areas deep in the interior of WA (where no migratory shorebirds are found) (Morcombe 2021). In contrast, the Eastern Curlew and Great Knot are strictly coastal, but can be found along the coastlines of the entire continent including Tasmania (Morcombe 2021). The other four species fall between these extremes; the Common Sandpiper is found across most of the continent but avoids western Queensland and NSW and the eastern Northern Territory as well as the interior of WA; the Pectoral Sandpiper is found across much of the continent but avoids Cape York Peninsula, the eastern coast of the Northern Territory, the Gulf of Carpentaria and the interior of both the Northern Territory and WA; Latham's Snipe is found across much of the country but avoids far southwest WA, and inland areas of SA and the Northern Territory in addition to the dry interior of WA; and the Black-tailed Godwit is absent from the coast and inland areas of western SA and eastern WA in addition to the dry interior of WA (and the western Northern Territory) (Morcombe 2021).

The other three shorebird species considered here are considered non-migratory in that they do not use the East Asian-Australasian Flyway or make movements on that scale (DoEE 2017); however, they are still highly nomadic and dispersive within Australia, and can be found in different parts of their range depending on rainfall patterns, water levels in different areas and foraging opportunities (Pizzey and Knight 2013, Morcombe 2021). All (particularly the Pied Stilt) avoid the very dry interior of WA as well as Tasmania (except for the Masked Plover, which reaches Tasmania), with the Australian Painted Snipe also avoiding the south coast of Australia the Eyre Peninsula westwards, as well as the coast between the Kimberley and Pilbara regions of WA; the Red-necked Avocet also avoids Cape York Peninsula and the western Gulf of Carpentaria; the Masked Plover also avoids the central WA coast (Morcombe 2021).

### *6.1.4. Habitat*

Most shorebirds typically forage at the edge of a variety of aquatic freshwater, brackish, estuarine or marine environments, on a variety of hard and soft substrates, although temporary floodwaters and inundated short vegetation is used by most species as well (Pizzey and Knight 2013, DoEE 2017, Morcombe 2021), and the Masked Plover often uses dry habitats like grassland near the waters of swamps, lagoons and saltmarshes (Morcombe 2021). In the context of inland areas such as those within the search region, typical habitat for most species discussed here includes swamps, lakes, dams, sewage farms, and sometimes salt lakes and saltworks ponds (Pizzey and Knight 2013, Morcombe 2021). In these environments, most primarily forage in muddy edges of these wetland environments, or on associated mudflats, with some (Sharp-tailed Sandpiper, Common Greenshank, Curlew Sandpiper, Pectoral Sandpiper and Marsh Sandpiper) also foraging in shallow water (Pizzey and Knight 2013, DoEE 2017, Morcombe 2021). Several species primarily forage in the shallow waters of irrigated crops, temporary floodwaters, saltmarsh, well-vegetated swamps and inundated vegetation (including grassland and heath) – these are the main habitats used by Latham's Snipe, Australian Painted-Snipe and Red-necked Avocet (Pizzey and Knight 2013, Morcombe 2021).

### *6.1.5. Breeding*

All migratory shorebirds discussed here do not breed in Australia, and hence are not discussed further.

The non-migratory shorebirds discussed, Australian Painted-Snipe and Pied Stilt typically nest in shallow water, or on the ground close to water, whereas the Red-necked Avocet and Masked Plover only nest on dry ground. The Australian Painted-Snipe favours vegetation such as dense low samphire bushes, grass or other partly concealing plants that may be located in shallow water, whereas the Masked Plover usually nests in the open on dry ground relatively far from cover (Morcombe 2021). Apart from Masked Plover, the three species often pick areas surrounded by water, such as islets (Morcombe 2021). Nest designs of the these species can be quite variable but seem to occur in two main forms – a platform or mound of vegetation or sticks (often built in shallow water in the case of Australian Painted-Snipe and Pied Stilt), or a shallow depression or scrape on dry ground that may be lined with vegetation, with Masked Plover exclusively building the latter (Morcombe 2021).

Clutch size between the non-migratory shorebirds is quite consistent, with clutches of three, four (in the case of Australian Painted-Snipe, always four), and in the case of Red-necked Avocet, five. Migratory shorebirds have similar clutch sizes as well (Morcombe 2021). Unusually, however, Masked Plover often produces multiple broods each breeding season.

In the context of the search region, the non-migratory shorebirds discussed usually breed from late winter (i.e. July or August) to spring/early summer (i.e. November or December), but breeding is possible for the Pied Stilt and Red-necked Avocet at a given location or habitat any time of year after substantial rains (and presumably, increased water levels or flooding) (Morcombe 2021). The main exception to this pattern of behaviour is the Australian Painted-Snipe, which has a fixed breeding season of October-December in southern Australia (Morcombe 2021).

Red-necked Avocet and Pied Stilts have similar mating and parenting systems – both breed in small loose or scattered colonies (although the Pied Stilt can also breed in solitary pairs), where both parents contribute to the incubation and care of offspring (Morcombe 2021, Birds in Backyards 2023). Masked Plover is somewhat similar – they are not colonial nesters, but are monogamous with both parents sharing all parental duties (Morcombe 2021). In contrast, Australian Painted-Snipe is a polyandrous species, with females mating with and laying clutches for multiple males and leaving them to incubate the eggs and care for the young (Morcombe 2021, Birds in Backyards 2023).

### *6.1.6. Movements*

The migratory shorebirds considered here are present in Australia annually from August/September to April/May, with precise timing depending on the species and yearly climatic conditions both in Australia and in their northern hemisphere breeding grounds (DoEE 2017, Morcombe 2021). They travel into and through Australia initially using the East Asian-Australasian Flyway, which is a migration route linking Australia to the northern hemisphere breeding grounds in China, Korea, Japan and Russia along the coastline and islands of East and South-east Asia (DoEE 2017). Consequently, they first arrive in the north of Australia before moving further south slightly later. However, once in Australia, they disperse along the Australian coastline as well as (for most species – Eastern Curlew and Great Knot rarely do this) dispersing inland depending on rainfall patterns to exploit the rich foraging opportunities presented by ephemeral wetlands and floodwaters (DoEE 2017, Morcombe 2021). Latham's Snipe is somewhat less tied to wetlands than other species and can therefore disperse into small patches of inundated vegetation scattered across the landscape, whereas most other species disperse to more easily-defined wetland areas when moving inland (Pizzey and Knight 2013, DoEE 2017, Morcombe 2021). Migratory shorebirds first depart from southern Australia, and then move through and depart from northern Australia slightly later.

The non-migratory shorebirds considered here are in Australia year-round but are highly dispersive and nomadic, moving to different areas depending on rainfall patterns (Pizzey and Knight 2013, Morcombe 2021, Birds in Backyards 2023), although some Masked Lapwings are sedentary breeding residents instead (Pizzey and Knight 2013). Australian Painted-Snipe and Pied Stilt in particular will move to areas that have had significant rainfall to take advantage of floodwaters and, in the case of the former, heavily-vegetated shallow ephemeral wetlands (Morcombe 2021, Birds in Backyards 2023). Red-necked Avocet may follow rains as well, but large flocks often congregate around large shallow salt lakes as evaporation occurs and salinity subsequently increases, to feed on the brine shrimp that commonly occur in these circumstances (Morcombe 2021).

#### *6.1.7. Social Behaviour*

Most shorebirds discussed here, both migratory and non-migratory, display broadly similar social behaviour. In inland areas, most species tend to be more dispersed than in coastal areas, as there is no high tide forcing them into common refugia (DoEE 2017). Nevertheless, many species often occur in small-large multi-species flocks, with the Red-necked Avocet particularly likely to occur in large flocks (often together with stilts like Pied Stilt) (Morcombe 2021). In contrast, Latham's Snipe and Australian Painted-Snipe are particularly likely to be found alone or in loose, small flocks (DoEE 2017, Birds in Backyards 2023). Most of the other species sit between these two extremes in inland areas, being sometimes found in large flocks together with other species, sometimes found in smaller flocks with fewer or only one species, and sometimes being found alone (Pizzey and Knight 2013, DoEE 2017, Morcombe 2021). Large multi-species flocks of shorebirds are likelier to be found around large wetland environments, although smaller numbers can still often be found in small wetlands, floodwaters and inundated vegetation.

#### *6.1.8. Conservation Status*

Red-necked Avocet, Masked Plover and Pied Stilt are considered widespread, common and secure species that are not listed as threatened or migratory in any Australian state or territory or federally.

Sharp-tailed Sandpiper, Common Sandpiper, Curlew Sandpiper, Pectoral Sandpiper, Marsh Sandpiper, Latham's Snipe, Eastern Curlew, Black-tailed Godwit, Great Knot and Common Greenshank are all listed as Migratory under the EPBC Act.

Some migratory shorebirds are listed as threatened under the EPBC Act (Eastern Curlew – Critically Endangered, Great Knot – Critically Endangered, Curlew Sandpiper – Critically Endangered), and under the BC Act in NSW (Curlew Sandpiper – Endangered, Great Knot – Vulnerable, Black-tailed Godwit – Vulnerable).

Australian Painted-Snipe is listed as "Endangered" under the EPBC Act but is not listed as a Migratory species. It is also listed as "Endangered" under the BC Act in NSW.

### 6.2. Local Abundance Analysis

#### *6.2.1. Sharp-tailed Sandpiper*

There were 10 records of this species within 20-km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 210 individuals, although most records had substantially fewer individuals (the next highest number was 60 individuals, and the median number of individuals at a record is 12). Most of the records were clustered around Yanga Lake, with a couple relatively near the Wakool River. Roughly 80% of records occurred since 2010, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, most observations occurred in October, with a handful of records in November, December and March. It is unclear why there is a spike in records in October, but the records correspond to the time of year when the species is present in Australia.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Sharp-tailed Sandpipers would rarely use habitat within the proposed JRWP footprint, and if they ever did it would likely when flood conditions attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less (ARC Centre of Excellence for Climate Extremes 2022). It is likelier that individuals or flocks (potentially including large flocks) could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels. Because this species is highly mobile and dispersive it is difficult to quantify the frequency and magnitude of such events.

### *6.2.2. Common Greenshank*

There was one record of this species within 20-km of a point within the proposed Junction Rivers Wind Project. This record occurred on Yanga Lake in October 2019, a relatively recent record, and was of a single individual. Possible explanations for the low number of records include a lack of observer effort, or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away during these times). However, given that many other waterbird species, including listed species and migratory shorebirds, have substantially more records in the search region, and the conspicuous calls of this species, it is likely that this species does not occur in the search region regularly or in high numbers.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Common Greenshank are unlikely to use habitat within the proposed JRWP footprint due to a lack of suitable habitat. It is likelier that individuals or flocks (potentially including large flocks) could very occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels, but the lack of records of this species in the search region indicates the occurrence of individuals in the surrounding region of the study area is a rare event, with flocks expected to be rarer still. Therefore, although it remains possible this highly mobile species could fly through the airspace of the proposed JRWP, it is expected that this would occur rarely if at all during the lifespan of the wind farm.

### *6.2.3. Common Sandpiper*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species. Given the records of other migratory shorebirds and waterbirds in the search region, and the conspicuous behaviour of this species, the lack of records is unlikely to be due to low observer effort, but instead because the species does not occur in the search region frequently or in high numbers if at all.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023)

On the basis of this data, and the known habits of the species, Common Sandpiper are unlikely to use habitat within the proposed JRWP footprint due to a lack of suitable habitat. It is somewhat likelier that individuals or flocks could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels but having never been recorded in the study

area or the surrounding search region, it is unlikely that such flights through the proposed JRWP would occur frequently (if ever).

### 6.2.4. Pectoral Sandpiper

There were two records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. These records occurred roughly 2 km south of the Wakool River with both records from June 1981, although one of them was of a duration of two months (i.e. the species was seen for two months). The number of individuals seen is unknown. Many other waterbird species, including listed species and migratory shorebirds, have substantially more records in the search region, and this species is not particularly cryptic, so it is likely that this species does not occur in the search region regularly or in high numbers. Since the two records from the search region are quite old, it is unlikely to have occurred there recently.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Pectoral Sandpiper are unlikely to use habitat within the proposed JRWP footprint due to a lack of suitable habitat. It is likelier that individuals or flocks (potentially including large flocks) could very occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels, but the lack of many or recent records of this species in the search region indicates the occurrence of the species in the surrounding region of the study area is a rare event. Therefore, although it remains possible this highly mobile species could fly through the airspace of the proposed JRWP, it is expected that this would occur rarely if at all during the lifespan of the wind farm.

### 6.2.5. Marsh Sandpiper

There were two records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. These records occurred at Yanga Lake in March and October 2019, so the records are relatively recent. Five individuals were seen in October and one was seen in March. Many other waterbird species, including listed species and migratory shorebirds, have substantially more records in the search region, and this species is relatively conspicuous, so it is likely that this species does not occur in the search region regularly or in high numbers.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Marsh Sandpiper are unlikely to use habitat within the proposed JRWP footprint due to a lack of suitable habitat. It is likelier that individuals or small flocks could very occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels, but the lack of records of this species in the search region indicates its occurrence there is a rare event. Therefore, although it remains possible this highly mobile species could fly through the airspace of the proposed JRWP, it is expected that this would occur rarely if at all during the lifespan of the wind farm.

### 6.2.6. Curlew Sandpiper

There was one record of this species within 20-km of a point within the proposed Junction Rivers Wind Project. This record occurred on Yanga Lake in May 1958, a very old record. The number of individuals observed is unknown. Possible explanations for the low number of records include a lack of observer effort (as this species is one of the less obvious shorebirds) or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away much of the time). However, given that many other waterbird species, including listed species and migratory shorebirds, have substantially more

records in the search region, it is likely that this species does not occur in the search region regularly or in high numbers.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Curlew Sandpiper are unlikely to use habitat within the proposed JRWP footprint due to a lack of suitable habitat. It is likelier that individuals or flocks could very occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels, but the lack of many or recent records of this species in the search region indicates its occurrence in the surrounding region is a rare event. Therefore, although it remains possible this highly mobile species could fly through the airspace of the proposed JRWP, it is expected that this would occur rarely if at all during the lifespan of the wind farm.

### *6.2.7. Eastern Curlew*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species. Given the records of other migratory shorebirds and waterbirds in the search region, and the large size and distinctive call of this species, the lack of records is unlikely to be due to low observer effort, but instead because the species does not occur in the search region frequently or in high numbers if at all. This corresponds to the generally accepted distribution of the species as being largely confined to coastal areas within Australia; the species is included in this analysis because it was predicted as potentially occurring according to the NSW Threatened Species website (OEH 2023).

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Eastern Curlew are very unlikely to use habitat within the proposed JRWP footprint or fly through the airspace of the proposed JRWP due to a lack of suitable habitat within the footprint or the surrounding region.

### *6.2.8. Great Knot*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species. Given the records of other migratory shorebirds and waterbirds in the search region, and the conspicuous and gregarious behaviour of this species, the lack of records is unlikely to be due to low observer effort, but instead because the species does not occur in the search region frequently or in high numbers if at all. This corresponds to the generally accepted distribution of the species as being largely confined to coastal areas within Australia; the species is included in this analysis because it was predicted as potentially occurring according to the NSW Threatened Species website (OEH 2021a).

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Great Knot are very unlikely to use habitat within the proposed JRWP footprint or fly through the airspace of the proposed JRWP due to a lack of suitable habitat within the footprint or the surrounding region.

### *6.2.9. Black-tailed Godwit*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species. Possible explanations for the low number of records include a lack of observer effort (as this species is one of the

less obvious shorebirds) or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away much of the time). However, given that many other waterbird species, including listed species and migratory shorebirds, have substantially more records in the search region, it is likely that this species does not occur in the search region regularly or in high numbers. This corresponds to the known behaviour of the species as generally preferring coastal areas within Australia although inland areas are used occasionally. The species is included in this analysis because it was predicted as potentially occurring according to the NSW Threatened Species website (OEH 2021b).

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Black-tailed Godwit are unlikely to use habitat within the proposed JRWP footprint due to a lack of suitable habitat. It is somewhat likelier that individuals or flocks could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels but having never been recorded in the study area or the surrounding search region, it is unlikely that such flights through the proposed JRWP would occur frequently (if ever).

#### *6.2.10. Latham's Snipe*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species. Possible explanations for the low number of records include a lack of observer effort (as this species is relatively cryptic) – its more flexible habitat usage means it is less likely that it has been kept away from the search region by dry conditions. Given that many other waterbird species, including listed species and migratory shorebirds, have substantially more records in the search region, this species may not occur in the search region regularly or in high numbers.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Latham's Snipe would rarely use habitat within the proposed JRWP footprint, and if they ever did it would likely when flood conditions attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less (ARC Centre of Excellence for Climate Extremes 2022), and even if such events occur it does not necessarily mean it will attract Latham's Snipe, given the lack of records of this species in the search region. It is somewhat likelier that individuals or small flocks could occasionally fly through the airspace of the proposed JRWP as they fly between habitats according to recent rainfall events. Because this species is highly mobile and dispersive it is difficult to quantify the frequency and magnitude of such events but given the lack of records of this species in the study area, it is unlikely it would occur frequently or involve large numbers of individuals.

#### *6.2.11. Australian Painted-Snipe*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory's own avifauna surveys in the study area did not record this species. Possible explanations for the low number of records include a lack of observer effort (as this species is relatively cryptic) or alternatively, dry conditions making the area unsuitable for this species (causing them to disperse away much of the time. However, given that many other waterbird species, including listed species and other shorebirds, have substantially more records in the search region, this species may not occur in the search region regularly or in high numbers.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Australian Painted-Snipe would rarely use habitat within the proposed JRWP footprint, and if they ever did it would likely when flood conditions attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less (ARC Centre of Excellence for Climate Extremes 2022), and even if such events occur it does not necessarily mean it will attract Australian Painted-Snipe, given the lack of records of this species in the search region. It is somewhat likelier that individuals or small flocks could occasionally fly through the airspace of the proposed JRWP as they fly between habitats according to recent rainfall events. Because this species is highly mobile and dispersive it is difficult to quantify the frequency and magnitude of such events but given the lack of records of this species in the study area, it is unlikely it would occur frequently or involve large numbers of individuals.

#### *6.2.12. Red-necked Avocet*

There were 25 records of this species within 20-km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 790 individuals, although most records had substantially fewer individuals (the median number of individuals at a record is 17). All records were clustered around Yanga Lake, indicating the species is unlikely to occur elsewhere in the search region. Roughly 96% of records occurred since 2010, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively (and possibly more likely given the conspicuous appearance and gregarious behaviour of this species), dry conditions making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, most observations occurred from October-February, with a spike of records in October. It is unclear why there is a spike in records in October, but the annual period of increased observations of the species somewhat overlaps with the main breeding season of the species. However, the species can breed at virtually any time of year, depending on rainfall and water levels.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Red-necked Avocet could very occasionally use habitat within the proposed JRWP footprint when flood conditions could possibly attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less (ARC Centre of Excellence for Climate Extremes 2022). It is likelier that large flocks could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels. Because this species is highly mobile and dispersive it is difficult to quantify the frequency of such events, but if it occurred, it could involve a very large number of individuals.

#### *6.2.13. Pied Stilt*

There were 47 records of this species within 20-km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 120 individuals, although most records had substantially fewer individuals (the median number of individuals at a record is five). Most records were clustered around Yanga Lake, with one along the Murrumbidgee River near Balranald, and one relatively far from any large water bodies or watercourses (roughly 8 km east of Yanga Lake). Roughly 89% of records occurred since 2010, meaning the bulk of the records are relatively recent. Possible explanations for the low number of records prior to this time include a lack of observer effort, or alternatively (and possibly more likely given the conspicuous appearance and gregarious behaviour of

this species), dry conditions making the area unsuitable for this species (causing them to disperse away during these times).

Within each year, most observations occurred from October-February, with peaks of records in October and February. It is unclear why these peaks exist, but the annual period of increased observations of the species somewhat overlaps with the main breeding season of the species. However, the species can breed at virtually any time of year, depending on rainfall and water levels.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Pied Stilt could very occasionally use habitat within the proposed JRWP footprint when flood conditions could possibly attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a handful of times per decade, or even less (ARC Centre of Excellence for Climate Extremes 2022). It is likelier that flocks could occasionally fly through the airspace of the proposed JRWP as they fly between wetlands according to recent rainfall events and water levels. Because this species is highly mobile and dispersive it is difficult to quantify the frequency of such events, but if it occurred, it could potentially involve a moderately large number of individuals given the social behaviour of the species.

#### *6.2.14. Masked Plover*

There were 119 records of this species within 20-km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 790 individuals, although most records had substantially fewer individuals (the median number of individuals at a record is 17). All records were clustered around Yanga Lake, indicating the species is unlikely to occur elsewhere in the search region. Records for this species were slightly more evenly spread across time than for most other species, with 54% of records occurring after 2010. There were particularly high numbers of records from 1970-79 (22; 18%), and 2010-19 (54; 45%), collectively accounting for more than half the records. The spread of records across time indicates the species is persistently present within the search region, and that a particularly high number of birds may have used the area in the 70s, and possibly from 2010-19 (although the latter could be due to increased observer effort, as this pattern has been seen in most if not all waterbird species examined in this report). The spread of records over time allows some idea of how the search region has been used over time.

Within each year, most observations occurred from October-February, with a spike of records in October. It is unclear why there is a spike in records in October, but the annual period of increased observations of the species somewhat overlaps with the main breeding season of the species. However, the species can breed at virtually any time of year, depending on rainfall and water levels.

Within each year, there was not a very clear pattern of occurrence across seasons – all months had broadly similar numbers of records. The big exception to this was a spike in records in October. The reason for this spike is not clear, although since it appears towards the end of the species' breeding season, it is possible the spike in records is driven by increased sightings of the species due to juvenile birds produced in the breeding season contributing to them.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Masked Plover could use any suitable habitat within the proposed JRWP footprint when wet or damp conditions could possibly attract them to forage and breed in or near the study area. This may occur more frequently than major flooding (ARC Centre of Excellence for Climate Extremes 2022) and could even allow the species to use the study area

somewhat regularly, although since they were never observed over two years of avifauna surveys this seems unlikely. It is likelier that large flocks could occasionally fly through the airspace of the proposed JRWP, particularly in autumn, as they fly between wetlands according to recent rainfall events and water levels.

## 6.3. Flight height analysis/review

Shorebirds are known to generally fly at relatively low heights when using particular water bodies or wetlands. When they make long-distance movements (generally roughly twice a year, corresponding to arrival and departure from Australia), they do so at great heights, well-above RSA height, and have very steep flight trajectories, ascending beyond RSA height rapidly (AB ESRD 2011). For this reason, a 400 m buffer around wetlands and watercourses is generally considered large enough to prevent most collisions between shorebirds and wind turbines (Islam et al. 2022, Everaert date unknown). Notably, in cumulatively over a decade of mortality monitoring at wind farms in Victoria (Moloney et al. 2019, Symbolix 2020), shorebirds have never been detected as a mortality, indicating that existing controls are generally sufficient to prevent mortalities.

Additionally, Eastern Curlew, Great Knot, Black-tailed Godwit, Latham's Snipe, Common Sandpiper and Australian Painted-Snipe are thought not to occur in the search region at all, or only briefly and/or infrequently, which minimises or virtually eliminates their risk of colliding with turbines. The distribution of records also suggests that Common Greenshank, Curlew Sandpiper, Marsh Sandpiper and possibly Red-necked Avocet are largely confined to Yanga Lake, which reduces their likelihood of entering the airspace of the proposed JRWP and colliding with turbines.

Overall, whilst shorebirds do fly at RSA height, they fly below or above it for the overwhelming majority of the time and are unlikely to regularly occur in the proposed JRWP. At worst, some may pass through the airspace of the proposed JRWP occasionally in large flocks, but even when this occurs, most flights seem likely to be below or (particularly for long-distance movements) above RSA height. Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude and are unlikely to be those of listed species. The possible exceptions to this would be:

- Sharp-tailed Sandpiper – individuals, small flocks, or at times large flocks could potentially, very occasionally fly through the airspace of the proposed JRWP, or use habitat in or near the proposed JRWP on the rare (less than annual, possibly decadal or less) occasions that floods produce suitable habitat there.
- Red-necked Avocet – large flocks could potentially and occasionally fly through the airspace of the proposed JRWP or use habitat in or near the proposed JRWP on the rare (less than annual, possibly decadal or less) occasions that floods produce suitable habitat there.
- Pied Stilt – moderately large flocks could potentially and occasionally fly through the airspace of the proposed JRWP or use habitat in or near the proposed JRWP on the rare (less than annual, possibly decadal or less) occasions that floods produce suitable habitat there.

However, even in these instances, these species would be making long-distance movements (unless they are using the study area), and based on the behaviour of other shorebirds, they would most likely be doing so well-above RSA height for long-distance movements, or below it for short-range movements.

# 7. Group 4: Terns

This group of waterbirds includes the following:

- Caspian Tern *Hydropogne caspia*
- Gull-billed Tern *Gelochelidon nilotica*
- Whiskered Tern *Chlidonias hybrida*

## 7.1. Overview of species biology and ecology

### *7.1.1. Description*

Terns are highly aerial waterbirds that vary considerably but not vastly in size between species. In the context of the environment surrounding the planned Junction Rivers Wind Project, the Whiskered Tern sits at the smaller end of the scale, being a small-medium sized bird about 23-25 cm long (Morcombe 2021), whereas the Caspian Tern is at the large end of scale, being a relatively large bird about 48-54 cm long (Morcombe 2021). Terns are characterised by their relatively long, narrow, pointy wings, short, bare legs with webbed feet, moderately long, sharp, straight beaks, and generally forked tails (Pizzey and Knight 2013, Morcombe 2021). Colours and plumage vary between species and between breeding and non-breeding seasons, but their plumage is usually coloured from a relatively muted palate of white, cream, brown, grey and black, although their beak and legs can be brighter colours like red or yellow (particularly in the breeding season) (Pizzey and Knight 2013, Morcombe 2021).

### *7.1.2. Diet*

Terns are active hunters of fish, although many species will consume other small animals like amphibians, reptiles, small mammals, crustaceans, insects and larvae opportunistically (Commonwealth of Australia 2020, Birds in Backyards 2023). Notably, however, of the species within the search region the Caspian Tern specialises almost exclusively on fish (Commonwealth of Australia 2020, Birds in Backyards 2023). They rely on their aerial agility and speed to quickly dive and skim for aquatic and marine prey near the surface of the water (although unlike cormorants, they will not swim and pursue prey underwater), or take insects on the wing (Morcombe 2021, Birds in Backyards 2023).

### *7.1.3. Distribution and Population*

All three species of terns that may occur around the planned Junction Rivers Wind Project are generally considered common, widespread and secure species, although two are listed as Migratory under the EPBC Act. All have distributions that extend beyond Australia and cover large swathes of the world. Furthermore, Caspian Tern is thought to be increasing globally, Whiskered Tern populations are considered to be fluctuating but stable, and although the population trend of the Gull-billed Tern is unknown it is not thought to be decreasing at a concerning rate (BirdLife International 2023). Within Australia, all three species are also considered common, widespread and secure, being found across most of the country, absent only from very dry and arid regions (particularly the very dry interior of WA, western SA and the inner west of the Northern Territory) (Morcombe 2021). Additionally, Whiskered Tern generally does not occur in Tasmania, although the other two species discussed do (Morcombe 2021).

### *7.1.4. Habitat*

As a group, terns will use a variety of aquatic and marine habitats to forage, from relatively small, freshwater farm dams in inland Australia to large harbours and bays along the coast (Pizzey and Knight 2013, Morcombe 2021). However, certain species, such as the Gull-billed Tern and Whiskered Tern, specialise in using inland wetlands (freshwater, brackish and saline), particularly relatively shallow ephemeral wetlands such as those created by floodwaters, mudflats, claypans, saltpans, saltmarsh and floodplains (although the Whiskered Tern has a preference for freshwater, and is also found in irrigated

pastures, and only occasionally in estuaries and other marine wetlands) (Morcombe 2021). In inland areas, Caspian Terns use some of these environments (floodwaters) as well, but seem to prefer larger, deeper, permanent water bodies like fresh or salt lakes, large rivers, reservoirs and sewage ponds (Morcombe 2021, Birds in Backyards 2023).

Terns are diurnal, and when roosting at night, the Caspian Tern typically roosts on bare ground (e.g. areas of exposed sand) adjacent to large aquatic or marine areas (Commonwealth of Australia 2020). The roosting behaviour of the other species is not as well-known but could be similar.

### *7.1.5. Breeding*

The three species of tern considered here use different habitats for breeding, although there is some overlap between the Gull-billed Tern and the Whiskered Tern. Caspian Terns commonly nest on offshore islands (and are therefore unlikely to nest in the search region, which is inland) (Morcombe 2021). In contrast, Gull-billed Terns and Whiskered Terns nest around temporary lakes and wetlands of inland swamps (and saltmarsh in the case of the Gull-billed Tern), with Gull-billed Terns preferring to nest on islets within wetlands and Whiskered Terns preferring to nest within vegetation on shallow water (Morcombe 2021).

Nest sites also differ between the three terns considered here, but again, there is some overlap. Both Caspian and Gull-billed Terns nest in shallow depressions scraped into the ground, typically on a sandy substrate (although Gull-billed Terns also use dried mud) and line with debris (Caspian Tern) or vegetation (Gull-billed Tern) (Morcombe 2021). In contrast, the Whiskered Tern builds a rough platform of vegetation on top of samphire or other low shrubs located in shallow water (Morcombe 2021).

Breeding seasons of the three tern species being considered differ considerably. Caspian Terns have a relatively strict breeding season from September to December (Morcombe 2021). Gull-billed Terns have a broader and more flexible breeding season that runs from September-May, but most breeding is completed in a much narrower window from October-December, roughly similar to the Caspian Tern (Morcombe 2021). In contrast, Whiskered Terns have highly variable breeding seasons that are very dependent on rainfall and floods, so although their breeding season generally runs from August to November in southern Australia, they can be prompted to breed at other times by heavy rainfall and floods (Morcombe 2021).

Terns appear to be relatively consistent in their clutch sizes. All three species considered here have clutches of 2-3 eggs, although 1-egg clutches are known from the Caspian Tern (Morcombe 2021).

All three species of tern being considered here breed in pairs within colonies, which can be large for all three species but are particularly likely to be large in the case of the Gull-billed and Whiskered Terns (Morcombe 2021). In all three species, both sexes share parental duties, including nest preparation, incubation of eggs and raising of young (Morcombe 2021, Birds in Backyards 2023).

### *7.1.6. Movements*

The three species of terns being considered here are nomadic and dispersive in the context of their use of inland habitats, particularly when using ephemeral wetlands and floodwaters (Caspian Terns can be sedentary near the coast, and possibly in inland permanent wetlands such as reservoirs as well) (Morcombe 2021, Birds in Backyards 2023). All of them, but particularly Gull-billed and Whiskered Terns, are highly responsive to cycles of flood and drought, moving to or between highly productive flooded ephemeral wetlands when the opportunity arises or as necessary (for birds shifting between temporary wetlands) (Morcombe 2021, Birds in Backyards 2023). Whiskered Terns in particular will use the resources provided by such wetlands to breed opportunistically (Morcombe 2021, Birds in Backyards 2023).

### 7.1.7. Social Behaviour

All tern species discussed will breed in pairs, typically within colonies of varying size and composition, as outlined in Section 7.1.5. Outside the breeding season, the Whiskered Tern typically occurs and forages in flocks, and the Caspian Tern moves and migrates in small flocks of family groups (Morcombe 2021, DCCEEW 2023b). The social behaviour of the Gull-billed Tern outside the breeding season is less well-documented.

### 7.1.8. Conservation Status

None of the tern species discussed are listed as threatened species and are considered widespread and secure species in every state and territory on mainland Australia. However, Gull-billed Tern and Caspian Tern are both listed as Migratory and all three species are listed Marine under the EPBC Act.

## 7.2. Local abundance analysis

### 7.2.1. Caspian Tern

There were 10 records of this species within 20-km of a point within the proposed Junction Rivers Wind Project, with the maximum number of individuals from any one record being 19 individuals, (the median number of individuals at a record is three). The majority of the records were clustered around Yanga Lake, with one record by the Murrumbidgee River near Balranald, and the vast majority (80%) of records were from 2010-2019 and are therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort (but this is a large, conspicuous bird so this seems unlikely), or alternatively, dry conditions (e.g. from during the Millennium Drought) making the area unsuitable for this species (causing them to disperse away during these times). It also has not been recorded after 2018, even though many of the subsequent years have been very wet, indicating the species is not resident within the search region but sporadically uses Yanga Lake and the Murrumbidgee River to forage.

Within each year, most records occurred from October-January, with the period from February-September having almost no records. It is unclear why there would be fewer observations from February-September, compared to October-January, as the latter overlaps more with the breeding season of the species but the species is unlikely to breed in the study area or the search region.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, Caspian Terns are unlikely to use habitat within t the proposed JRWP footprint, due to a lack of suitable habitat. If they ever did, it would be due to floodwaters creating temporary wetlands in or near the proposed JRWP for them to forage from, although this is likely to be a very infrequent event (less than annual, potentially decadal or more infrequent) (ARC Centre of Excellence for Climate Extremes 2022) and they would still be unlikely to breed. A more realistic scenario is of individuals or small flocks flying through the proposed JRWP airspace as the species moves between areas of temporary wetland and floodwater in high-rainfall years. Since this movement is dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be, but it would be unlikely to consist of groups larger than a handful of individuals.

### 7.2.2. Gull-billed Tern

There were five records of this species within 20-km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 14 (median: 3). Four of the records were clustered around Yanga Lake, with the final record occurring relatively far from any large water body or watercourse after accounting for spatial uncertainty, roughly 12.8 km east of Yanga Lake. All records are

from 2010-2019 and are therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort (potentially unlikely, as this is a conspicuous bird), or alternatively, dry conditions (e.g. from during the Millennium Drought) making the area unsuitable for this species.

The records appear to be scattered across the months within the year (there is a small peak in May but given the small size of the dataset this may not be very meaningful), but no records were ever made during summer. There is no clear seasonal trend of occurrence in the search region.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, Gull-billed Terns could very occasionally use habitat within the proposed JRWP footprint, and if they ever did, it would be due to floodwaters creating temporary wetlands in or near the proposed JRWP for them to forage from. This could create some limited opportunities for breeding in the vicinity of the proposed JRWP but is unlikely to occur frequently at all (less than annually, possibly decadal or even less frequent) (ARC Centre of Excellence for Climate Extremes 2022), although because the species breeds in large colonies if this does occur it could create many opportunities for collision with turbines. A more realistic scenario is of individuals or small flocks flying through the proposed JRWP airspace as the species moves between areas of temporary wetland and floodwaters, or between these wetlands and the coast during dry years. Since this movement is dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be, but it would be unlikely to consist of very large groups.

### *7.2.3. Whiskered Tern*

There were 56 records of this species within 20-km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 200 (median: 3). Most records were clustered around Yanga Lake, with one old record situated relatively near the Murrumbidgee River and Balranald, suggesting the species generally confines itself to Yanga Lake within the search region. The vast majority (96%) of records have occurred since 2010 and are therefore reasonably recent. Possible explanations for the low number of records prior to this time include a lack of observer effort (although, being a tern, this species has relatively conspicuous flight behaviour), or alternatively, dry conditions (e.g. from during the Millennium Drought) making the area unsuitable for this species, causing them to disperse away from the area during this time.

Within each year, the period from October-February has the most observations, with peaks in October, December and February. In contrast, only a handful of observations occur during the other months of the year from March-September. The peaks of observations in October, December and February generally do not overlap with the most common breeding period of this species (August-November; October does overlap), but the species has highly variable breeding activity that can be prompted by heavy rainfall and rise in water levels at other times of year. The resultant fledglings and juveniles from breeding efforts could also be contributing to the higher number of records in December and February, which would explain why there is a "lag" between peak observation times and peak breeding.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, Whiskered Terns could very occasionally use habitat within the proposed JRWP footprint, and if they ever did, it would be due to floodwaters creating temporary wetlands in or near the proposed JRWP for them to forage from. This could create opportunities for breeding in the vicinity of the proposed JRWP, and this species of tern is the likeliest to take advantage of this, but this is unlikely to occur frequently at all (less than annually, possibly decadal or even less frequent) (ARC Centre of

Excellence for Climate Extremes 2022). However, because the species can breed in large colonies, if this does occur it could create many opportunities for collision with turbines. A more realistic scenario is of flocks (potentially including large flocks) flying through the proposed JRWP airspace as the species moves between areas of temporary wetland and floodwaters, or between these wetlands and the coast during dry years. Since this movement is dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be but could potentially include relatively large groups passing through the proposed JRWP.

## 7.3. Flight height analysis/review

Terns are generally high-flying, aerial birds that are likely to spend considerable amounts of time at RSA height. Caspian Terns (Rueda-Uribe et al. 2022) and Whiskered Terns (Swift 1960) both have specifically been recorded flying at RSA height, including when making long-distance movements (Rueda-Uribe et al. 2022) and in tight groups performing aerial displays (Swift 1960). The proportion of flights made at RSA heights is unknown for each species, but the known flight behaviour of these species suggests that they spend a considerable proportion of flights at RSA height. Therefore, the presence and use of any aquatic habitat in the proposed JRWP and near turbines could pose a risk to these species, as they may fly at RSA height in this context. However, such habitat is not expected to appear in the vicinity of the proposed JRWP very often at all (less than annually, possibly decadal or less frequent). They may also fly at RSA height when travelling relatively long distances as they move between drying, ephemeral wetlands and floodwaters, so it is possible that flocks of these species, including large flocks in the Whiskered Tern, could fly through the study area at RSA height and potentially experience collision with turbines. It is difficult to comment on the frequency and magnitude of such events given the variable flock sizes of terns and how they track ephemeral wetlands across the landscape (which is driven by stochastic phenomena like rainfall), but for Whiskered Tern in particular, large flocks flying through the airspace of the proposed JRWP at RSA height are possible, even if, based on the available records, this is probably an uncommon occurrence.

# 8. Group 5: Very large waterbirds

This group of waterbirds includes the following:

- Brolga *Grus rubicunda*
- White-bellied Sea-eagle *Haliaeetus leucogaster*
- Australian Pelican *Pelecanus conspicillatus*
- Straw-necked Ibis/Straw-necked Ibis *Threskiornis spinicollis*

Australasian Bittern also fits into this category and has been considered. However, it is the subject of a separate review.

## 8.1. Overview of species biology and ecology

### *8.1.1. Description*

The large waterbirds here are an eclectic collection from an ecologically, morphologically and taxonomically diverse range of species. Each species is best described separately.

Brolgas are cranes, and they are very large birds, growing up to 1.3 m tall and with a wingspan of up to 2.4 m (Morcombe 2021). They are entirely grey apart from the red skin on their bare head and face, have long, featherless legs, a long neck, a long but sturdy and straight beak, and fly with their long legs and neck outstretched (Morcombe 2021).

White-bellied Sea-eagles are a kind of eagle, and they are large birds, growing up to 85 cm long (Morcombe 2021). Adults are entirely white apart from the grey feathers than cover the dorsal surface of their wings and their grey flight feathers (Morcombe 2021). The base of the underside of their tail is also grey (Morcombe 2021). They legs are featherless up to their wrists, and they have large and long, sharp talons, as well as a heavy hooked beak (Morcombe 2021). Juveniles are brown streaked with cream and buff, with spots of white on the ends of the underside of their wings (Morcombe 2021).

Australian Pelicans are pelicans, and they are very large birds (the largest flying bird in Australia), growing up to 1.8 m long (Morcombe 2021). They have an unmistakable huge, long pink bill that has a prominent pouch, as well as short featherless legs and webbed feet, with a yellow ring around their eye, and a mostly white body with black flight and posterior feathers (Morcombe 2021).

The Straw-necked Ibis is a species of ibis, and it is a large bird, growing up to 70 cm long (Morcombe 2021). They are characterised by a long, downcurved bill, a white ventral surface and a glossy black dorsal surface, flight feathers and wing coverts with an iridescent green and violet sheen (Morcombe 2021). Additionally, they have straw-like spiny feathers on the lower parts of their neck, and bare grey-black skin on their face (Morcombe 2021).

### *8.1.2. Diet*

The large waterbirds here are an eclectic collection from an ecologically, morphologically and taxonomically diverse range of species, with very different diets. Each species is best described separately.

Brolga are omnivorous birds, primarily feeding on tubers and certain crops but also consuming insects, molluscs, amphibians and mice (with much of their carnivory likely opportunistic) (Birds in Backyards 2023).

White-bellied Sea-eagles are strictly carnivorous, sometimes hunting and eating birds and mammals, but preferring aquatic or marine prey such as fish, turtles and sea snakes (Birds in Backyards 2023). They also scavenge from carrion near surface water, and steal food from smaller birds (Birds in Backyards

2023). This species often perches or soars above or near open expanses of water, diving and grabbing prey from the surface of the water upon sighting it (Pizzey and Knight 2013, Morcombe 2021).

Australian Pelicans are strictly piscivorous, specialising in eating fish (Birds in Backyards 2023). They generally use their distinctive bill pouches as nets to scoop fish from water, and uses the hook on its upper mandible to grip slippery prey securely (Birds in Backyards 2023).

Straw-necked Ibiss are carnivorous and hunt small prey items such as terrestrial invertebrates (especially grasshoppers and locusts), frogs, small reptiles and mammals by probing with its beak or skimming them from the water surface (Birds in Backyards 2023).

### *8.1.3. Distribution and Population*

Australian Pelican and Straw-necked Ibis are common, widespread and secure species that are not listed as threatened in any Australian state or territory or federally, although both are listed under the EPBC Act as Marine species. Both have very wide distributions spanning practically the entire continent including Tasmania, although they both avoid the very dry interior of WA and western SA (Morcombe 2021).

In contrast, the Brolga and White-bellied Sea-eagle are both listed as threatened species in NSW, with the White-bellied Sea-eagle also listed as a Marine species under the EPBC Act. Brolgas occur along the northern Australian coast, including the Top End and most of the Northern Territory, and all of Queensland, extending down west of the Great Dividing Range into NSW and northern, central and western Victoria, as well as eastern SA, and are absent from Tasmania (Morcombe 2021). White-bellied Sea-eagles occur along the entire Australian coastline including Tasmania, and occur across the Top End, most of Queensland and NSW except for in their far western regions, in all of Victoria, and in southern SA including the Eyre Peninsula (Morcombe 2021). They are much more restricted to the coast in WA but penetrate inland within the Kimberley region (Morcombe 2021).

### *8.1.4. Habitat*

The large waterbirds here are an eclectic collection from an ecologically, morphologically and taxonomically diverse range of species, with very different diets. Each species is best described separately.

Brolgas typically congregate in large, permanent freshwater wetlands during the drier parts of the year and are concentrated closer to the coast at this time (Morcombe 2021). In the wetter parts of the year, they disperse inland to ephemeral freshwater wetlands, wet, green grassland and shallow floodwaters, probably to traditional breeding grounds (Morcombe 2021). However, the species can use brackish environments as well. The various habitats used by this species include freshwater swamps, grasslands and floodplains (flooded and dry), the margins of billabongs and lagoons, irrigated pasture, and occasionally tidal environments like estuaries and mangroves (Morcombe 2021). They may generally be found wading through shallow water or standing on dry land (Pizzey and Knight 2013).

White-bellied Sea-eagles inhabit a variety of coastal environments including islands, reefs, bays, beaches, headlands, estuaries and mangroves (Morcombe 2021). Within inland areas, they are more selective in their habitat use, and occur in swamps, lagoons, floodplains, and particularly along major rivers or on very large bodies of water (Morcombe 2021). They are typically found perched conspicuously on high, exposed limbs or cliffs, or soaring on thermals and wind deflected upwards by topographical features like cliffs (Morcombe 2021).

Australian Pelicans are very flexible in their habitat selection, and surprisingly for their body size, will use almost any large or small body of water (Morcombe 2021). These can range from sheltered coastal bays and estuaries to temporary desert pools (Morcombe 2021). They are typically seen swimming on the

surface of the water, standing or sitting on the ground nearby, or soaring on thermals to great heights (Pizzey and Knight 2013, Morcombe 2021).

Straw-necked Ibiss use a variety of wetlands and dry open habitats. They can be found in wet or dry grassland, and often on cultivated or irrigated pasture, and occasionally in the shallows of wetlands. They are generally absent from arid or marine areas (Morcombe 2021). Flocks are often seen perching conspicuously on dead trees (Morcombe 2021).

### *8.1.5. Breeding*

Brolgas typically breed in ephemeral freshwater wetlands, in areas with a clear view of their surroundings (Birds in Backyards 2023). Within them, they can nest on dry land, or in areas of shallow water such as within swamps (Morcombe 2021). Nests on dry land can be extremely simple, consisting of bare ground with a few sticks to stop the eggs from rolling away, whereas nests in swamps and similar habitats are more complex; these are usually mounds of trampled grass, reeds and other plants, and are built in water less than 30 cm deep, so eggs are above the waterline in a slight depression (Morcombe 2021). Brolgas normally breed from August-December in southern Australia and have clutches of 2-3 eggs (Morcombe 2021). They breed in solitary pairs, with both parents sharing parental duties – birds disperse into these pairs into widespread ephemeral breeding habitats during the breeding season, and are territorial, actively excluding other birds from their breeding territory (Birds in Backyards 2023).

In inland areas, White-bellied Sea-eagles usually breed near very large permanent water bodies and watercourses, nesting in elevated areas within sight of water, such as cliff ledges, or high in large trees (Morcombe 2021). Nests are a huge pile of sticks, and are re-used and enlarged annually, eventually reaching over 2 m across almost as deep (Morcombe 2021). Pairs often randomly rotate through several nests (Morcombe 2021). This species generally breeds in winter and spring (July-October) in southern Australia, and lays clutches of two eggs (Morcombe 2021). Pairs generally breed together solitarily, and generally exclude other birds (apart from immature offspring) from their breeding territory (Birds in Backyards 2023). Both sexes share parental duties although the male is somewhat less involved (Morcombe 2021, Birds in Backyards 2023).

Australian Pelicans usually breed on small islands or sand spits within remote lakes and estuaries, nesting in scrapes on the ground lined with debris (Morcombe 2021). The breeding season of this species is highly variable as it can breed any time after significant rainfall increases water levels but is most often from August-November in southern Australia (Morcombe 2021). This species typically lays a clutch of 2-3 eggs and breeds in colonies (Morcombe 2021). The female alone builds the (admittedly basic) nest, but both parents share incubation and parenting duties (Morcombe 2021, Birds in Backyards 2023). Pairs breed within very large colonies, up to 40,000 strong (Birds in Backyards 2023).

Straw-necked Ibiss typically nest in reedbeds or other emergent aquatic vegetation like cumbungi or lignum, as well as in paperbarks and mangroves growing in water, and occasionally on the ground of islands within wetlands (Morcombe 2021). Nests are large, rough platforms interwoven and trampled plants, and lined with grass (Morcombe 2021). This species generally nests from July-December in southern Australia but can be prompted to commence breeding throughout the year and/or after heavy rain in certain areas (Morcombe 2021). They generally lay clutches of 3-5 eggs, with both sexes incubating and helping to raise young (Morcombe 2021, Birds in Backyards 2023). Breeding pairs live in colonies that are often of mixed-species composition, with other ibis, spoonbills and egrets often also present (Morcombe 2021).

### *8.1.6. Movements*

Straw-necked Ibiss and Australian Pelicans are nomadic and dispersive birds (Morcombe 2021). Both regularly disperse and move relatively long distances as they track suitable habitat across the landscape,

in the form of wetlands, or for the former, wet or dry grassland and irrigated or cultivated pasture (Morcombe 2021). Australian Pelicans will seek areas where there is a sufficient supply of food (fish) for them to subsist, and often fly in distinctively V-shaped flocks (which can be large), or pairs (Morcombe 2021, Birds in Backyards 2023).

In contrast, White-bellied Sea-eagles are generally sedentary as mature breeding adults – they have a home territory they breed in, and they generally do not leave it (Morcombe 2021). However, young or immature birds are often highly dispersive as they travel great distances to find suitable, unoccupied habitat in which they can set up their own territories (Morcombe 2021).

Brolgas are dispersive and seasonally migratory (Morcombe 2021). During the drier months of the year, most individuals congregate and flock together at a few, large, permanent, often coastal wetlands that act as a refuge for them (Morcombe 2021). With the arrival of the wet months of the year, these flocks disperse into breeding pairs, and breeding pairs disperse (sometimes considerable distances) and set up exclusive and defended breeding territories, usually inland, in the ephemeral, typically freshwater wetlands scattered across the landscape (Morcombe 2021, Birds in Backyards 2023). Once the wet season ends and these habitats dry out, the breeding season concludes, and individuals gather in large flocks around large permanent wetlands once more (Morcombe 2021).

#### *8.1.7. Social Behaviour*

The social behaviour of the large waterbirds discussed during the breeding season is discussed in Section 8.1.5.

Outside the breeding season, White-bellied Sea-eagles remain sedentary as breeding pairs within their breeding territory (Morcombe 2021).

Brolga pairs are highly territorial during the breeding season, but outside the breeding season this species can be quite social, as it gathers and flocks in large numbers around the relatively few large, permanent, often coastal wetlands in the landscape or region that act as a refuge during the relatively dry non-breeding season (Morcombe 2021, Birds in Backyards 2023).

Straw-necked Ibiss and Australian Pelicans may breed in large colonies, but they can also remain in large flocks during the non-breeding season (Morcombe 2021, Birds in Backyards 2023). Australian Pelicans may form large flocks that fish co-operatively, using their numbers to drive fish into small, dense masses where they are easier to hunt (Morcombe 2021, Birds in Backyards 2023). The social behaviour of the Straw-necked Ibis is less well-documented, but large flocks gather around abundant food sources such as grasshopper and locust plagues (Morcombe 2021).

#### *8.1.8. Conservation Status*

All the large waterbird species discussed are listed as Marine species under the EPBC Act, except for Brolga.

Additionally, both White-bellied Sea-eagle and Brolga are both listed as threatened species under the BC Act, with both considered “Vulnerable”.

### 8.2. Local abundance analysis

#### *8.2.1. Brolga*

There were no records of this species within 20-km of a point within the proposed Junction Rivers Wind Project. Nature Advisory’s own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, and the known habits of the species, Brolga are unlikely to use habitat within the proposed JRWP footprint, and if they ever did it would likely be when flood conditions attract them to forage and breed in or near the study area. However, this is unlikely to occur frequently, perhaps a 50% chance of this occurring during the lifespan of the wind farm (ARC Centre of Excellence for Climate Extremes 2022), and even then, they have never been recorded in the search region. It is marginally likelier that large flocks could occasionally fly through the airspace of the proposed JRWP as they gather in permanent wetlands or scatter into their breeding grounds, but having never been recorded in the study area, it is unlikely that such flights through the proposed JRWP would occur frequently (if ever).

### *8.2.2. White-bellied Sea-eagle*

There were 82 records of this species within 20-km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 2 (median: 1). Most of the records were clustered around Yanga Lake and the Murrumbidgee and Wakool Rivers. Records for this species were slightly more evenly spread across time than for most other species, with 50% of records occurring after 2000. There were particularly high numbers of records from 1970-79 (15; 18%), and 2010-19 (36; 44%), collectively accounting for more than half the records. The spread of records across time indicates the species is generally present as a resident within the search region, and that a particularly high number of birds may have used the area in the 70s, and possibly from 2010-19 (although the latter could be due to increased observer effort, as this pattern has been seen in most if not all waterbird species examined in this report). The spread of records over time allows some idea of how the search region has been used over time.

Across the months within the year, the number of records appears to be broadly similar, with peaks in April and December. Notably, these months lie outside the breeding season of the species in southern Australia (July-October), and could represent young birds from local breeding attempts contributing to local observations (as may have been the case in December), and young birds dispersing into the search region from other, more distant areas (as may have been the case in April). However, it is difficult to determine for certain why observations peaked during these months but remained broadly similar for the rest of the year.

Most records were associated with large water bodies and watercourses, but a handful were relatively distant (roughly 2-4 km) from them. Most of these records were old (latest 1981), so it is possible the species does not use the search region in this manner anymore. Many of these records were from the 70s, and this could indicate that this decade was particularly wet and allowed the species to expand into flooded areas that were normally dry. However, this species generally confines itself to areas of permanent water, which would suggest this is not what happened in the 70s.

Nature Advisory's own avifauna surveys in the study area did not record this species (Nature Advisory 2023).

On the basis of this data, White-bellied Sea-eagles are unlikely to regularly use habitat within the proposed JRWP footprint as no suitable habitat there to form a territory exists. If the species ever uses habitat within the proposed JRWP footprint, it would most likely be dispersive immature birds flying across the landscape between patches of suitable wetland habitat. However, this latter scenario is potentially possible, as young birds produced by the breeding efforts of adults in the search region would disperse from their parents' territories in search of their own, potentially crossing through the proposed JRWP. This could create some limited opportunities for collision between this species and turbines at the proposed JRWP, particularly because the soaring behaviour of this species at RSA height puts it at risk of collision, and this species has been found to be a turbine-caused mortality before (albeit in very low numbers) (Moloney et al. 2019).

### 8.2.3. Australian Pelican

There were 316 records of this species within 20-km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 1416, but most records had far fewer individuals (median: 19). Most records were clustered around Yanga Lake and the Murrumbidgee and Wakool Rivers, but a substantial number were located relatively far from these large water bodies and watercourses as well. The majority (81%) of records have occurred since 2010 and are therefore reasonably recent. Possible explanations for the low number of records prior to this time include dry conditions (especially from during the Millennium Drought) making the area unsuitable for this species, causing them to disperse away from the area during this time. Low observer effort is considered unlikely to have caused the skew towards recent records, as the very large size and distinctive shape of this species renders it highly conspicuous and instantly recognisable.

Within each year, the period from October-February has the most observations, with peaks in October, December and February. This period accounted for 58% of the observations of the species, so it was still seen regularly in the other months of the year. The peaks of observations in October, December and February generally do not overlap with the most common breeding period of this species (August-November; October does overlap), but the species has highly variable breeding activity that can be prompted by heavy rainfall and rise in water levels at other times of year. The resultant fledglings and juveniles from breeding efforts could also be contributing to the higher number of records in December and February, which would explain why there is a "lag" between peak observation times and peak breeding. However, it is difficult to be certain that this is the cause of the peaks in observations of the species.

A substantial number of records (30-50) of the species were located relatively distant (>2 km away) from large water bodies and watercourses. Some of the most recent of these, from 2017, are over 12 km from any of the three large water bodies and watercourses present in the search region. This species is known to use even very small patches of suitable habitat, and these records scattered across the landscape away from water could represent such behaviour, with the species using small farm dams or other similar small water bodies. Alternatively, these records could represent observations of individuals undertaking long-distance movements between patches of wetland.

Nature Advisory recorded this species twice during avifauna surveys (Nature Advisory 2023). One was of an individual flying at RSA height at Impact Point 6 and the other was of an individual flying below RSA height at Reference Point 2 (Nature Advisory 2023).

On the basis of this data, Australian Pelicans could use any suitable habitat within the proposed JRWP footprint, and if they did, it would most likely be due to floodwaters creating temporary wetlands (even very small ones) in or near the proposed JRWP for them to forage from, although even the creation or existence of a small farm dam could potentially attract some individuals to the area. In extreme instances, large areas of suitable habitat created by flooding and inundation could create opportunities for breeding in the vicinity of the proposed JRWP, but this is unlikely to occur frequently at all (less than annually, possibly decadal or even less frequent) (ARC Centre of Excellence for Climate Extremes 2022). However, because the species can breed in very large colonies, if this does occur it could create many opportunities for collision with turbines in quick succession, although most of the birds would probably stay very close to the wetland habitats and would be unlikely to encounter turbines if they were situated more than 400 m away (Islam et al. 2022, Everaert date unknown). A more realistic scenario is of flocks (potentially including large flocks) flying through the proposed JRWP airspace as the species moves between areas of ephemeral wetland. Since this movement is dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be, but it could potentially include relatively large groups passing through the proposed JRWP.

### 8.2.4. Straw-necked Ibis

There were 103 records of this species within 20-km of a point within the proposed JRWP, with the maximum number of individuals from any one record being 410, but most records had far fewer individuals (median – rounded up: 6). Most records were clustered around Yanga Lake and the Murrumbidgee and Wakool Rivers, but a substantial number were located relatively far from these large water bodies and watercourses as well. Records for this species were slightly more evenly spread across time than for most other species, with roughly 50% of records occurring after 2000. There were particularly high numbers of records from 1970-79 (20; 18%), and 2010-19 (34; 44%), collectively accounting for more than half the records. The spread of records across time indicates the species is persistently present within the search region, and that a particularly high number of birds may have used the area in the 70s, and possibly from 2010-19 (although the latter could be due to increased observer effort, as this pattern has been seen in most if not all waterbird species examined in this report). The spread of records over time allows some idea of how the search region has been used over time.

Within each year, the number of observations was broadly consistent across all months, with the exception of a substantial peak in observations in October. This period accounted for 17 of the observations of the species, so it was still seen regularly in the other months of the year. The peak of observations in October occurred with the most common breeding period of this species (July-December), but the species has highly variable breeding activity that can be prompted by heavy rainfall and rise in water levels at other times of year. The high number of observations in October could potentially be due to the species acting more conspicuously (foraging harder and less cautiously for food for offspring, nesting in large colonies) because of breeding activity However, it is difficult to be certain that this is the cause of the peaks in observations of the species.

A substantial number of records (roughly 50) of the species were located relatively distant (>2 km away) from large water bodies and watercourses. Some of the most recent of these, from 2015, are over 12 km from any of the three large water bodies and watercourses present in the search region. This species is known to not be confined to wetlands as it makes use of dry habitat, such as dry grassland as well, and these records scattered across the landscape away from water could represent such habitat use. Alternatively, these records could represent observations of individuals undertaking long-distance movements between patches of wetland.

Nature Advisory recorded this species twice during avifauna studies in the study area, with one individual recorded one at Impact Point 7 and two individuals recorded once at Impact Point 8. All three individuals were recorded under RSA height (Nature Advisory 2023).

On the basis of this data, Straw-necked Ibis could use any suitable habitat within the proposed JRWP footprint, and if they did, it would most likely be due to floodwaters creating temporary wetlands (even very small ones) in or near the proposed JRWP for them to forage from, although they could also forage from dry habitats such as dry grassland in the study area. In extreme instances, large areas of suitable habitat created by flooding and inundation could create opportunities for breeding in the vicinity of the proposed JRWP, but this is unlikely to occur frequently at all (less than annually, possibly decadal or even less frequent) (ARC Centre of Excellence for Climate Extremes 2022). However, because the species can breed in large colonies, if this does occur it could create many opportunities for collision with turbines in quick succession, although most of the birds would probably stay very close to the wetland habitats and would be unlikely to encounter turbines if they were situated more than 400 m away (Islam et al. 2022, Everaert date unknown). Corroborating this, although this species has been recorded as a turbine-related mortality, it appears this is uncommon (Symbolix 2020). A more realistic scenario is of flocks (potentially including large flocks) flying through the proposed JRWP airspace as the species moves between areas of ephemeral wetland and other habitat patches in the landscape. Since this movement is partially

dependent on rainfall, which is a stochastic phenomenon, it is difficult to determine how frequent such an event would be, but it could potentially include relatively large groups passing through the proposed JRWP.

## 8.3. Flight height analysis/review

All four species of large waterbird discussed here are known or expected to fly at RSA height (Lyons et al. 2018, Smales 2005, Smales date unknown, MacGillivray 1923, Birds in Backyards 2023). The proportion of flights made at RSA height is unknown for most of these species, although White-bellied Sea-eagles have been recorded making 70% of their flights between 30-120m, so they likely spend considerable time at RSA height (Smales 2005). Each species will be considered separately from this point.

Brolgas are not thought to occur frequently, long, or in high numbers in the search region, as they have no records from within the search region, and they are a very large, relatively conspicuous bird of considerable ornithological interest. Additionally, buffers of 400 m around wetlands and other conventional measures to prevent waterbird collisions with turbines (Islam et al. 2022, Everaert date unknown) have been sufficient to prevent Brolga collisions with turbines at a variety of wind farms across Victoria that cumulatively have more than a decade of mortality monitoring between them (Moloney et al. 2019, Symbolix 2020). This species is considered unlikely to collide with turbines, regardless of its regular flight heights.

White-bellied Sea-eagles are thought to be permanent, sedentary residents at large water bodies and watercourses in the region - Yanga Lake, the Murrumbidgee River, and the Wakool River. Such residents would typically occur as breeding pairs of mature adults; this species does not flock. The spatial distribution of record clusters in the search region suggests 2-4 pairs inhabiting the search region. This species has been documented making 70% of their flights at 30-120 m high, so they likely spend a significant amount of time soaring or otherwise flying at RSA height, which puts them at relatively high risk of collision with turbines (Smales 2005). Resident pairs typically do not move far from the large water bodies and watercourses around which their territories are based, and since the proposed JRWP is to be located relatively distant from Yanga Lake and the Murrumbidgee and Wakool Rivers, it is unlikely resident adults in the search region would enter the airspace of the proposed wind farm and therefore risk collision with turbines. However, immature birds are highly dispersive, as they fly across landscapes in search of suitable unoccupied habitat in which they can form their own territory, and such birds produced by the breeding efforts of local resident pairs could feasibly fly through the airspace of the proposed JRWP, where their flight behaviour would put them at risk of collision with turbines. On the assumption that a handful of breeding pairs are or were scattered among Yanga Lake, the Murrumbidgee River and the Wakool River in the search region, a worst-case scenario would involve 6-8 locally bred fledglings annually colliding with wind turbines at the proposed JRWP as they dispersed. The species has been declining in NSW, particularly south-west NSW, and so the collisions could potentially have an unacceptable impact on the local or regional populations of the species (DCCEEW 2023c). However, this is a worst-case scenario – it assumes maximum reproductive output and perfect survivorship and fledging among the offspring produced by local pairs every year, and every one of those fledglings or immature birds colliding with turbines at the proposed JRWP every year, which is unlikely. Furthermore, the species generally follows watercourses when making movements in inland areas, which would direct dispersing immature birds away from the proposed JRWP. Nevertheless, it is conceivable that 1-2 mortalities could occur each year (although collisions every few years instead are perhaps more likely), and this could still have a smaller but detrimental impact on the local population.

Australian Pelicans evidently have a strong presence in the search region, as seen from the large number of records of the species in the search region and the sometimes very high number of individuals associated with particular records. Their dispersive, nomadic habits and ability to use most wetlands,

even small and ephemeral ones, means there is a realistic possibility the species could use any suitable habitat in or near the proposed JRWP footprint (although this may not occur frequently – likely less than annually). This species is known to soar at great heights (1000-3000 m), so it must fly at RSA height at least during ascent and descent. If Australian Pelican flies like most waterbirds, flying very high when making long-range movements and only approaching the ground when directly above their water body of interest, it is likely that a 400 m buffer between wind turbines and wetlands (including wetlands that may currently be dry but could flood or fill in future) would greatly reduce the risk of this species colliding with turbines (Islam et al. 2022, Everaert date unknown). However, the species was recorded on at least one occasion flying at RSA height within the proposed JRWP footprint, at Impact Point 6, so it is expected that some mortalities of this species would occur as the species evidently flies at RSA height away from wetland habitat at least occasionally. Collisions may be relatively infrequent if there are few individuals using habitat in or near the proposed JRWP, but in the rare event that high rainfall and floods create large expanses of suitable habitat there, very large flocks of the species could potentially disperse to and even breed within the study area. In such a scenario, with such high numbers flying relatively near turbines, potentially including high numbers of young, inexperienced birds, potential exists for a substantial number of mortalities to occur in quick succession. However, such events are likely to be rare – extensive floods in the study area only occurred after a triple La Nina event, which has a roughly 50% chance of occurring at all during the life of the wind farm and unlikely to occur for more than breeding season of Australian Pelican. Furthermore, since this species is common, widespread and secure, it is highly unlikely that even relatively high numbers of individuals being hit by turbines for one breeding season would have significant detrimental impacts on the national population although local populations could feasibly be impacted by such an event, with a small possibility for the regional population to be impacted as well.

Straw-necked Ibiss have a substantial presence in the search region, as is evident from the relatively high number of records of the species in the search region, and the high number of individuals associated with certain records. Their dispersive, nomadic habits and ability to use both wet and dry habitats (e.g. wetlands, dry grassland) means there is a realistic possibility the species could use suitable habitat within or near the proposed JRWP footprint. This could occur frequently, although the species has only been observed twice within the study area, and not in high numbers, during Nature Advisory's avifauna surveys of the area. Although suitable habitat for the species in the study area likely exists, it is unlikely to be of high quality (as the study area generally does not have wetlands or wet grasslands unless there has been a very high amount of rainfall), and so the species is unlikely to regularly use the proposed JRWP in large numbers (the presence of small flocks should always be considered possible). This species is thought to make at least some flights at RSA height, but if it flies like most waterbirds, it is likely to generally fly above RSA height when making long-range movements (such as when it follows the appearance of high-quality habitat patches around the landscape), and below RSA height when making short-range movements. A 400 m buffer between wetlands and turbines should therefore reduce the risk of this species colliding with turbines (Islam et al. 2022, Everaert date unknown). However, since this species can use areas of dry habitat, it may not necessarily confine most of its activities to wetlands when in the study area, and may therefore be more susceptible to collision with turbines than most other waterbirds examined in this report. Such collisions are not expected to be high in number and given the apparently low presence of the species in the study area, would likely be relatively infrequent, and unlikely to significantly impact even the local population. The only scenario in which higher levels of mortality could be expected is if a high-rainfall event created substantial areas of wetland in or near the proposed JRWP and this species subsequently bred there – since this species typically breeds in colonies, there is potential for a higher number of individuals, including a relatively high number of inexperienced flyers, using the airspace of the proposed JRWP, which could elevate collision rates of the species with turbines. Such events are expected to be relatively rare – the appearance of wetland habitats in the vicinity of the

proposed JRWP was prompted by a triple La Nina event, which has a 50% chance of occurring once in the lifespan of the proposed wind farm and unlikely to occur more than this. The collision of a relatively high number of individuals with turbines at the proposed JRWP for one breeding season could detrimentally impact the local population but is unlikely to affect the population of the species at a regional or national scale as it is a common, widespread and secure species.

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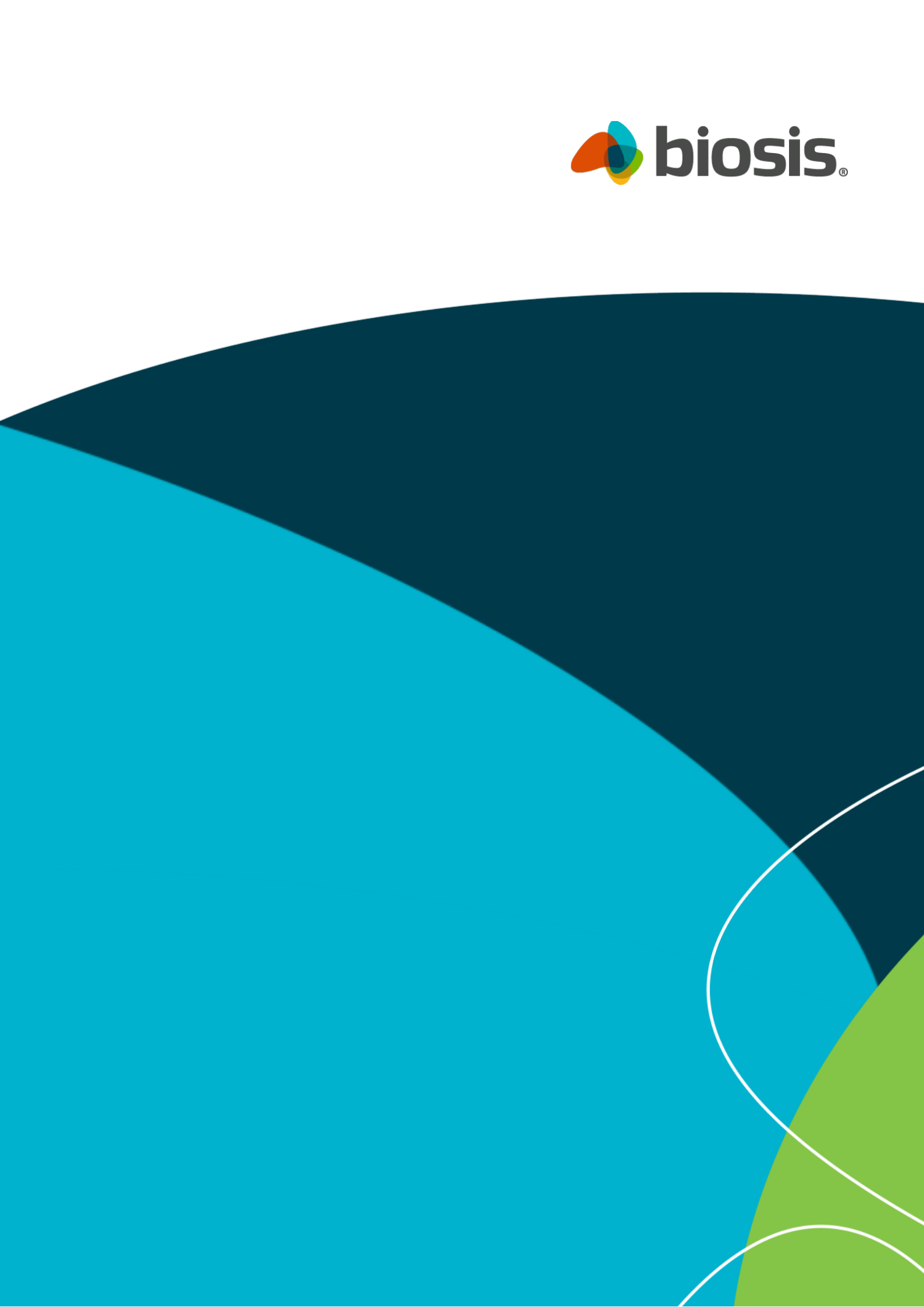
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