Junction Rivers Wind Project

Biodiversity Development Assessment Report

Response to Submissions – Amended BDAR

FINAL REPORT

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

11 Aug 2025

Biosis offices

NEW SOUTH WALES

Albury

Phone: (02) 6069 9200

Email: albury@biosis.com.au

Gosford

Phone: (02) 9101 8700

Email: gosford@biosis.com.au

Newcastle

Phone: (02) 4911 4040

Email: newcastle@biosis.com.au

Sydney

Phone: (02) 9101 8700

Email: sydney@biosis.com.au

Western Sydney

Phone: (02) 9101 8700

Email: sydney@biosis.com.au

Wollongong

Phone: (02) 4201 1090

Email: wollongong@biosis.com.au

Document information

Report to:	Umwelt Pty Ltd / Windlab Pty Ltd
Prepared by:	Callan Wharfe, Dimity Webster, Nicholas Lloyd
Accredited Assessor:	Callan Wharfe BAAS18138
Biosis project no.:	37502
File name:	37502.Junction.Rivers.WF.RTS.BDAR.FIN01.20250811
Citation:	Biosis 2025. Junction Rivers Wind Project BDAR. Report for Umwelt and Windlab. Wharfe, C. Bambrick, D and Lloyd, N., Biosis Pty Ltd., NSW. Project no. 37502

Document control

Version	Internal reviewer	Date issued
Draft version 01	Mitch Palmer	13/12/2023
Final version 01	Mitchell Palmer Matt Looby	15/05/2024
RtS Draft version 01	Mitchell Palmer	23/05/2025
RtS Final version 01	Mitchell Palmer	11/08/2025

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Windlab Australia: Tim Stuckey, April Rose Victoria, Chelsea Sanchez
- Umwelt: (Australia): Lachlan Sweeney, Jon Novoselac
- Commonwealth Department of Climate Change, Energy, the Environment and Water for access to the Protected Matters Search Tool of the Australian Government.
- NSW Department of Climate Change, Energy, the Environment and Water for access to the BioNet Atlas of NSW Wildlife.

Biosis staff involved in this project were:

- Callan Wharfe, Dimity Webster, Nicholas Lloyd (authors).
- Nicholas Lloyd, Matthew Looby, Dimity Webster, Callan Wharfe, Todd Horton, Georgie Zacks, Zoe Marchant & Rosie Gray (field surveys).
- Lauren Harley, Jennifer Townsend, Callan Wharfe (GIS and mapping).

© Biosis Pty Ltd

This document is subject to copyright and may only be used for the purposes in respect of which it was commissioned and in accordance with the Terms of Engagement of the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:

Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

Glossary x
Certification and Declarations xii
Summary xiii
STAGE 1 – BIODIVERSITY ASSESSMENT 1
1 Introduction 2
1.1. Project description 2
1.1.1. Infrastructure components 2
1.1.2. Potential staging 3
1.2. Purpose of this assessment 5
1.3. Response to submissions 5
1.4. Project terminology 11
1.5. Sources of information 11
1.6. Legislative requirements 13
2. Landscape Context 19
2.1. Subject land description 19
2.1.1. Native vegetation cover 20
2.1.2. IBRA Bioregions and subregions 23
2.1.3. Rivers and streams 24
2.1.4. Wetlands 24
2.1.5. Connectivity 25
2.1.6. Geological features of significance 26
2.1.7. Areas of outstanding biodiversity value 26
2.1.8. NSW (Mitchell) Landscape 26
2.1.9. Additional landscape features 28
2.2. Land categorisation assessment 28
3. Native vegetation 46
3.1. Native vegetation methods 46
3.1.1. Native vegetation extent 46
3.1.2. Review of existing information 46
3.1.3. Field investigation of biodiversity values 46
3.1.4. Local data 48
3.2. Native vegetation results 48
3.2.1. Non-native vegetation 48
3.2.2. Planted native vegetation 48
3.2.3. Plant community types 49
3.2.4. Threatened ecological communities 65
3.3. Vegetation integrity assessment 111
3.3.1. Vegetation zones and patch size class 111
3.3.2. Vegetation integrity 113
3.3.3. Vegetation integrity score 115

3.3.4. Scattered paddock trees 115
4. Threatened species 134
4.1. General habitat types and features 134
4.1.1. Flora habitat assessments 135
4.1.2. Fauna habitat assessments 137
4.2. Ecosystem credit species 138
4.3. Species credit species 139
4.3.1. Threatened species survey details 144
4.3.2. Expert reports 226
4.3.3. Threatened species summary and polygons 226
5. Identifying prescribed impacts 245
5.1. Assessment of the occurrence of prescribed impacts 245
5.2. Identification of potential impacts associated with wind farm developments 248
5.2.1. Background review and bird and bat utilisation surveys 248
5.2.2. Regent Parrot, Australasian Bittern and waterbirds 258
5.2.3. Identification of resident, nomadic and migratory species and flight paths 258
6. Collision and barrier effect risk assessments 269
6.1. Qualitative risk assessment 269
6.1.1. Regional Review of Waterbirds in the Riverina (Nature Advisory 2023e) 270
6.1.2. Literature review on habitat use of the Australasian Bittern (Nature Advisory 2023c) 274
6.1.3. Regent Parrot targeted assessment report (Nature Advisory 2023d) 275
6.1.4. Risk matrix methodology 275
6.1.5. Risk matrices 277
6.1.6. At-risk species 284
6.2. Collision risk modelling 286
6.3. Turbine risk assessment 286
6.3.1. Turbine strike consequence 286
6.3.2. Turbine strike likelihood assessment 289
6.3.3. Turbine risk assessment 300
STAGE 2 — IMPACT ASSESSMENT 306
7. Avoid and minimise impacts 307
7.1. Actions to avoid/minimise project impacts 307
7.1.1. Alternative locations' potential impacts on biodiversity values and justification for selecting the project location 307
8. Assessment of impacts unable to be avoided 354
8.1. Direct impacts 354
8.1.1. Summary of direct impacts 354
8.1.2. Assessment of direct impacts 355
8.2. Indirect impacts 361
8.3. Prescribed impacts 379
8.3.1. Human-made structures and non-native vegetation 382

8.3.2. Non-native vegetation 382
8.3.3. Habitat connectivity 383
8.3.4. Water bodies, water quality and hydrological processes 386
8.3.5. Wind farm developments 387
8.3.6. Vehicle strikes 414
8.4. Impacts to Groundwater Dependent Ecosystems (GDE) 418
8.5. Impacts considered uncertain 418
8.6. Cumulative impacts 418
9. Mitigation and management of impacts 421
9.1. Adaptive management strategy 433
9.1.1. Biodiversity Management Plan (BMP) 433
9.1.2. Bird and Bat Adaptive Management Plan (BBAMP) 434
10. Impact summary 448
10.1. Direct and indirect impact to biodiversity values 448
10.2. Serious and irreversible impacts 448
10.3. Identification of impacts requiring offset, not requiring offset and areas not requiring assessment 449
10.3.1. Impact requiring offset 449
10.3.2. Impacts not requiring offset 452
10.3.3. Impacts not requiring assessment 452
11. Biodiversity credit report 471
12. Assessment against EPBC Act and FM Act 484
12.1. Environment Protection and Biodiversity Conservation Act 1999 484
12.1.1. Project assessment against the EPBC Act 484
12.1.2. MNES within the subject land 486
12.1.3. Survey effort for MNES entities 506
12.1.4. Avoidance of impacts to MNES 506
12.1.5. MNES potentially impacted by the project 507
12.1.6. Mitigation to MNES 521
12.1.7. Offsetting of residual impacts to MNES 524
12.2. Fisheries Management Act 1994 526
13. Biodiversity offset strategy 527
13.1. Overview 527
13.2. Offsetting obligations and options 527
13.3. Local offset feasibility 529
13.4. Nature positive opportunities 531
13.5. Offset staging plan 532
References 560
APPENDICES 570
Appendix 1. Survey methods 571
Appendix 2. BAM Candidate species assessment 572
Appendix 3. Flora 584

Appendix 4. Fauna 813
Appendix 5. EPBC Act Significant Impact Criteria assessments 849
Appendix 6. Assessment of impacts to planted native vegetation 878
Appendix 7. Streamlined assessment module – Scattered trees assessment 887
Appendix 8. Bird and Bat Adaptive Management Plan - Working draft 911
Appendix 9. Nature Advisory Bird and Bat Assessments 912
Appendix 10. Biosis microbat technical report 913
Appendix 11. Desert Mouse BAM Species Expert Report 914

Tables

Table 1 Junction Rivers Wind Project components 3
Table 2 Stage 1 potential infrastructure components 4
Table 3 Agency issues, advice and recommendations, Biosis' response and how / where items addressed 6
Table 4 PCTs mapped within the assessment area (DPE 2023a) 21
Table 5 PCT 16 Black Box grassy open woodland wetland 50
Table 6 PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland 52
Table 7 PCT 23 Yarran tall open shrubland 54
Table 8 PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland 55
Table 9 PCT 58 Black Oak – Western Rosewood open woodland 56
Table 10 PCT 163 Dillon Bush (Nitre Bush) shrubland 59
Table 11 PCT 170 Chenopod sandplain mallee woodland/shrubland 60
Table 12 Summary of BC Act TECs within the subject land 65
Table 13 Key diagnostic characteristics for the EPBC Act listed TEC (DAWE 2021) 67
Table 14 Plains mallee box woodlands CEEC condition classes 70
Table 15 Plains mallee box woodlands CEEC condition classes and thresholds and indictors 71
Table 16 Vegetation zones within the subject land 111
Table 17 BAM plots completed within the Subject Land 113
Table 18 Vegetation zone integrity scores 115
Table 19 Ecosystem credit species (predicted species) with potential to occur 138
Table 20 Candidate flora species credit species 141
Table 21 Candidate fauna species credit species 143
Table 22 Weather observations during targeted flora and fauna surveys (Balranald, NSW) 144
Table 23 October 2024 targeted flora surveys species grouping and transect widths 146
Table 24 Targeted flora survey personnel and relevant experience 149
Table 25 Summary of targeted flora survey effort and results 150
Table 26 Barking Owl and Bush Stone-curlew replicate surveys 153
Table 27 Targeted nocturnal bird survey personnel and relevant experience 155
Table 28 Summary of nocturnal bird survey method and results 156
Table 29 Nature Advisory diurnal bird survey effort 157

Table 30 Targeted diurnal bird survey personnel (Nature Advisory) and relevant experience 159
Table 31 Summary of diurnal bird survey method and results 160
Table 32 Targeted diurnal bird survey personnel and relevant experience 165
Table 33 Summary of diurnal breeding period survey effort and results 166
Table 34 Nature Advisory microbat survey effort 167
Table 35 List of sampling sites and associated habitat unit and type. 169
Table 36 Call identification confidence ratings 171
Table 37 Targeted microbat survey personnel and relevant experience 172
Table 38 Bat call analysis results Nature Advisory and Biosis combined 173
Table 39 Threatened species polygons within the development footprint 227
Table 40 Prescribed impacts associated with the project 246
Table 41 Bat call analysis results 254
Table 42 Nomadic/migratory avian species movements within Australia 260
Table 43 Migratory avian species movements within and outside of Australia 262
Table 44 Review of microbat behaviour 263
Table 45 Summary of literature review on waterbird collision risk (Nature Advisory 2023e) 271
Table 46 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike and barrier effect for birds and microbats (Nature Advisory 2023f) 277
Table 47 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for birds and microbats (Nature Advisory 2023f) 277
Table 48 Bird and bat collision risk likelihood consequence undertaken by Biosis and Nature Advisory (Nature Advisory 2023f) 282
Table 49 Species determined to be at risk of impact from turbine collision through qualitative risk assessments by Biosis and Nature Advisory (Nature Advisory 2023f) 284
Table 50 Species not subject to qualitative risk assessment determined to be at-risk (Nature Advisory 2023e, Nature Advisory 2023a) 285
Table 51 Adapted BCS turbine strike consequence matrix 287
Table 52 Turbine strike consequence for at-risk species 287
Table 53 Turbine strike likelihood criteria 291
Table 54 WTG separation distances (row colourings match RSA gaps displayed in above figure) 294
Table 55 Turbine strike likelihood results 297
Table 56 Turbine risk assessment matrix 300
Table 57 Turbine risk assessment results 301
Table 58 Turbine risk assessment summary 304
Table 59 Avoidance and minimisation of impact 309
Table 60 Summary of direct impacts to vegetation 354
Table 61 Summary of direct impacts species credit habitat or individuals 355
Table 62 Summary of direct impacts to Scattered Paddock Trees 355
Table 63 Summary and assessment of direct impacts 356
Table 64 Assessment of indirect impacts 362
Table 65 Identification of prescribed impacts 380
Table 66 Prescribed impact assessment – wind farm developments 389
Table 67 Potential impacts to identified ‘more sensitive’ at-risk species 400

Table 68 Cumulative impact summary 419
Table 69 Measures to mitigate and manage impacts 422
Table 70 General investigation and monitoring triggers for bird and bat strike 436
Table 71 General investigation and monitoring triggers for bird and bat strike 437
Table 72 Monitoring requirements for carcass searches 438
Table 73 Consideration of likely required mitigation measures 439
Table 74 Offsets required (ecosystem credits) 449
Table 75 Offsets required (species credits) 450
Table 76 Offsets required (scattered trees) 451
Table 77 Offsets not required (ecosystem credits) 452
Table 78 Response to Submissions EPBC Bilateral Assessment Information 484
Table 79 MNES within the subject land 486
Table 80 Detailed summary of MNES with potential for impact within the subject land 488
Table 81 Summary of significant impact assessment of EPBC threatened species, ecological communities and migratory species 508
Table 82 Residual impacts to MNES 522
Table 83 Summary of project offset requirement 527
Table 84 PCTs confirmed present within the subject properties 529
Table 85 Summary of OTGs and PCTs mapped and estimated ecosystem credit generation across the subject properties 530
Table 86 Estimated ecosystem credits generated across subject properties and suitability for offsetting project impacts 531
Table 87 Offset staging plan – Stage 1 impacts and credit requirements 532
Table 88 Offset staging plan – Stage 2 impacts and credit requirements 534
Table 89 Scattered trees offset staging plan – Stage 1 impacts and credit requirements 535
Table 90 Scattered trees offset staging plan – Stage 2 impacts and credit requirements 536

Appendix Tables

Table A 1 Threatened flora species assessment 572
Table A 2 Threatened fauna species assessment 580
Table A 3 BAM plot floristics 586
Table A 4 BAM plot summary 652
Table A 5 PCT 13 Black Box - Lignum woodland wetland 808
Table A 6 PCT 15 Black Box open woodland wetland with chenopod understorey 808
Table A 7 PCT 17 Lignum shrubland wetland 809
Table A 8 PCT 19 Cypress Pine woodland 809
Table A 9 PCT 28 White Cypress Pine open woodland 809
Table A 10 PCT 159 Old Man Saltbush shrubland 810
Table A 11 PCT 164 Cotton Bush open shrubland 810
Table A 12 PCT 165 Derived corkscrew grass grassland/forbland 811
Table A 13 PCT 173 Sandplain mallee 811
Table A 14 PCT 216 Black Roly Poly low open shrubland 812

Table A 15 PCT 238 Permanent and semi-permanent freshwater lakes wetland PCT 238 Permanent and semi-permanent freshwater lakes wetland 812
Table A 16 Fauna species recorded at the subject land 813
Table A 17 Bird and bat collision risk and barrier risk likelihood assessment 814
Table A 18 Corben's Long-eared Bat flight characteristics 849
Table A 19 SIC assessment for Corben's Long-eared Bat 850
Table A 20 SIC assessment for Regent Parrot 853
Table A 21 SIC assessment for Grey Falcon 856
Table A 22 SIC assessment for Southern Whiteface 859
Table A 23 SIC assessment for Pink Cockatoo 863
Table A 24 SIC assessment for Australasian Bittern 866
Table A 25 SIC assessment for Sharp-tailed Sandpiper - Migratory 870
Table A 26 SIC assessment for Common Greenshank 872
Table A 27 SIC assessment for Gull-billed Tern 874
Table A 28 SIC assessment for Caspian Tern 876
Table A 29 Planted native vegetation – BAM streamlined assessment D.1 882
Table A 30 Tree cover benchmark data for relevant PCTs 888
Table A 31 Mapped scattered trees likely to be impacted by the project 889
Table A 32 Mapped scattered trees likely to be impacted by the project 892
Table A 33 Offset credit calculations for impacted scattered trees 892
Table A 34 Summary of BC Act TECs represented as scattered trees 893

Figures

Figure 1 Subject land 14
Figure 2 Site map 30
Figure 3 Location map 36
Figure 4 Land category 42
Figure 5 Native vegetation extent 43
Figure 6 Vegetation within the subject land 77
Figure 7 TECs within the subject land 94
Figure 8 Patch sizes within the subject land 112
Figure 9 Vegetation zones and plot locations 117
Figure 10 Targeted species surveys 175
Figure 11 Threatened species polygons 228
Figure 12 Indicative nomadic and migratory flight paths 267
Figure 13 Indicative local flight paths 268
Figure 14 WTG location, pinch points and flyways 294
Figure 15 Extract from Technical Information Note TIN051 Bats and onshore wind turbines, showing how buffer distance is determined from top of canopy to blade tip 296
Figure 16 Alternative options and avoidance 320
Figure 17 Final development footprint 337

Figure 18 Indirect impacts 377
Figure 19 Prescribed impacts 416
Figure 20 Impacts requiring offsets, not requiring offset, not requiring assessment 454
Figure 21 MNES within the subject land 525
Figure 22 Project and offset staging 537
Figure 23 Scattered trees mapped within the subject land 894

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 (now CPHR)
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*
CPHR	Conservation Programs, Heritage and Regulation group of the NSW Department of Climate Change, Energy, the Environment and Water (formally BCS)
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.

Term	Definition
EMS	Environmental Management Strategy
EEC	Endangered Ecological Community
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

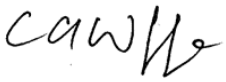
© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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:	11/08/2025
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 2,100 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 2,248 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.

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
- 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.
- Pink Cockatoo *Lophochroa leadbeateri* commonly recorded during surveys.
- 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 initial BBUS work for the project, which included 24 months of bird surveys, over eight seasons, and five seasonal microbat surveys, completed between February 2021 and October 2022 to provide baseline data on the utilisation of the subject land by microbats. Additional microbat surveys are now in progress and are being completed by Biosis. A summer 2025 survey has been completed in January 2025, with autumn and winter 2025 seasons still pending. At-height surveys are also being completed, with spring 2024 and summer 2025 surveys complete, and additional surveys to be undertaken in autumn and winter 2025. A total of 81 bird species were recorded across the 24 months of survey, and eleven 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 locally occurring 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.

Response to Submissions

The project's Environmental Impact Statement (EIS) was submitted in July 2024 and received a range of Agency and public submissions. This BDAR has been updated in response to key submissions received, particularly with reference to those received from the Conservation Programs, Heritage and Regulation (CPHR) group (formerly Biodiversity Conservation and Science Directorate [BCS]) of the NSW Government Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW), and the NSW National Parks and Wildlife Service (NPWS).

Key updates to the BDAR and overall biodiversity impacts assessment process includes:

- Additional targeted threatened flora and fauna surveys completed in late-winter and spring 2024.
- Additional microbat surveys, including at-heigh surveys, completed in spring 2024 and summer 2025, with further surveys planned for autumn and winter 2025.
- Revised turbine risk, and species risk, assessments incorporating new survey data and Agency feedback.
- Assumed presence for one flora species and two fauna species for which adequate surveys to exclude presence could not be completed.
- Relevant updates to impact assessments.

- Following completion of additional survey work, and 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.

It should be noted that the project's overall turbine risk profile has increased from that assessed as part of the EIS (2024). This is due largely to the reassessment of the overall risk ratings of Pink Cockatoo and Wedge-tailed Eagle, as well as the incorporation of additional field data on the presence of nests and hollow-bearing trees, and the inclusion of aviation lighting as part of the project. This reassessment and recapitulation is considered to address CPHR's feedback on the generally low levels of risk previously assessed, and will ensure sufficient operational monitoring and adaptive mitigation strategies are employed where required.

Unavoidable impacts

Summary of direct impacts to vegetation

Vegetation zone	TEC	Area impacted (ha)	VI Score
PCT 16_Moderate	-	3.80	53.4
PCT 16_Low	-	0.36	28.6
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
PCT 58_High	-	0.85	91.0
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	59.5
PCT 170_Low	-	0.56	29.7
PCT 170_DNG	-	3.50	15.0
Total	-	**75.68**	-

Summary of direct impacts species credit habitat or individuals

Species	Biodiversity Risk Weighting	Area impacts (ha)
Atriplex infrequens	2.0	14.34 (Assumed present)
Crowned Gecko	2.0	8.74 (Assumed present)
Painted Burrowing Frog	2.0	17.92 (Assumed present)
Pink Cockatoo	2.0	37.40

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.

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.

An assessment of potential habitat and impacts to Desert Mouse *Pseudomys desertor,* by the BAM Species Expert, confirmed impacts are unlikely to occur and as such an assessment of potential Serious and Irreversible Impacts (SAIIs) is not required. The project has been assessed as likely to result in a Significant Impact under the EPBC Act to Pink 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 to both of these species, and a suite of biodiversity offsets (including nature positive strategies) have been proposed, and will be secured post approval.

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:

- 1,097 ecosystem credits for impact to native vegetation and threatened species habitat.
- 344 species credits for assumed impacts to *Atriplex infrequens*.
- 173 species credits for assumed impacts to Crowned Gecko
- 432 species credits for assumed impacts to Painted Burrowing Frog.
- 840 species credits for impacts to Pink Cockatoo.
  - Offsets for Pink Cockatoo must also meet the requirements of the EPBC Act Offsets Policy (CoA 2016).

It should be noted that there has been a general reduction in offset credit requirements between the EIS stage and the current RtS stage of the BDAR. This is due to a reduction in Biodiversity Risk Weighting for PCTs included in the assessment.

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, during and post the project's Assessment phase.

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 original 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 were 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 in May 2024. Agency and public submissions were subsequently received, and this BDAR has been updated as part of the Response to Submissions (RtS) Report.

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 3**
Main substation (33/220kV and/or 33/330kV)	Maximum of 5.0 ha	Up to 3**
Underground and/or overhead cables (33kV)	5 m width trench	Approx.78 kms (total length of trenches) 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 is dependent on the access to transmission infrastructure and will include the balance of the WTGs and ancillary infrastructure outlined in Table 1, 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 74, Table 75 or Table 76 of this BDAR. If micro-siting results in an increase in impacts of biodiversity values outlined in in Table 74, Table 75 or Table 76 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 (standard BAM assessment module) and 00044469/BAAS18138/23/00044470 (streamlined scattered trees assessment module) 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.

Furthermore, to account for proposed project staging outlined above (Section 1.1.2) the following BAM-C development assessment cases have been created:

- Stage 1 - 00034462/BAAS18138/25/00058626
- Stage 2 - 00034462/BAAS18138/25/00058627
- Stage 1 (scattered trees module) - 00034462/BAAS18138/25/00058633
- Stage 2 (scattered trees module) - 00034462/BAAS18138/25/00058634

1.3. Response to submissions

Following submission of the EIS and the accompanying BDAR, NSW Conservation Programs, Heritage and Regulation (CPHR) group (formerly Biodiversity Conservation and Science Directorate [BCS]) and NSW National Parks and Wildlife Service (NPWS) requested further information on 03 September 2024. A summary of the responses to BDAR specific comments is provided in Table 3 below.

Table 3 Agency issues, advice and recommendations, Biosis' response and how / where items addressed

Comment No.	Heading	CPHR recommendations	How / where addressed
CPHR			
5	BBUS effort is insufficient and cannot be used to reliably inform the BBAMP without additional survey effort.	5.1 - Complete another 18 months of bat utilisation surveys including at height data as part of the BBUS program. 5.2 - Include the full season of bat utilisation survey results in a revised BBAMP 5.3 - Assess raptor nests and breeding within the site and include the results in the collision risk assessment in a revised BBAMP	• Biosis has processed and analysed Nature Advisory (NA) existing data, not included in the BDAR, which includes 1x autumn, 1x winter, 2x spring (2022) seasons of microbat data. • Biosis to collect 1x spring (2024), 1x summer, 1x autumn, 1x winter (2024) season of at-height microbat data, and an additional 1x summer, 1x autumn, 1x winter (2024) site-based microbat data (including increasing effort from six survey sites to 12). • The above will provide 24 months of site-based seasonal replicate data, and 12 months of at-height seasonal replicate data. • Surveys were completed for raptor nests in October 2024. • Additional data already collected has been incorporated into this BDAR, remaining data will be utilised in the finalisation of the BBAMP. • Refer Sections 4.3.1, 5.2, 6, 8, and 9.
6	Measures to mitigate uncertain impacts to birds and bats in the BBAMP framework lack the necessary commitment and detail to be effective.	6.1 - Revise the draft BBAMP in consultation with BCS, and ensure outcomes based on the results of the BBUS data are fully justified with supporting information and literature. 6.2 - Revise the turbine risk ratings incorporating flight path mapping data and completed BBUS data. 6.3 - Review the monitoring triggers for turbine collisions.	• The updated final list of at-risk bird and bat species is provided in in Section 6.1.6. • BBAMP framework, turbine risk and monitoring triggers have been reviewed and updated. • Refer Sections 6, 8, and 9.
7	The large area method has been incorrectly applied to threatened flora surveys.	7.1 - Review Table 20 of the BDAR and only include grid-based surveys for those species with an area of associated PCTs in the development corridor of >50 hectares 7.2 - Complete additional surveys using parallel traverses for any candidate flora species where the sum of the associated PCTs is less than 50 hectares.	• Addition targeted flora survey completed in October 2024 implementing a parallel traverse search method within the project's development footprint and development corridor. • Candidate flora species were reviewed and justification is provided for any areas not subject to survey.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Comment No.	Heading	CPHR recommendations	How / where addressed
		7.3 - Review and revise candidate flora species polygons if required. 7.4 - Identify and justify any vegetation zones where surveys were not completed due to perceived poor condition.	• Refer Section 4.3.1.
8	Some targeted threatened fauna species surveys do not comply with the BAM.	8.1 - Provide additional information to confirm threatened species surveys were conducted in accordance with relevant guidelines and TBDC. If additional surveys cannot be done, presence must be assumed or an expert report provided. 8.2 - Conduct targeted surveys for breeding candidate threatened raptors or assume presence in all associated habitat.	• Additional targeted fauna surveys completed in late-winter and spring 2024. • Presence has been assumed for a small number of fauna species for which adequate surveys to exclude presence could not be completed. • A Species Expert Report has been prepared for impacts to potential habitat for Desert Mouse. • Refer Section 4.3.
9	More detail is needed to justify exclusion of candidate species.	9.1 - Provide additional justification for the exclusion of candidate flora and fauna species consistent with section 5.2 of the BAM. 9.2 - Where species cannot be excluded, complete targeted surveys in accordance with section 5.3 of the BAM and supporting guidelines.	• Candidate flora and fauna species have been revised. • Additional targeted survey work has been completed. • Presence has been assumed for a small number of fauna species for which adequate surveys to exclude presence could not be completed. • A Species Expert Report has been prepared for impacts to potential habitat for Desert Mouse. • Refer Section 4.3.
10	Assumed presence species polygons are not consistent with section 5.2.5 of the BAM.	10.1 - Update assumed presence species polygons to be consistent with section 5.2.5 (4) of	• Assumed presence polygons have been revised and justification is provided. • Refer Section 4.3.3.
11	The BDAR needs to include more detail to demonstrate that biodiversity impacts have been avoided or minimised.	11.1 - Commit to using avoidance technology such as ultrasonic noise and radar to minimise impacts on birds and bats. 11.2 - Justify the use of a 400-metre buffer from flooded lakes and wetlands as an avoidance method.	• BBAMP framework, turbine risk, proposed mitigation, and monitoring triggers have been reviewed. • Refer Sections 6 and 9.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Comment No.	Heading	CPHR recommendations	How / where addressed
		11.3 - Review turbine risk ratings taking into consideration the mapped flight paths and BBUS. This data should be used to further inform avoidance measures.	
12	Potential occurrence of EPBC TECs must be assessed against the listed conservation advice.	12.1 - Provide evidence to support exclusion of PCT 170 in the development corridor from the Plains Mallee Box Woodland TEC. This must include assessment against the EPBC Act approved conservation advice.	• Presence of TEC has been further addressed. • Refer Sections 3.2.4 and 12.1.
13	Native vegetation cover in landscape assessment requires review to include all native vegetation.	13.1 - Review native vegetation cover in the assessment area to include all woody and non-woody native vegetation (including planted native vegetation). 13.2 - Once complete, review the native vegetation percent cover and if required update the BAM-C and the BDAR, and address any changes to predicted and candidate species if triggered by a higher percent cover category.	• Native vegetation cover mapping and BAM Calculator have been updated. • No material changes to the assessment have resulted from these updates.
14	The direct impact assessment should include asset protection commitments, identify the change in vegetation integrity, and consistently and clearly report the impact to hollow-bearing and scattered trees.	14.1 - Identify asset protection measures for the proposal and revise the assessment to include any associated impact to native vegetation and threatened species habitats. 14.2 - Update Table 47 to include the change in vegetation integrity score due to the proposal. 14.3 - Revise Section 8.1.1, Table 45 and Table 50 to consistently and clearly report the number of hollow-bearing trees to be impacted by the proposal.	• Section 8.1 has been updated as required. • No Asset Protection Zones will occur outside the current development footprint, as such no changes in impacts reported are required.
15	The indirect impact assessment should include turbine noise and loss of fauna habitat.	15.1 - Amend Section 8.2 and Table 51 of the BDAR to provide evidence-based justification for impact prediction about turbine noise and the risk of starvation, exposure and loss of shade or shelter on threatened fauna. 15.2 - Revise Table 51 to include any asset protection (fire mitigation) requirements or reference to where such measures are detailed in the EIS. Revise the assessment of changed fire regimes if there is no stated commitment in the EIS to fire mitigation measures.	• Section 8.2 has been updated as required.

Comment No.	Heading	CPHR recommendations	How / where addressed
16	Mitigation measures should be detailed in the BDAR to demonstrate effective management of impacts and to give confidence that the offset liability is adequate.	16.1 - Update Section 9 of the BDAR (including Table 56) to detail auditable mitigation and management measures that follow the SMART principles. 16.2 - Include specific measures for minimise inadvertent clearing of non-woody components of TECs, native vegetation communities, and protecting native vegetation in adjacent TSRs from sediment-laden runoff during construction.	• Section 9 has been revised.
17	The indirect impact assessment requires review and the BDAR must detail the measures to mitigate indirect impacts.	17.1 - Provide further evidence for indirect impact risk ratings in Table 51 based on known effective mitigation measures.	• Sections 8.2 and 9 have been updated as required.
18	The two stages proposed for credit retirement should be allocated to two separate child cases for vegetation zones and scattered trees.	18.1 - Add a new child case within the parent case in BOAMs for stage 2 of the development. 18.2 - Add a new child case within the parent case to split the scattered trees by stage. 18.3 - Revise Table 73 and 74 to include the scattered tree impact summary for Stage 1 and Stage 2).	• BAM Calculator cases have been updated with separated child cases created.
19	The Pink Cockatoo credit liability in Table 62 is incorrectly reported.	19.1 - Revise Table 62 to accurately report the Pink Cockatoo credit liability for the 'PCT170 Moderate' vegetation zone.	• Species credit liabilities have been updated.
20	Any threatened flora records should be verified by a herbarium	20.1 - Provide verification of threatened flora from a herbarium.	• This has not been possible.
21	A complete MNES assessment should be provided to address the Assessment Bilateral.	21.1 - Amend Table 65 to match the text in section 12.1.1. Amend Table 67 of the BDAR to include further justification to support excluding MNES species from further assessment. 21.2 - Revise the BDAR to specifically address prescribed impacts to MNES. 21.3 - Amend section 12 of the BDAR and specifically address each of the bilateral assessment requirements as detailed in Attachment C to this response.	• Section 12.1 has been updated as required.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Comment No.	Heading	CPHR recommendations	How / where addressed
NPWS			
1	Land reserved under the National Parks and Wildlife Act 1974	1.1. - Document the distance between the Yanga SCA/NP boundary and the nearest proposed WTG, stating distance and depicting the applied buffer zone as part of the EIS. Provide a stated commitment to retain the buffer during the final stages of the JRWFP design and WTG micrositing.	• As stated in the EIS and outlined within section 7 of this BDAR, the project layout was revised to remove turbines north of the transmission line to increase the buffer distance from Yanga SCA and Yanga NP. Section 8.3.3, 12.1.6 and Table 69 have been updated to include the distances from WTG 18 from Yanga SCA and WTG 1 from Yanga NP and outline a commitment to retain a 2.5 km buffer during the final stages of the project design and WTG micrositing.
3	Biodiversity	3.1 - Values of the Yanga Group are considered in the overall impact assessment, inclusive of their wetland and migratory bird habitat, local and landscape level connectivity as a significant part of the Lowbidgee Floodplain. Effects of the JRWFP on threatened woodland, migratory and waterbirds, resources use and in sustaining breeding colonies needs to be adequately considered. 3.2 - Consultation with NPWS in the preparation and delivery of the Bird and Bat Adaptive Management Plan, and inclusion of the NPWS in ongoing monitoring outcomes and statutory reporting on JRWFP operation.	• Section 8.2 and 8.3 has been updated as required. • Additional detail has been added to outline the avoidance and minimisation steps undertaken to ensure impacts on the Yanga group have been addressed. Additional detail and assessment connectivity and potential cumulative and indirect impacts to the Yanga Group has been added within sections 2.1.4, 4.1.2, 6, 8.2, 8.3, 8.3.3, 8.6 and Table 40 • NPWS will be included in consultation in the finalisation of the BBAMP

1.4. 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 2,096 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).

1.5. 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).

1.6. 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.*

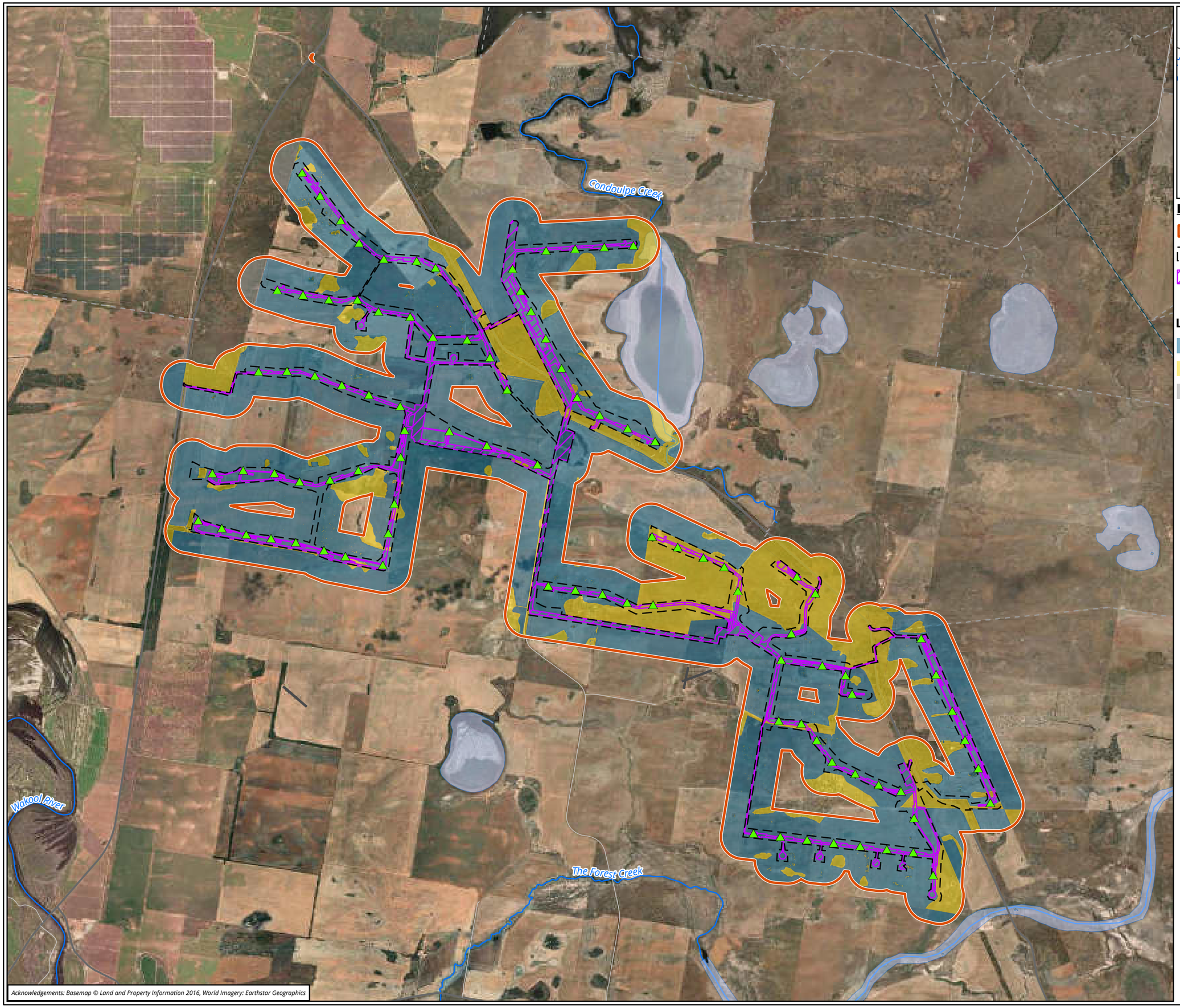
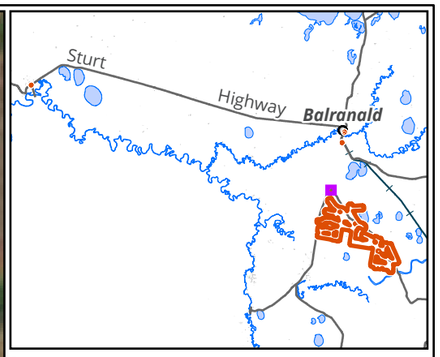


Figure 1.1 Subject land

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

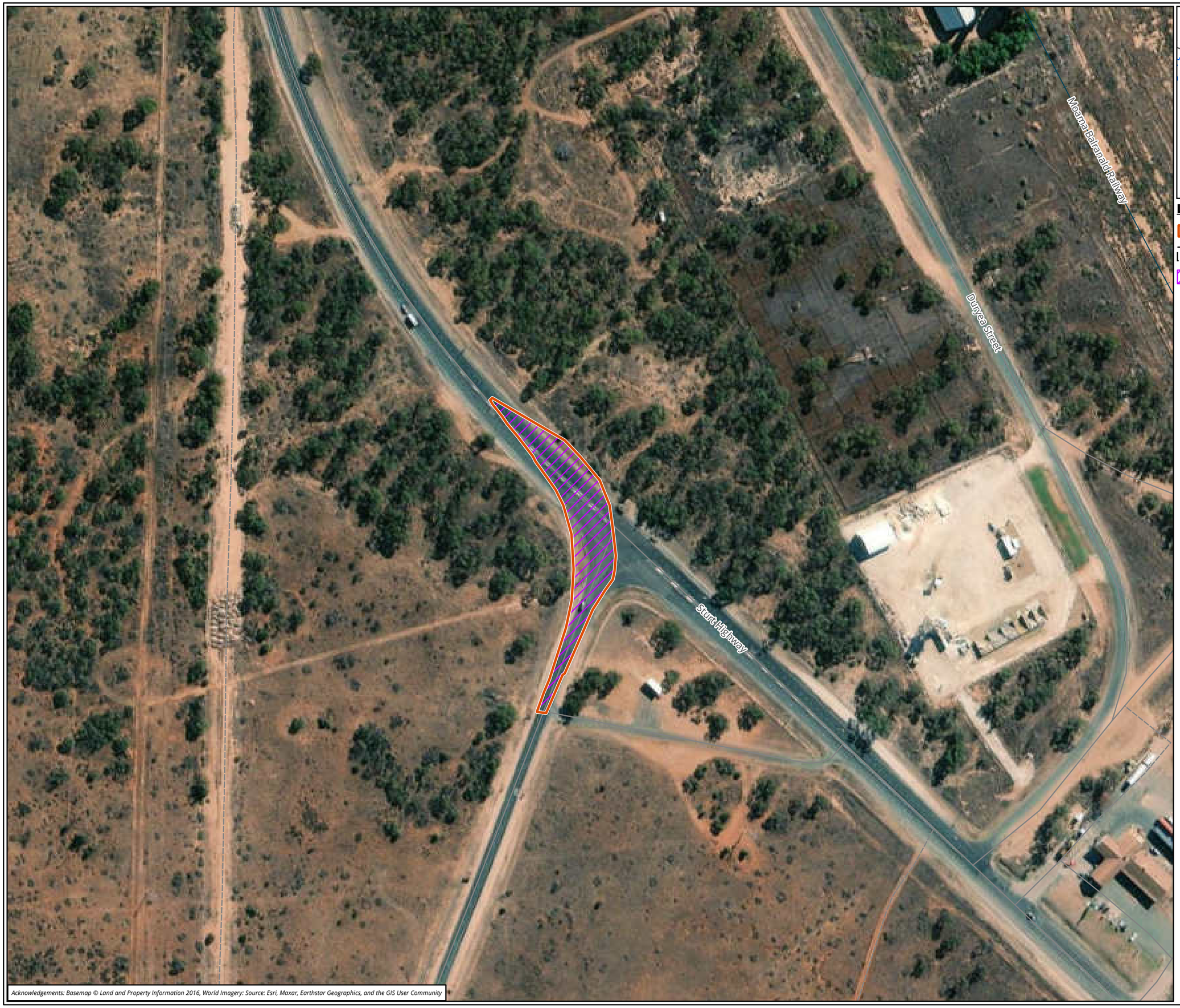
Coordinate System:
GDA 1994 MGA Zone 54

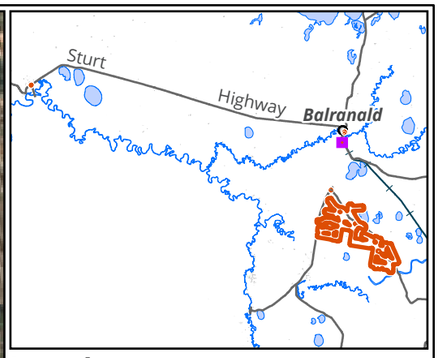
N

biosis

Matter: 37502, Date: 15 March 2024,
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





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

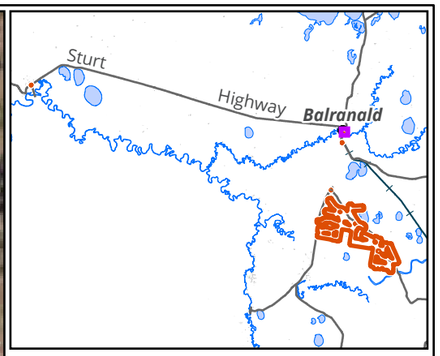
Coordinate System:
GDA 1994 MGA Zone 54

N

biosis

Matter: 37502, Date: 15 March 2024,
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



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

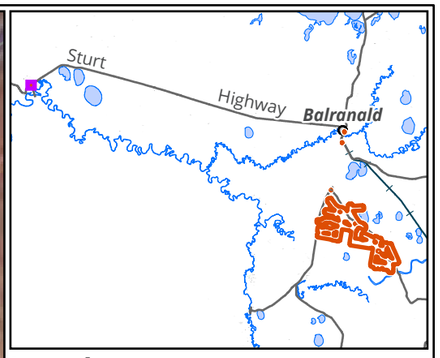
Coordinate System:
GDA 1994 MGA Zone 54

N

biosis

Matter: 37502, Date: 15 March 2024,
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



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

Matter: 37502, Date: 15 March 2024,
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 4. Table 5 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 11,364.35 hectares, which is illustrated on Figure 5. This is a native vegetation cover of 42.21% (31-70 % 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 15,600 hectares.

Table 4 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 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	Associated Threatened Ecological Communities (TECs)	BC Act Status	EPBC Act Status
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, Riverina and Naracoorte Coastal Plain Bioregions.	Not listed	Critically Endangered
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	Associated Threatened Ecological Communities (TECs)	BC Act Status	EPBC Act Status
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 (National Parks and Wildlife Services 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 (National Parks and Wildlife Services 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 2025). 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 2019). 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 (OEH 2010). 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 (OEH 2010) 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 linking the subject land to 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.

Around 14% of the Lowbidgee Floodplain DoI wetland occurs within the bounds of the Yanga National Park, Yanga State Conservation Area and Yanga Regional Park. This area is known to host large waterbird breeding colonies (NSW DCCEEW 2024b). The aquatic habitat within the seasonal watercourse Condoulpe Creek and dryland lake, Condoulpe Lake, within the subject land receive water seasonally from the Murrumbidgee River via Yanga Lake and Yanga Creek.

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 (DECC 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 (DECC 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 (DECC 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 (DECC 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* (DECC 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 (DECC NSW 2002).

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:

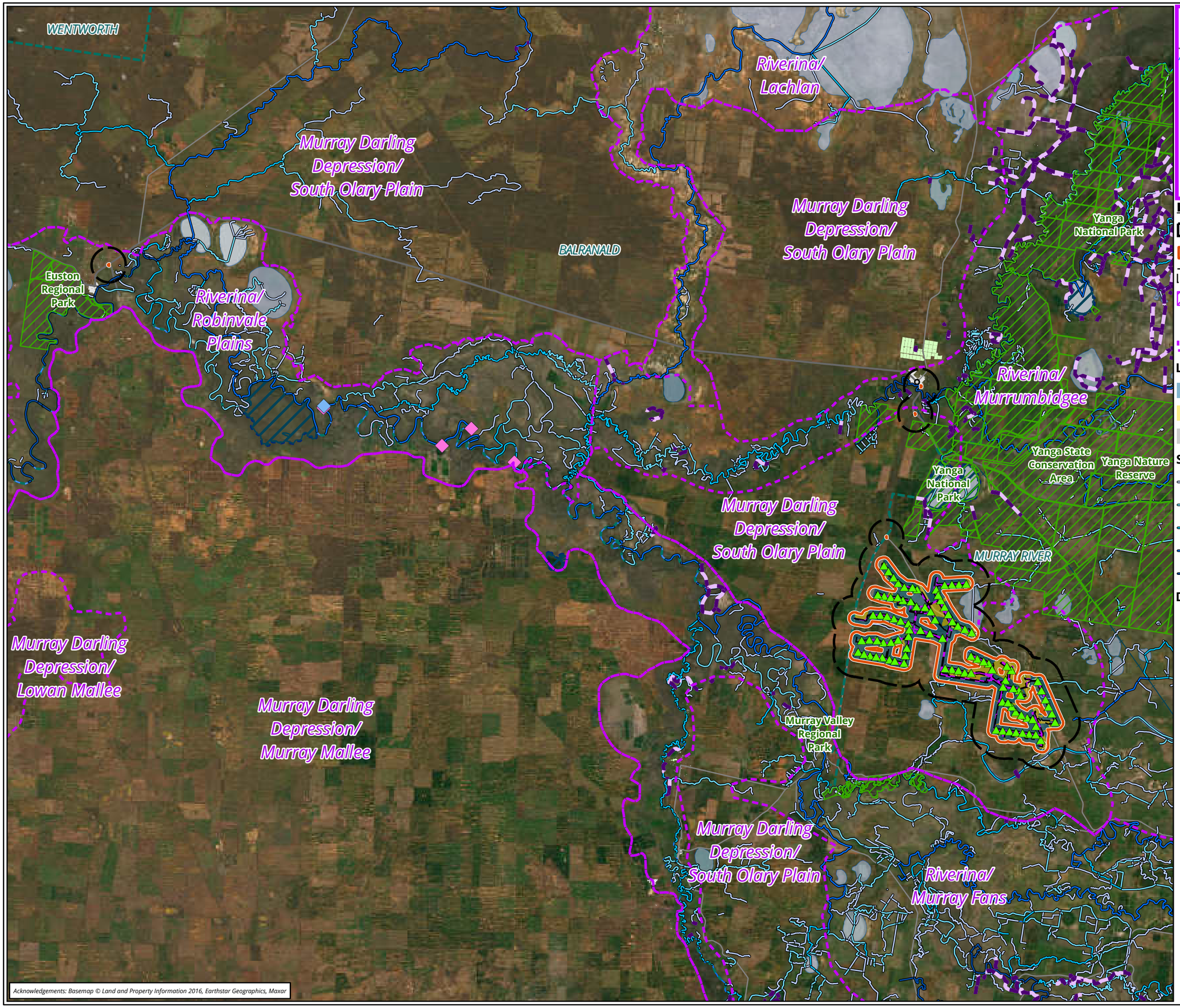
- Vulnerable and sensitive regulated land.
- Land not cleared of native vegetation before 1 January 1990 or unlawfully cleared of native vegetation after 1 January 1990.
- Land containing native vegetation grown or preserved using public funds.
- Land subject to an expired remedial action to restore 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*.

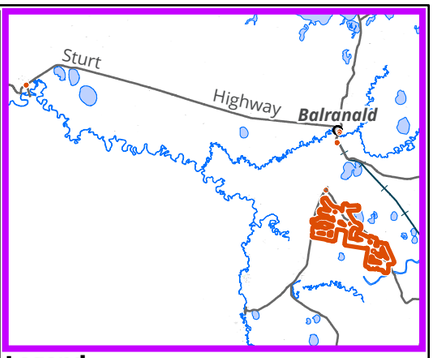
- Land containing medium conservation value grasslands.
- Land containing low conservation grasslands beneath the canopy or drip line of woody vegetation.
- Land is a travelling stock reserve (unless the land is located in the Western Division).
- The land is otherwise prescribed by the Local Land Services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

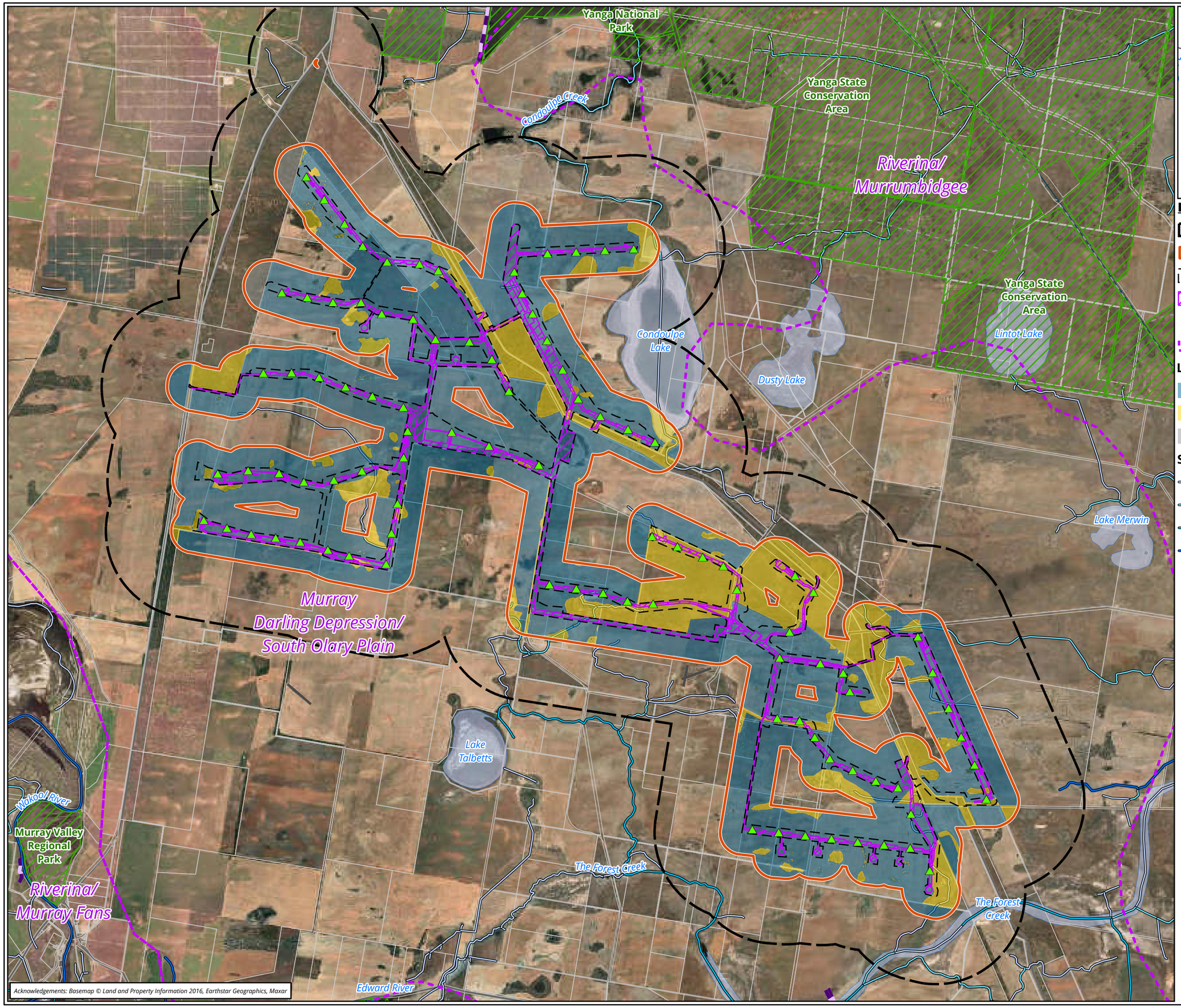
Scale: 1:318,000 @ A3

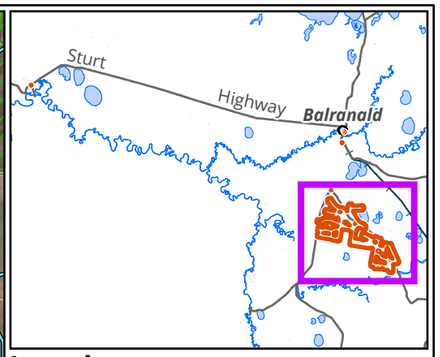
Coordinate System: GDA2020 MGA Zone 54

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_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

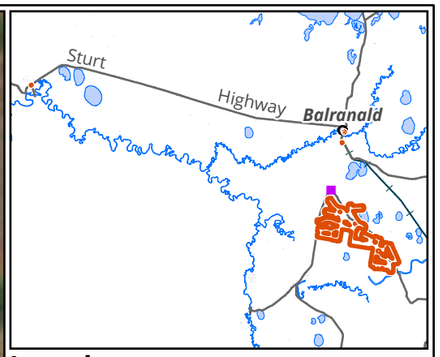
Meters

Scale: 1:80,000 @ 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_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

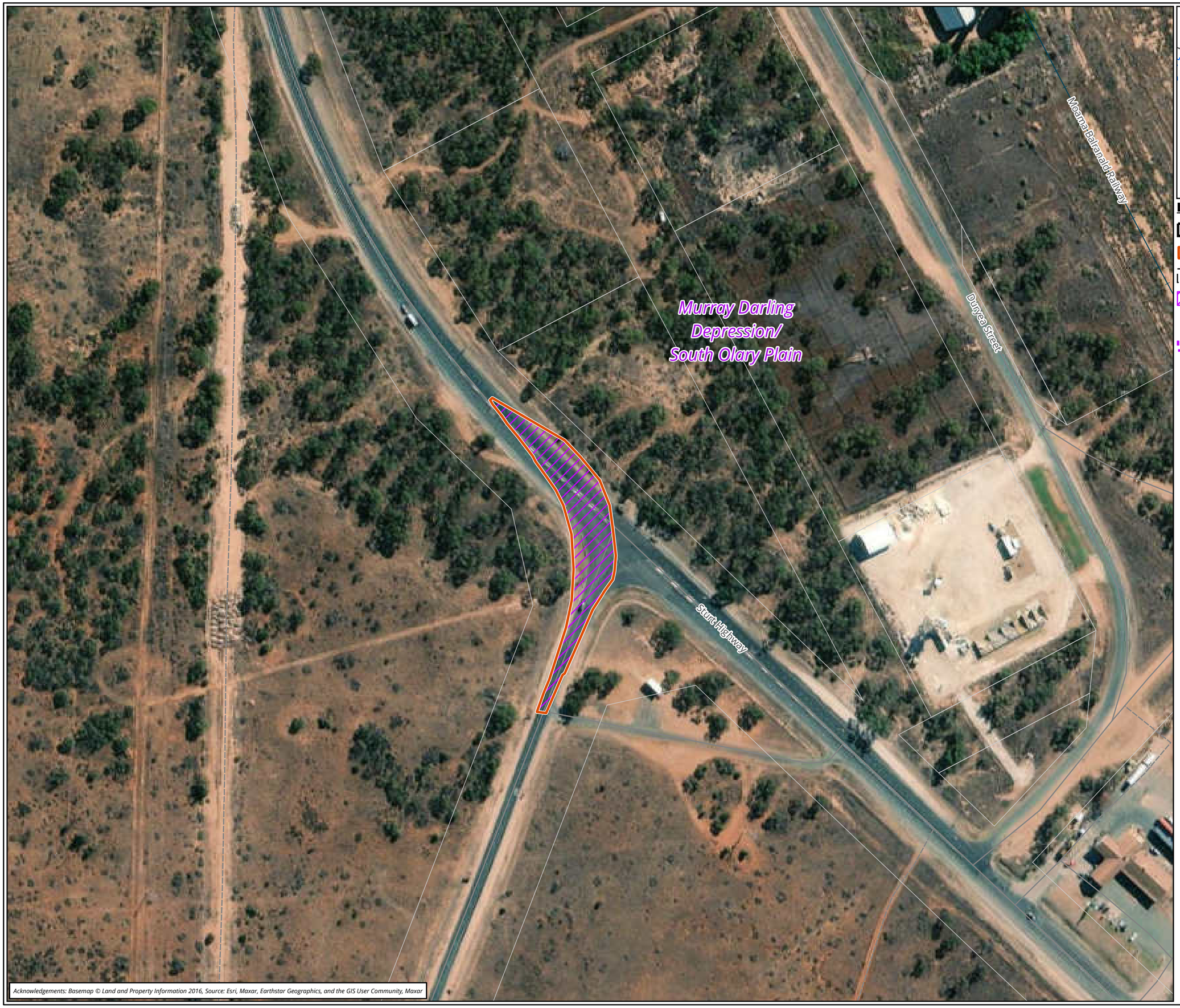
Scale: 1:2,000 @ A3

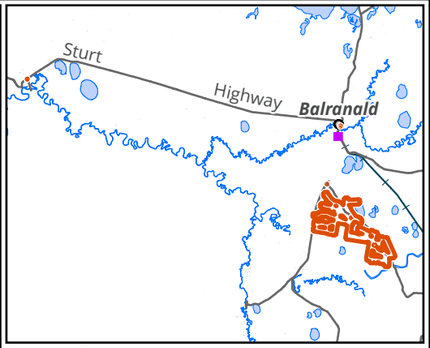
Coordinate System:
GDA2020 MGA Zone 54

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_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

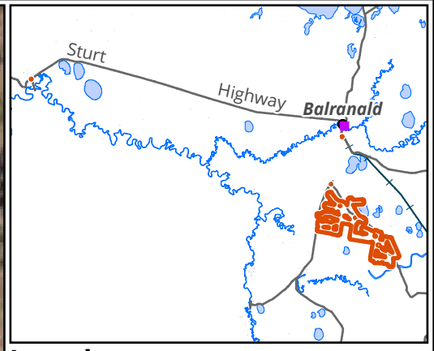
Scale: 1:2,000 @ A3

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_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

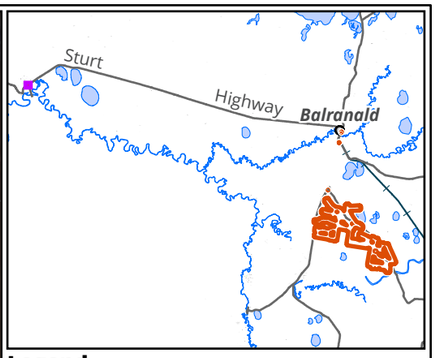
Scale: 1:2,000 @ A3

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_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

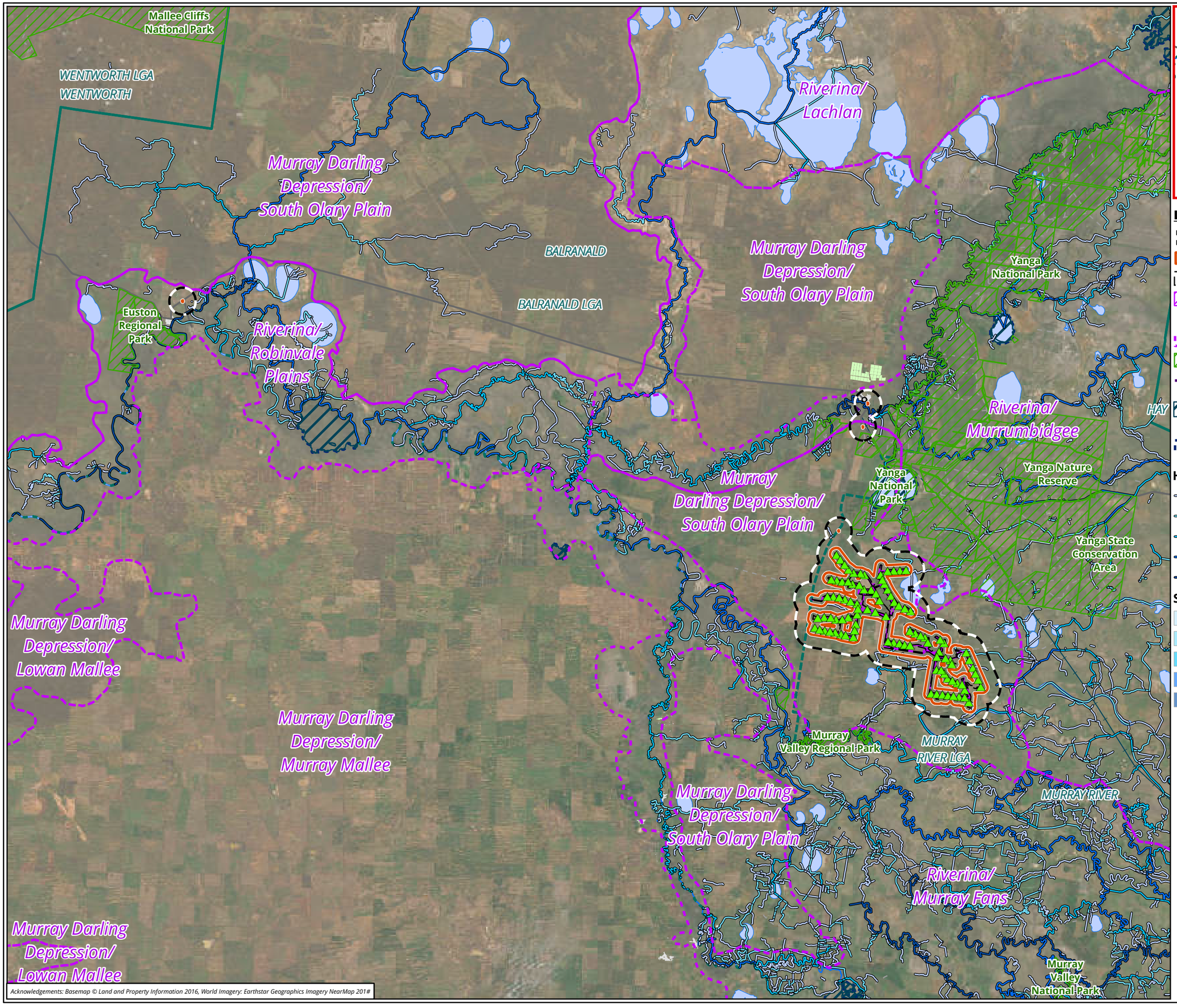
Scale: 1:2,000 @ A3

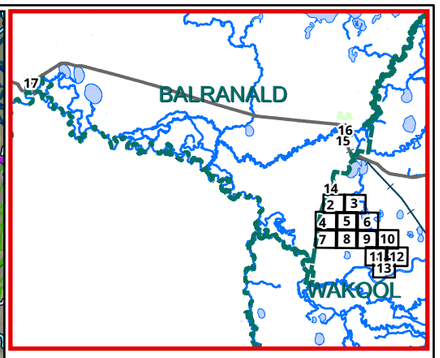
Coordinate System:
GDA2020 MGA Zone 54

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_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

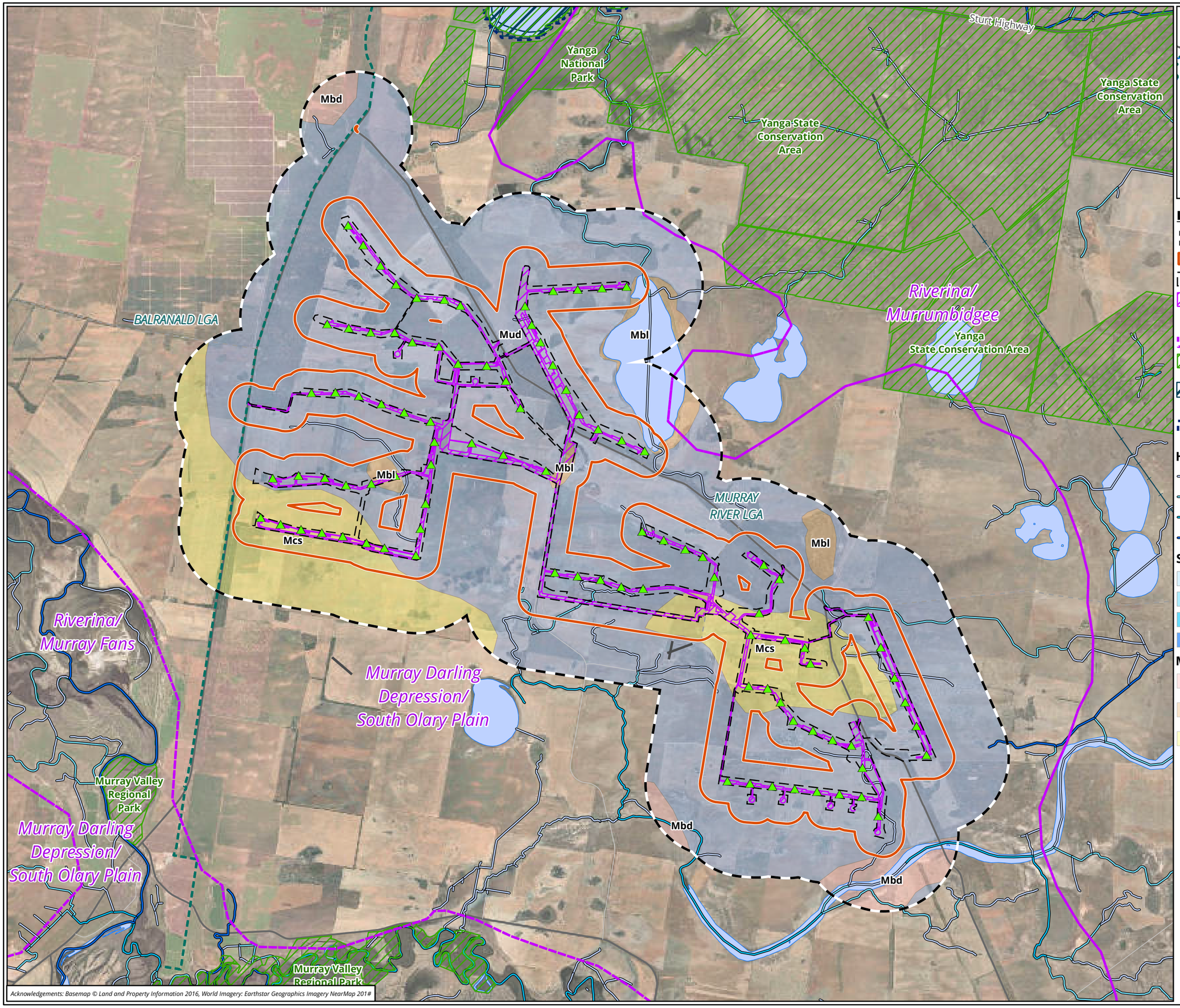
Coordinate System:
GDA2020 MGA Zone 54

N

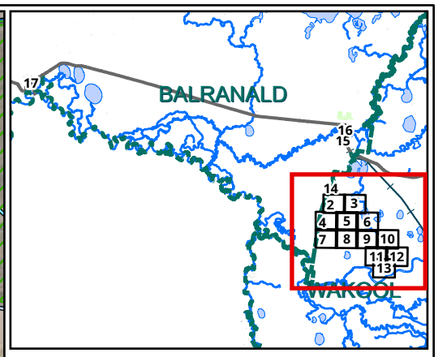
biosis

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

00



Acknowledgements: Basemap © Land and Property Information 2016, World Imagery: Earthstar Geographics Imagery NearMap 201#



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

00

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

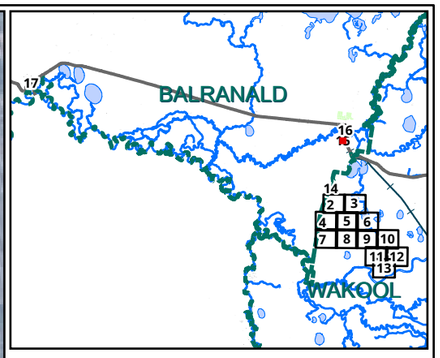
N

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

00

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

- 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

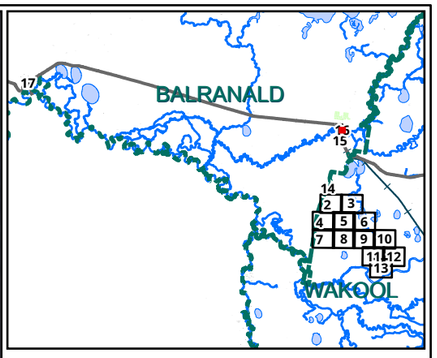
Coordinate System:
GDA2020 MGA Zone 54

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

00



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

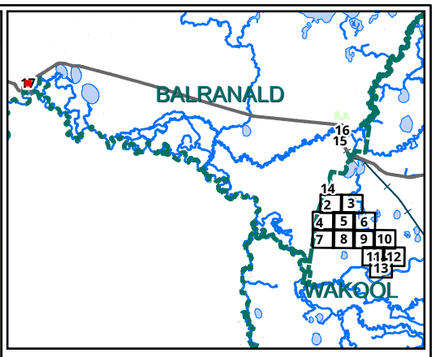
N

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

00

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

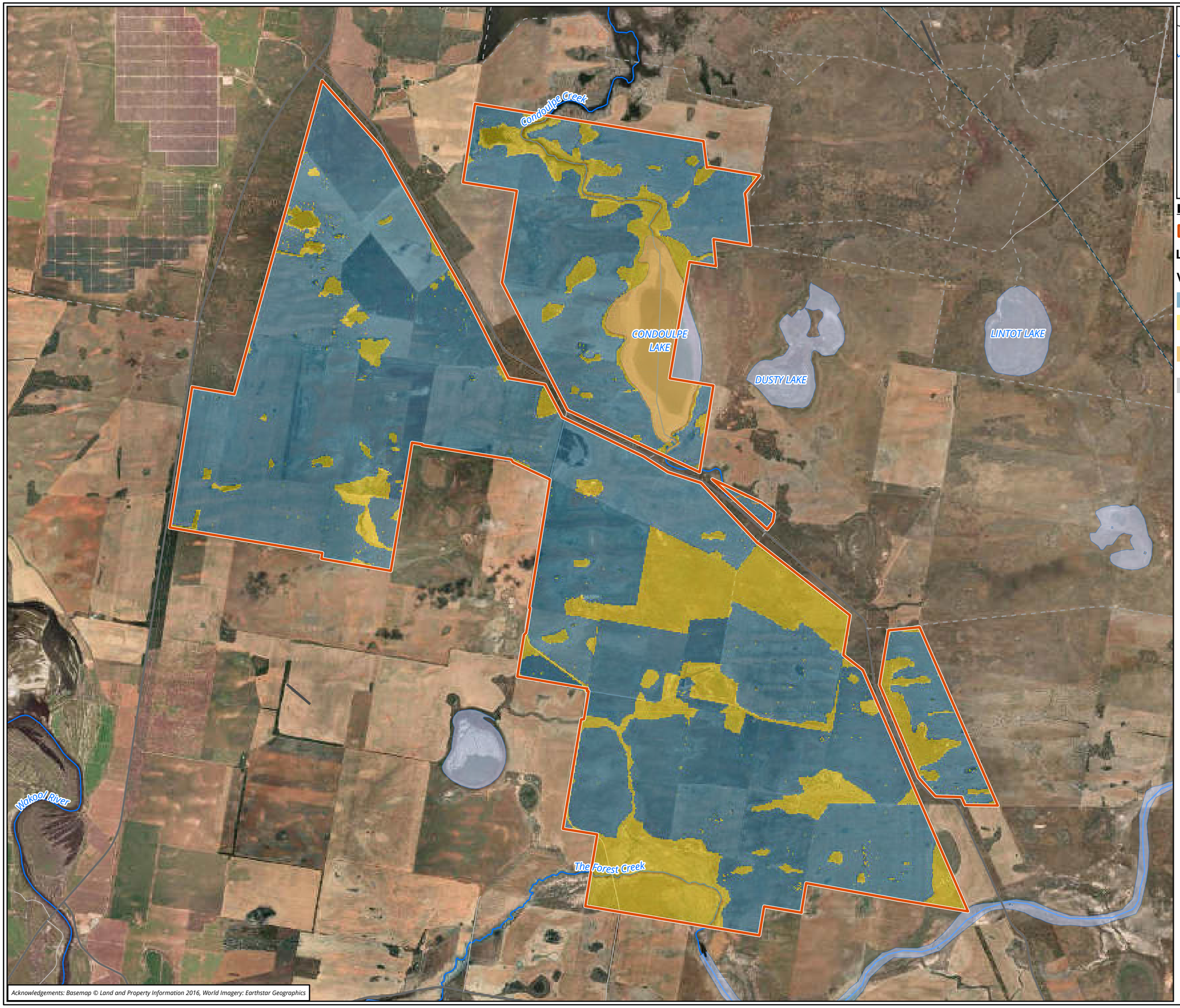
Coordinate System:
GDA2020 MGA Zone 54

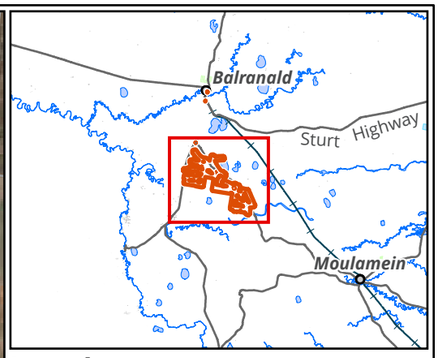
N

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

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

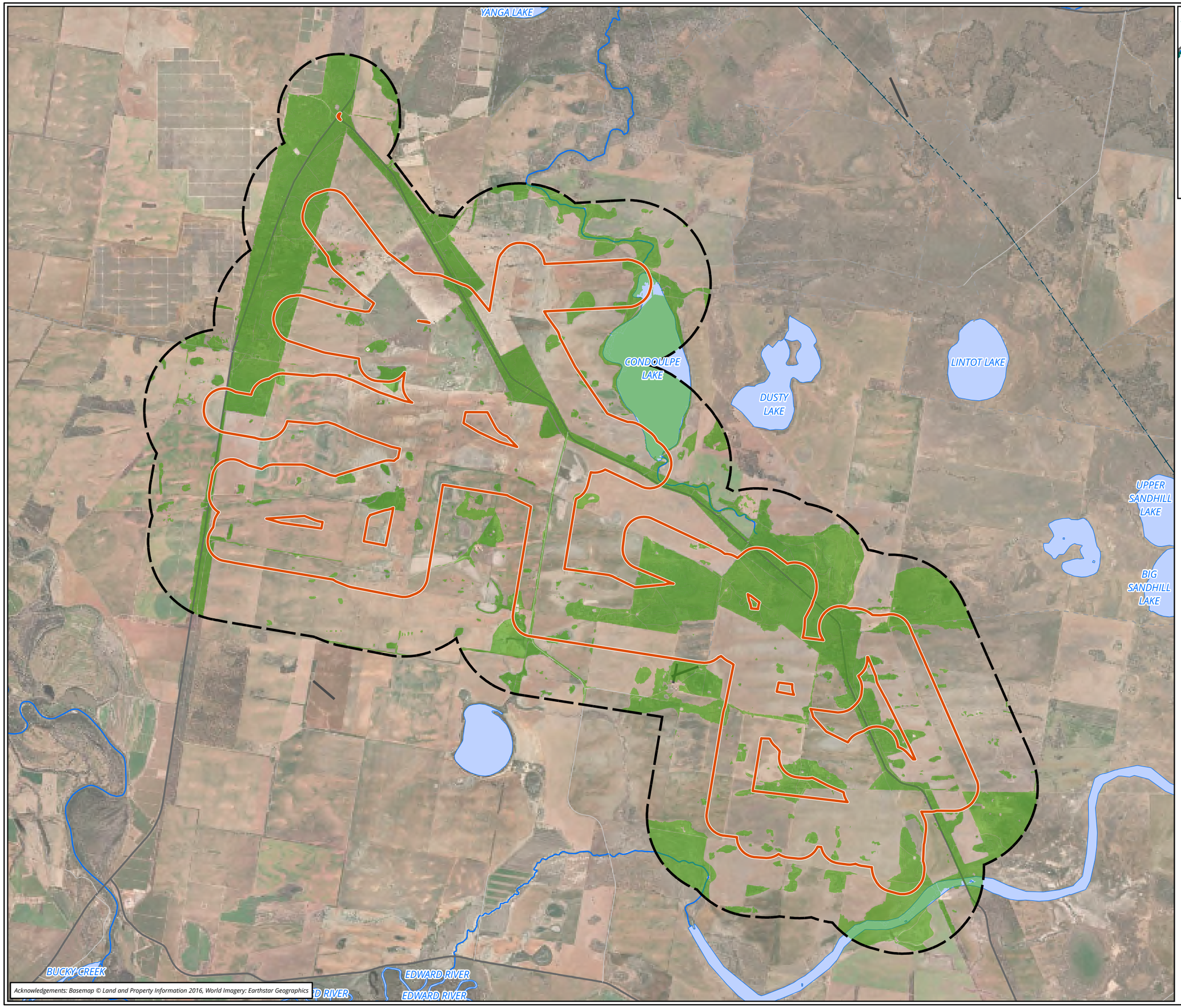
Scale: 1:80,000 @ A3

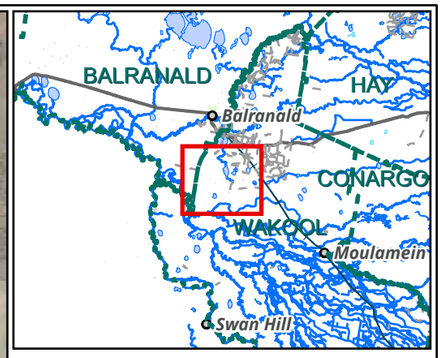
Coordinate System:
GDA 1994 MGA Zone 54

N

biosis

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

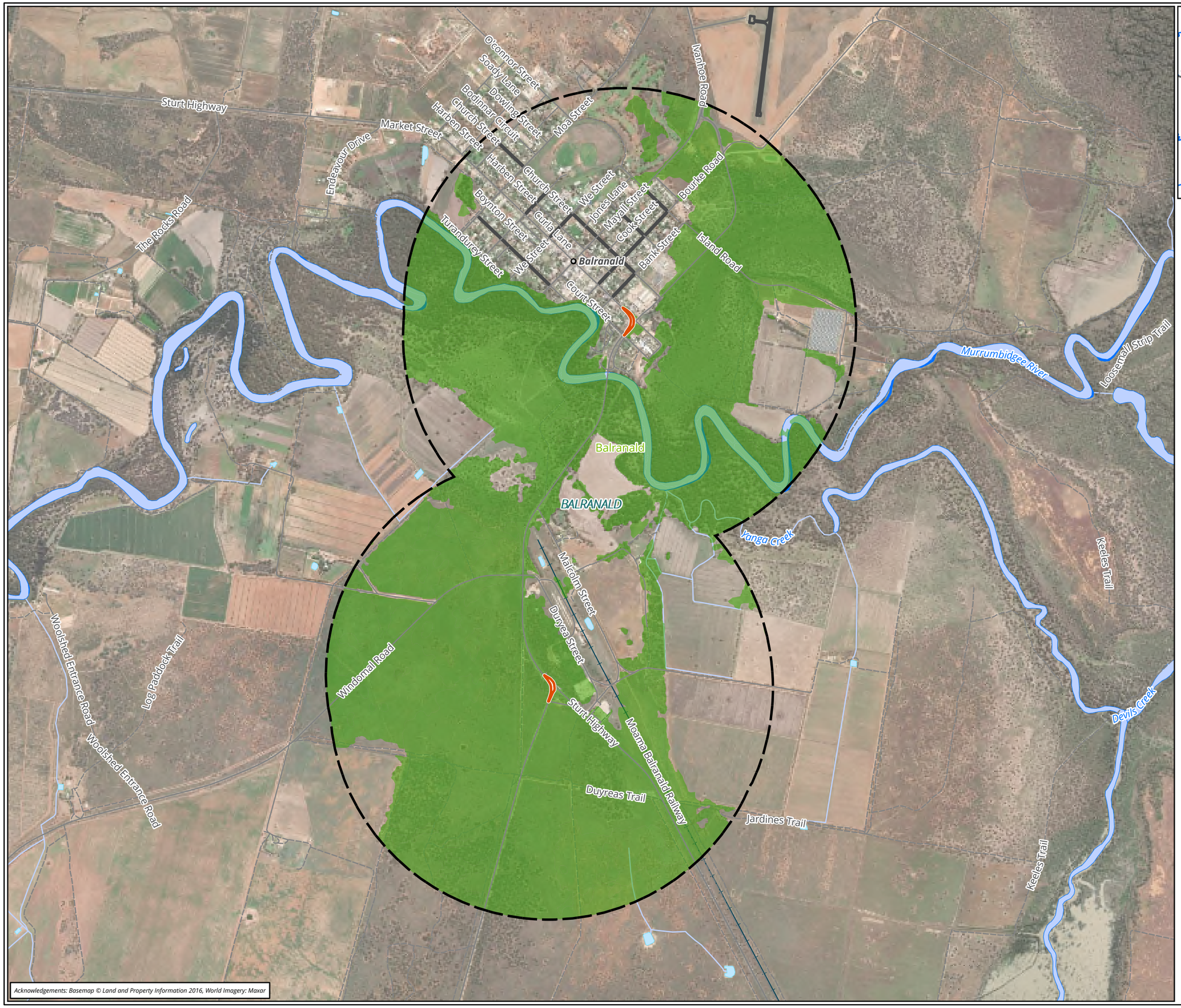
Scale: 1:88,000 @ A3

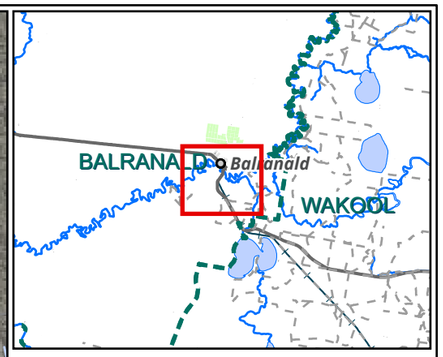
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: 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

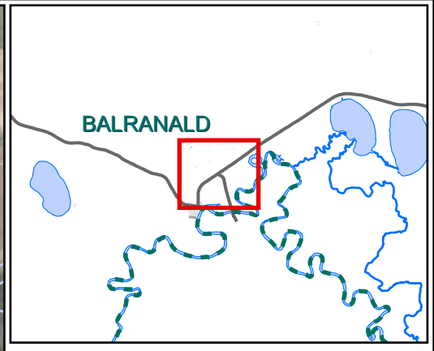
N

Scale: 1:24,000 @ A3

Coordinate System:
GDA2020 MGA Zone 54

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
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

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: 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 1.5.

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 October 2024 under the terms of Biosis' Scientific Licence issued by the EES under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2026). Fauna survey was conducted under approval CSB 17/892 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2026). 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 flora species surveys and BAM plots.
- 24 October 2022 – 27 October 2022 Threatened flora 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.
- 26 August 2024 – 30 August 2024 Targeted nocturnal bird surveys.
- 14 October 2024 – 18 October 2024 Targeted diurnal bird breeding habitat surveys.
- 28 October 2024 – 31 October 2024 Threatened flora 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.

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 5).
- PCT 21 Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion (Table 6).
- PCT 23 Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones (Table 7).
- PCT 57 Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion (Table 8).
- PCT 58 Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion (Table 9).
- PCT 163 Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones (Table 10).
- PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Table 11).

Table 5 to Table 11 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.

Table 5 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 Low – 10.72 ha DNG – 14.76 ha 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • Soil - occurs on clays and alluvial loams and clays. • Landform – occurs on alluvial plains. • 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*. 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. **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 6 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • Soil – occurs on calcareous sandy loam soils. • 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*. The PCT differs from similar PCT 22 Semi-arid shrubby Buloke - Slender Cypress Pine woodland for the following reasons: • Buloke *Allocasuarina luehmannii* is generally absent from this part of NSW • It does not comprise a shrubby understorey partly dominated by *Dodonaea viscosa* subsp. *angustissima* • It does not occur on highly calcareous soils. 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. **Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act. **Justification:** *Acacia loderi* and characteristic species of this community were not identified within this PCT. 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 7 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • Soil – occurs on red-brown, sandy-loam soils. • Dominant species – dominant shrubs layer of Yarran and herb-rich understorey including *Calotis hispidula, Einadia nutans, Minuria leptophylla, Crassula colorata* and *Goodenia fascicularis.* 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*. **Commonwealth EPBC Act:** This community is not associated with a TEC listed under the EPBC Act. **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 8 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • 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. • 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. **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 9 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 Moderate – 73.28 ha DNG – 97.72 ha 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • Soil - occurs on red to red-brown loam, sand and texture contrast soils. • Landform – occurs on level to undulating sandplains, sandy rises and interdune swales. • Dominant species – low open cover of Western Rosewood, Black Oak with either a shrubby or grassy understorey. 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). **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 10 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • Soil - occurs light grey to brown clay and loam soils. • Dominant species – dominant cover of Dillon Bush and native grasses. 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*). **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 11 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 Low - 4.08 ha

PCT 170 Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	
	DNG – 22.58 ha 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 usually about 8 m tall dominated by several mallee species including; Red Mallee *Eucalyptus socialis* and Snap and Rattle *Eucalyptus gracilis,* with White Mallee *Eucalyptus dumosa,* and *Eucalyptus oleosa* (also commonly referred to as Red Mallee) present as occasional but never dominant canopy species. 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 (PCTs 171, 172) or the mallee communities of the slightly wetter areas in the east (PCTs 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: • IBRA region and subregion – Riverina region and Murrumbidgee subregion. • Soil - occurs on calcareous red-brown, sandy-loam or loamy clay soils. • Landform – occurs on eolian sandplains or in inter-dune plains or swales. • 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. 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. **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. Further assessment is provided in Section 3.2.4 below.
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 2023b). 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 2025) 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. One EPBC Act listed TEC was given consideration (Plains Mallee Box Woodlands) but was determined as unlikely to occur within the subject land due to landscape setting, underlying geology and soils and floristics (see further discussion below). TECs are as outlined below, in Table 12 and illustrated on Figure 7

Table 12 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 • 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 • 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* (NSW Scientific Committee 2021).

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 (NSW Scientific Committee 2021):

- 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 (NSW Scientific Committee 2021), 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 (NSW DCCEEW 2025).

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 2021).

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 2021):

- 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 2021) 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.

Plains Mallee Box Woodlands

Mallee vegetation is present within the subject land and PCT 170 Chenopod sandplain mallee was assessed for its potential association with the EPBC Act listed CEEC *Plains mallee box woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions* (Plains Mallee Box woodlands). The subject land occurs adjacent to the very northern distribution of this CEEC within NSW, noted primarily as the Kyalite-Tooleybuc-Koraleigh-Speewa area, all to the south of the Edward and Wakool Rivers, with possible extensions east toward Moulamein (DAWE 2021), along the Edward River. The NSW distribution of Plains Mallee Box Woodlands CEEC is strongly associated with relatively medium-heavy textured soils on near-level to gently sloping plains typically found on ancient sedimentary deposits, often part of Quaternary alluvial and colluvial sediments, with influences from underlying sandstone or siltstone formations (DAWE 2021). These more fertile parts of the mallee region in NSW have been heavily cleared for dryland cropping and agricultural development.

The subject land supports mallee vegetation formations and occurs within the Murray Darling Depression IBRA bioregion, receives on average between 260 millimetres and 450 millimetres of rainfall per year, and is in a semi-arid landscape with undulating sandplains, peneplains and some level more fertile plains. As such the TEC has the potential to occur.

The primary diagnostic species of Plains Mallee Box Woodlands are Black Mallee Box *Eucalyptus porosa* or Bull Mallee *Eucalyptus behriana*. With Black Mallee Box generally occurring in the western part of the TEC's range. These species were not identified within PCT 170 within the subject land. White Mallee *Eucalyptus dumosa* is noted within the Approved Conservation Advice as a possible structural dominant in some areas where mallee stands share landscape setting, understorey and other characteristics that are consistent with the ecological community. The Approved Conservation Advice notes dominance of White Mallee as 'variant 3' and absence of *Eucalyptus porosa* and *Eucalyptus behriana* as an example of variations in structure of this TEC (DAWE 2021).

As outline in the Approved Conservation Advice for the CEEC, in order to be protected as a matter of national environmental significance, areas of the ecological community must meet both:

- The key diagnostic characteristics.
- At least the minimum condition thresholds.

An assessment of the mallee vegetation patches with potential to be the CEEC within the subject land is presented in Table 13 to Table 15 below.

Table 13 Key diagnostic characteristics for the EPBC Act listed TEC (DAWE 2021)

Key diagnostic characteristics	Justification
Occurs in New South Wales, Victoria and South Australia, within Murray Darling Depression, Riverina and Naracoorte Coastal Plain IBRA Bioregions.	• The subject land occurs within the Murray Darling Depression IBRA Bioregion at the extreme eastern outliers of this bioregion.
Within these bioregions, the ecological community typically occurs on near-level plains or occasionally on gently sloping terrain surrounding and within run-on landscape depressions. Soils are variable but are typically duplex, with clay loam or occasionally sandy clay loam topsoil textures mostly of aeolian origin, above deep fine textured clay subsoils.	• The subject land is a mosaic of mallee sand dune systems and some run-on areas with more fertile soil that has been cleared and cropped. Run-on landscape depressions and mallee sand dune systems differ in hydrology, topography and soil composition. Run-on depressions are low-lying areas that collect water and sediments, creating moisture-rich environments with finer clay or loamy soils. Common examples of run-on landscapes include gilgai depressions in vertosol soils, swales between dunes and claypans on floodplains. In contrast, mallee sand dune systems are elevated landforms shaped by wind, with coarse, well-drained sandy soils that allow water to run off quickly, resulting in drier conditions. This difference in landscape setting, combined with structurally dominant mallee eucalypts and understory floristics, is critical in separating the CEEC from more common and widespread mallee vegetation. Refer to Plate 1 for landscape settings in the subject land. • The parts of the subject land where larger remnants of PCT 170 occur are mostly associated with mallee dune systems. Run-on areas and more fertile moisture retaining soils have been cleared for cropping but still retain smaller degraded patches of mallee vegetation. Refer to Plate 1.
The primary diagnostic species particular to this community are the dominance of the box- barked eucalypt species *Eucalyptus porosa* (Black mallee box) or *E. behriana*	• White Mallee *E. dumosa* is present within the subject land, however the species is not considered dominant in mallee vegetation.

Key diagnostic characteristics	Justification
(Bull mallee, Broad-leaved mallee box). However, *E. calycogona* (Square-fruited mallee), or *E. dumosa* (White mallee) may be dominant in some areas where the understorey characteristics are consistent with those described below, and landscape features are consistent with those described above.	• Red Mallee *Eucalyptus socialis* and Snap and Rattle *Eucalyptus gracilis* dominate the majority of patches of PCT 170 Chenopod sandplain mallee, however White Mallee is the dominant species in a low proportion of patches on the community. • Patches of PCT 170 dominated by White Mallee have been conservatively considered to meet this key diagnostic characteristic and are further assessed below.
The mature tree canopy is usually 5-10 m tall, occasionally to around 15 m, with a sparse to open tree layer. Tree canopy cover is typically 10-15%.	• PCT 170 supporting White Mallee was sampled at four locations within the subject land in accordance with the BAM. • BAM plots collected show tree canopy cover ranges from 10 % to 40 % in these patches. • All patches are isolated and degraded. • The patch supporting 10 % covers relates to no more than a single scattered tree, with the other patches ranging from 25 % to 40 % canopy cover. Notably higher than the required key diagnostic characteristic.
A small tree and/or large shrub layer may be present, but is typically very sparse with < 5% cover and a height range of 3-5 m. A medium shrub layer 1-3 m tall may also be present with typically very sparse cover < 10%.	• Small trees and/or medium to large shrubs are present at low cover, ranging from 0.8 % to 5.4 % cover.
A distinctive low to decumbent chenopod sub-shrub layer can be a key feature in many occurrences.	• A decumbent chenopod sub-shrub layer is present within the patches.
The ground layer may be dominated by tussock grasses, which is most conspicuous after rains, but may be inconspicuous depending on drought conditions, livestock grazing or other ground disturbance.	• Grasses do not dominate any patches, with grass species absent from two of the four patches sampled, and just 3.5 % and 0.5 % grass cover recorded across the remaining two patches. • Grasses were recorded commonly elsewhere within the subject land, and are considered to dominate many other areas where soils retain moisture and support higher fertility.
Triodia spp. (spinifex) are typically absent from the ground layer and never dominant.	• *Triodia* spp. were recorded very rarely within the subject land, and not within the patches of the potential CEEC.

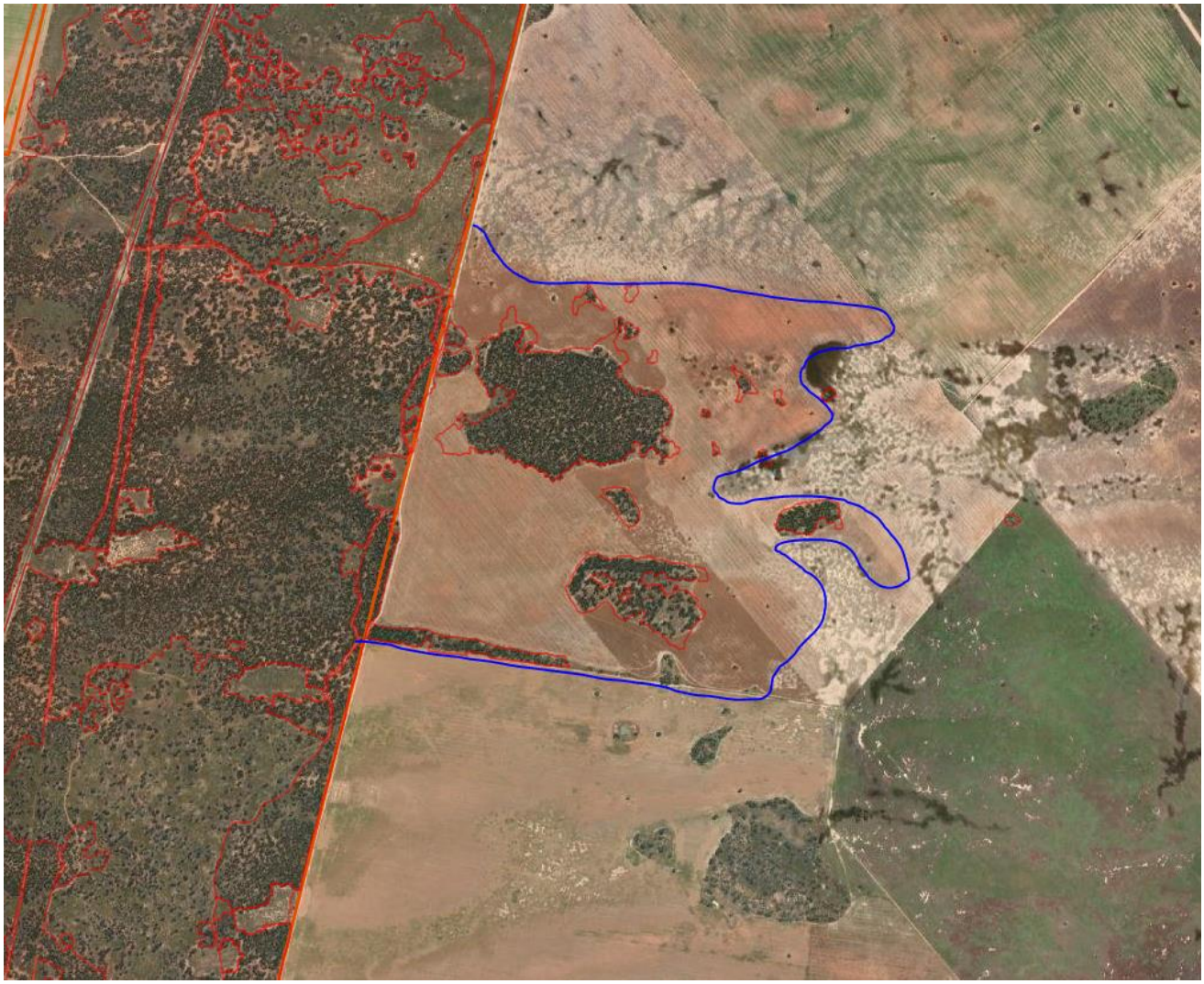


Plate 1 **Mallee dune systems with well-drained poor fertility red sandy soils (outlined in blue) supporting PCT 170 (red polygons) on the western side of the subject land adjacent to Yanga Way. Run-on areas to the east (right of image) have been cleared for cropping and support very small degraded patches of PCT 170 and remnant patches of PCT 16 Black Box grassy open woodland wetland of rarely flooded depressions. This is the typical pattern of mallee vegetation occurrence in the subject land.**

The patches of PCT 170 where White Mallee was recorded, and hence are considered potential occurrences of Plains mallee box woodlands CEEC, are not considered strong matches for the above key diagnostic characteristic. It is noted in the Approved Conservation Advice that the listed ecological community is defined as patches of native vegetation that meet all of the listed key diagnostic characteristics. The community within the subject land does not match the listed requirements for a combination of landscape setting, canopy cover or supporting a ground layer dominated by tussock grasses, however further assessment against the listed *Condition classes and thresholds* is provided below.

Table 14 below provides a summary of the potential condition classes and associated thresholds for the EPBC Act listed community, noting that only Condition Classes A and B equate to listed community (DAWE 2021).

Table 14 Plains mallee box woodlands CEEC condition classes

Condition class	Patch condition or context indicators	Minimum patch size	Listing status (DAWE 2021, s5.2)
Class A – high quality Patches with close to or above a benchmark level for most measures	• Sites with 3 or more indicators rated as Category 3	• 0.5 ha	• Conforms to the listed community
Class B – moderate quality Patches approaching a benchmark level for most measures	• Sites not meeting Class A and with 3 or more indicators rated as Category 2 or 3	• 2 ha	• Conforms to the listed community
Class C – poor quality Patches with somewhat less than a benchmark level for most measures	• Sites with less than 3 indicators rated as Category 2 or 3	• n/a	• Does not conform to the listed community

A patch is defined as a discrete and mostly continuous area of the ecological community, as described by the key diagnostics, but can include small-scale variations, gaps and disturbances (made for "breaks" up to 30 metres) within this area.

Table 15 Plains mallee box woodlands CEEC condition classes and thresholds and indictors

Condition classes and thresholds and indictors				Biosis patches (refer to BAM plot numbers on Figure 9)			
	Category 1	Category 2	Category 3	B38	B44	B909	B913*
Patch size	-	-	-	0.39 ha	2.60 ha However White Mallee is not dominant and comprises 5% of total 40% canopy cover	0.50 ha (approx.) Within low condition vegetation with 80 – 150 m separation to the next nearest trees	0.03 ha
Patch condition indicators				**Assessed values**			
Large Trees *Number/ha*	Largely absent: <5/ha	Few: 5-15/ha	Many: ≥15/ha	**Category 1** 1 / 0.1 ha plot	**Category 3** 5 / 0.1 ha plot Noting only 13% of total canopy cover is comprised of White Mallee	**Category 1** 0 / 0.1 ha plot	**Category 1** 0 / 0.1 ha plot
Tree canopy cover *% cover*	Absent: <1% canopy cover	Scattered and sparse: 1% - 5% canopy cover	Complete: >5% canopy cover	**Category 3** 30 % tree cover	**Category 3** 40 % tree cover Noting only 5% cover is comprised of White Mallee	**Category 3** 10 % tree cover Noting 10 % cover relates to a single scattered tree in the 0.04 ha plot, actual cover of patch likely to be 1% - 5% cover	**Category 3** 25 % tree cover
Understorey *Number of major life forms present*	Largely absent: <5 life forms present	Limited structural diversity: 5-8 life forms present	Obvious structural diversity: ≥9 life forms present	**Category 2** 5 life forms present	**Category 2** 5 life forms present	**Category 2** 6 life forms present	**Category 2** 6 life forms present

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Condition classes and thresholds and indictors				Biosis patches (refer to BAM plot numbers on Figure 9)			
	Category 1	**Category 2**	**Category 3**	**B38**	**B44**	**B909**	**B913***
Recruitment *Proportion of species showing adequate recruitment*	Absent: <30% of species showing adequate recruitment	Uncommon: 30% - 70% of species showing adequate recruitment	Common: ≥70% of species showing adequate recruitment	**Category 1** Whilst this data was not specifically captured no canopy regeneration was recorded, and due to the heavily weed infested nature of the patch, >30% species requirement is highly unlikely.	**Category 1** As adjacent	**Category 1** As adjacent	**Category 2** Conservatively assumed based on low weed cover, noting no canopy regeneration was present.
Organic litter *% cover*	Absent or <1% cover	Low cover: 1%-5% cover	Expected cover: >5% cover	**Category 3** >5 % cover	**Category 3** >5 % cover	**Category 3** >5 % cover	**Category 3** >5 % cover
Logs / Woody debris *m/0.1 ha*	Absent: <50cm/0.1 ha	Uncommon: 50cm-2.5m/0.1 ha	Expected amount: >2.5m/0.1 ha	**Category 3** >2.5 m / 0.1 ha	**Category 3** >2.5 m / 0.1 ha	**Category 2** 50 cm - 2.5 m / 0.1 ha	**Category 2** 50 cm - 2.5 m / 0.1 ha
Weediness *% exotic cover*	Visually dominated by exotics: >50% cover	Easily observed exotics: 10% to 50% cover	Rarely observed exotics: <10% cover	**Category 1** >50 % exotic cover	**Category 1** >50 % exotic cover	**Category 1** >50 % exotic cover	**Category 2** 10-50 % exotic cover
Patch context indicators							
Connectivity *Contiguous with other native vegetation*	Not contiguous with other native vegetation	Contiguous with areas of native vegetation totalling ≥5 ha	Contiguous with areas of native vegetation totalling ≥10 ha	**Category 1** Contiguous with native vegetation totalling <5ha	**Category 1** Not contiguous with other native vegetation	**Category 1** Contiguous with native vegetation totalling <5ha	**Category 1** Not contiguous with other native vegetation
Presence of flora and fauna species listed under state or national env. law	None recorded.	1-3 listed flora or fauna species	≥4 listed flora or fauna species	**Category 1** No listed species recorded in patch	**Category 1** No listed species recorded in patch	**Category 1** No listed species recorded in patch	**Category 1** No listed species recorded in patch

Condition classes and thresholds and indictors			Biosis patches (refer to BAM plot numbers on Figure 9)			
Category 1	Category 2	Category 3	B38	B44	B909	B913*
Assessment conclusions						
Number of Category 1 indicators			**5**	**4**	**5**	**3**
Number of Category 2 indicators			**1**	**1**	**2**	**4**
Number of Category 3 indicators			**3**	**4**	**2**	**2**
			Not the listed community – Does not meet minimum patch size and number of Category 2 and 3 indicators	**Not the listed community** – White Mallee is not dominant and thus does not meet the key diagnostic characteristics	**Not the listed community** – Does not meet minimum patch size and number of Category 2 and 3 indicators	**Not the listed community** – Does not meet minimum patch size and number of Category 2 and 3 indicators

***Patch B913 comprises a vegetation zone not impacted by the project, and as such as not presented on Figure 9. This vegetation zone has been termed 'PCT 170_Paddock trees', and represents small patches of PCT 170 vegetation that do not meet the definition of 'Scattered paddock trees' under the BAM. Further information is provided in Section 3.3.4 and Appendix 7.**

Photos of each patch of potential Plains Mallee Box woodlands CEEC, assessed in accordance with the BAM and EPBC Act listing requirements, are provided below.

Photo 1 **Patch B38. Not the listed community – Does not meet minimum patch size and number of Category 2 and 3 indicators**

Photo 2 **Patch B44. Not the listed community – White Mallee (5 % of total 40 % canopy cover) is not dominant and thus does not meet the key diagnostic characteristics**

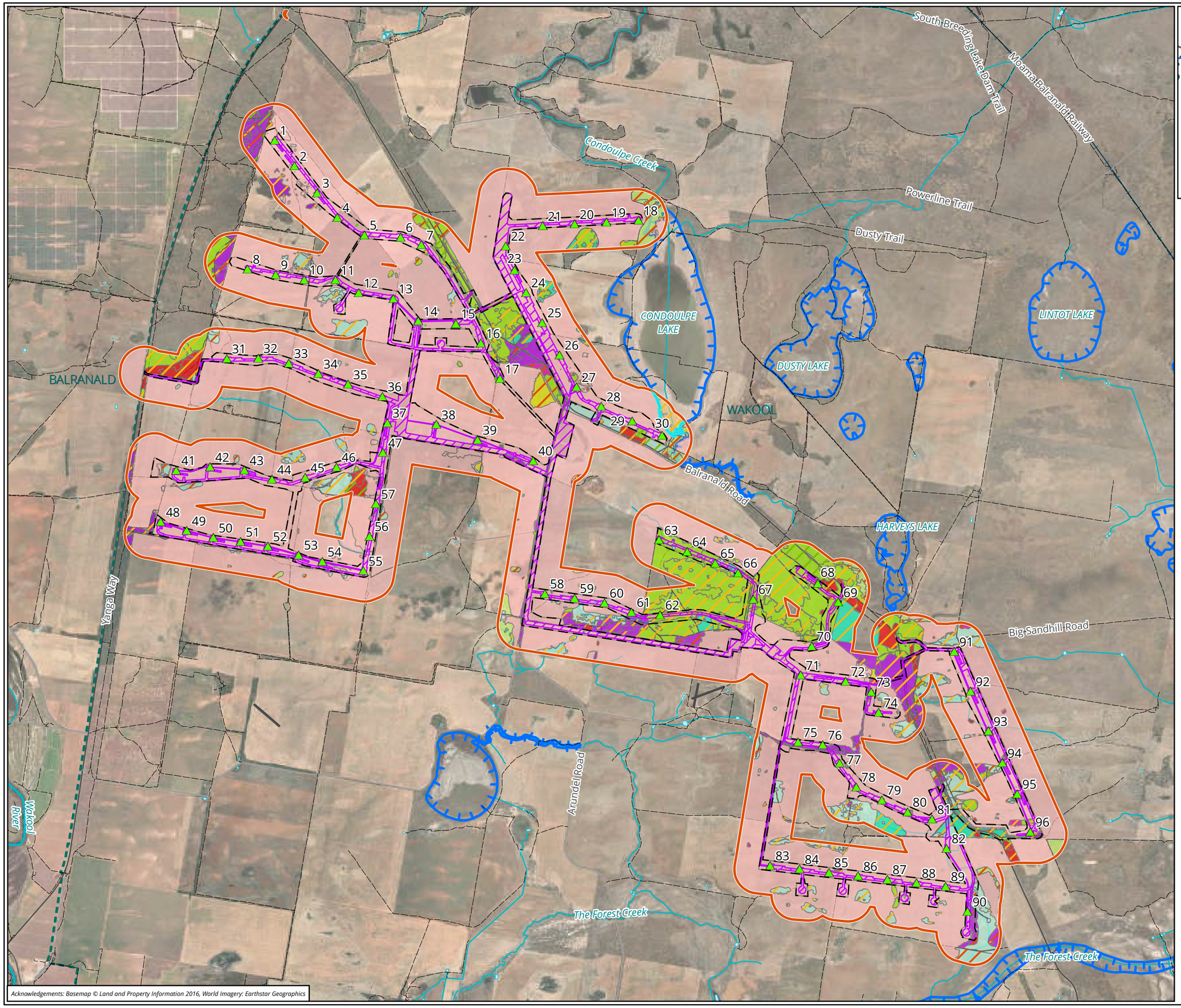
Photo 3 **Patch B909 (facing south). Not the listed community – Does not meet minimum patch size and number of Category 2 and 3 indicators**

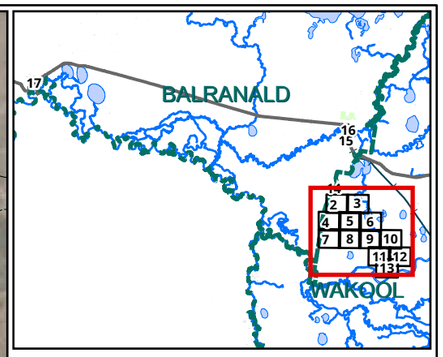
Photo 4 **Patch B909 (facing north). Not the listed community – Does not meet minimum patch size and number of Category 2 and 3 indicators**

Photo 5 **Patch B913. Not the listed community – Does not meet minimum patch size and number of Category 2 and 3 indicators**

Photo 6 **Patch B913. Not the listed community – Does not meet minimum patch size and number of Category 2 and 3 indicators**

It should also be noted that six White Mallee trees, conforming to the BAM definition of Scattered Paddock Trees (refer Section 3.3.4 and Appendix 7), will be impacted by the project (refer Table A 31, Appendix 7). These trees have been assessed as, at best, meeting the condition class requirements for *Class C – poor quality*, and therefore do not conform to the EPBC Act listing requirements (DAWE 2021).





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

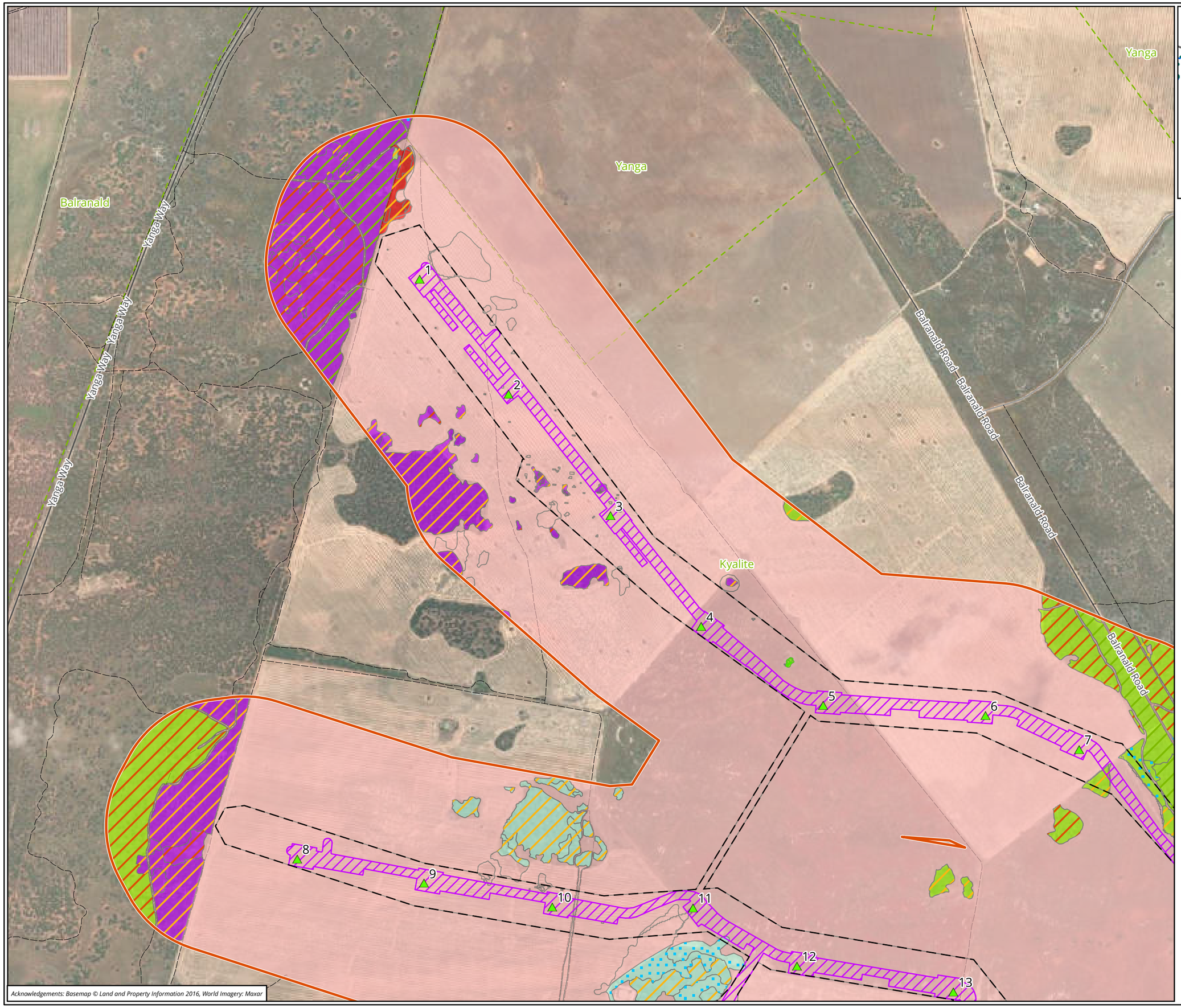
Coordinate System: GDA2020 MGA Zone 54

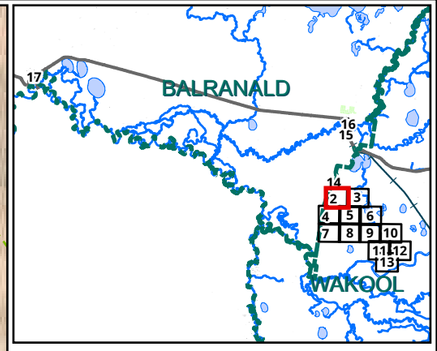
N

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

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





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

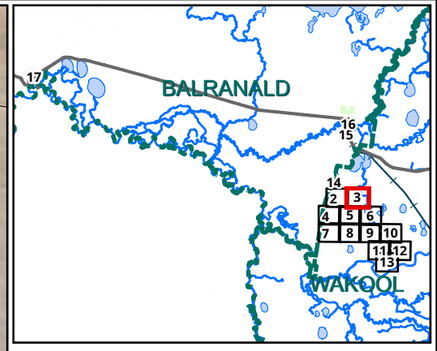
Scale: 1:16,000 @ A3

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_F6_BiosisVeg



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

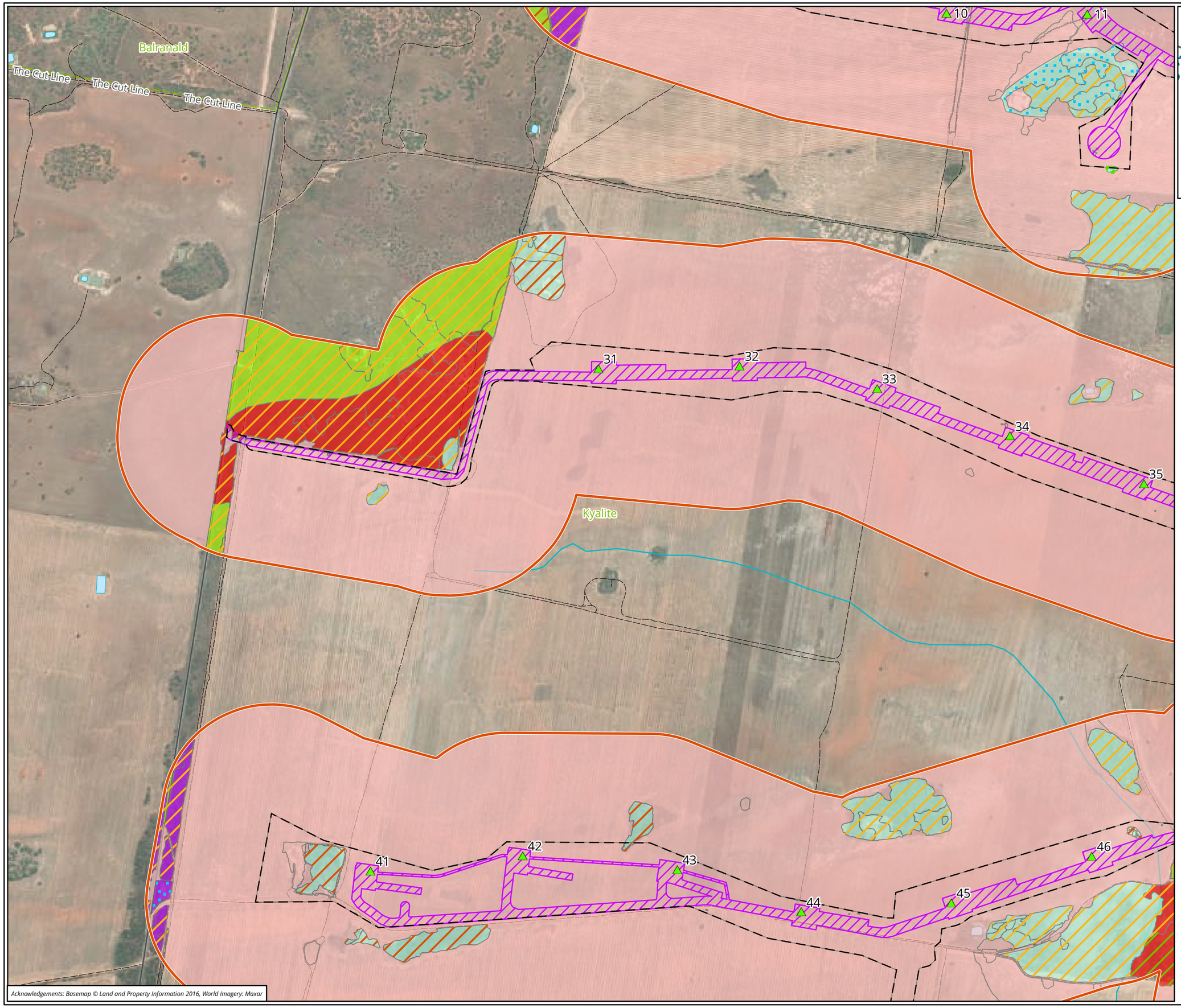
Scale: 1:16,000 @ A3

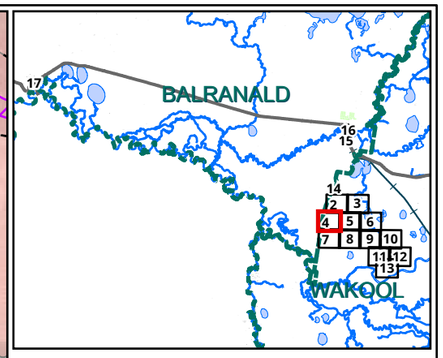
Coordinate System: GDA2020 MGA Zone 54

biosis

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

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





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

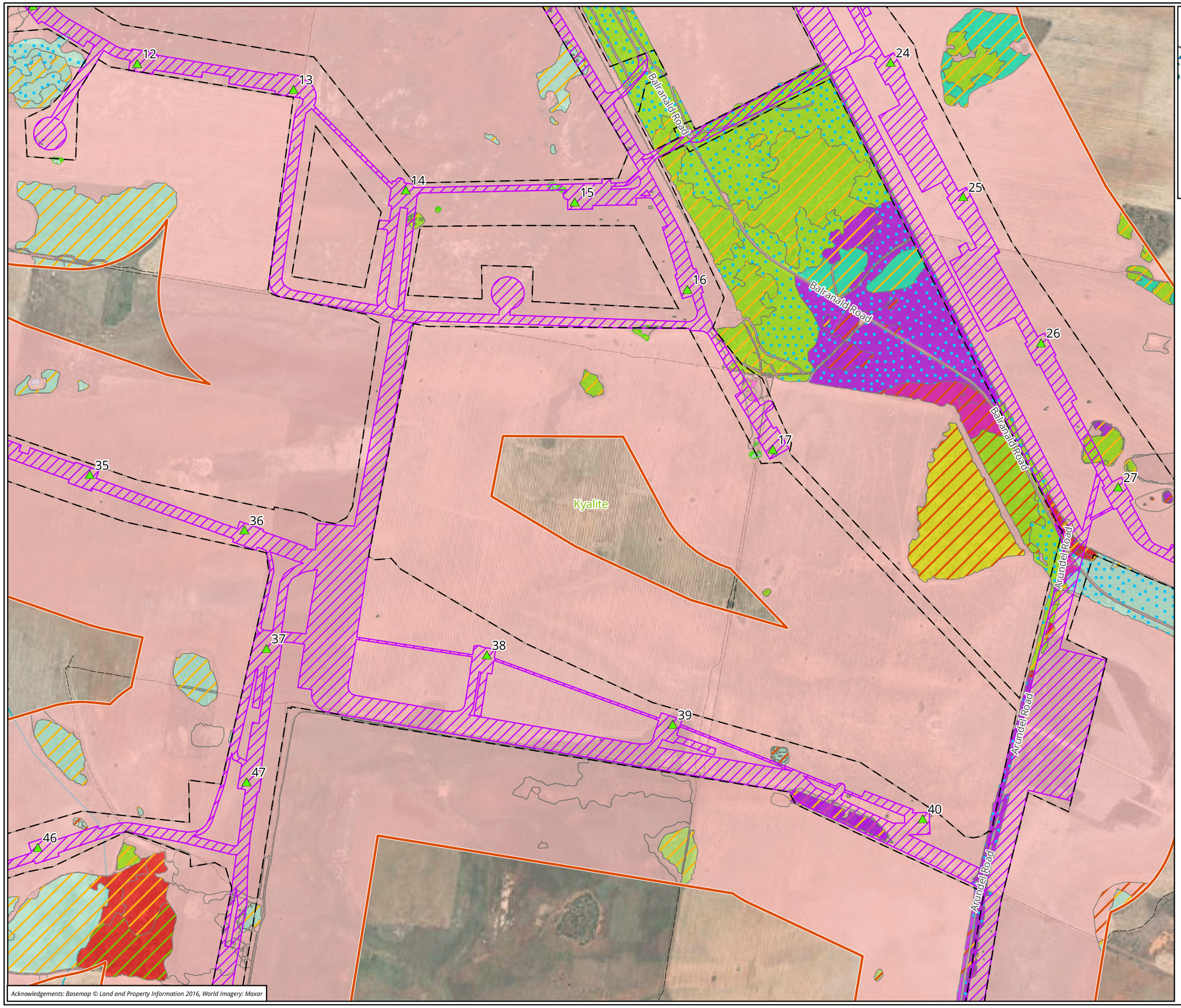
Coordinate System: GDA2020 MGA Zone 54

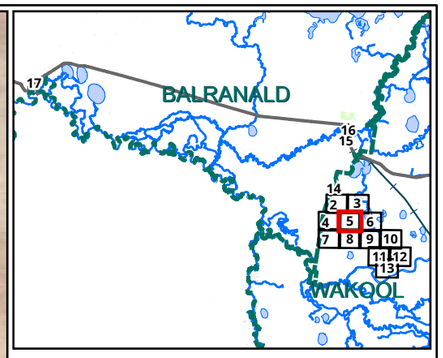
N

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

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





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

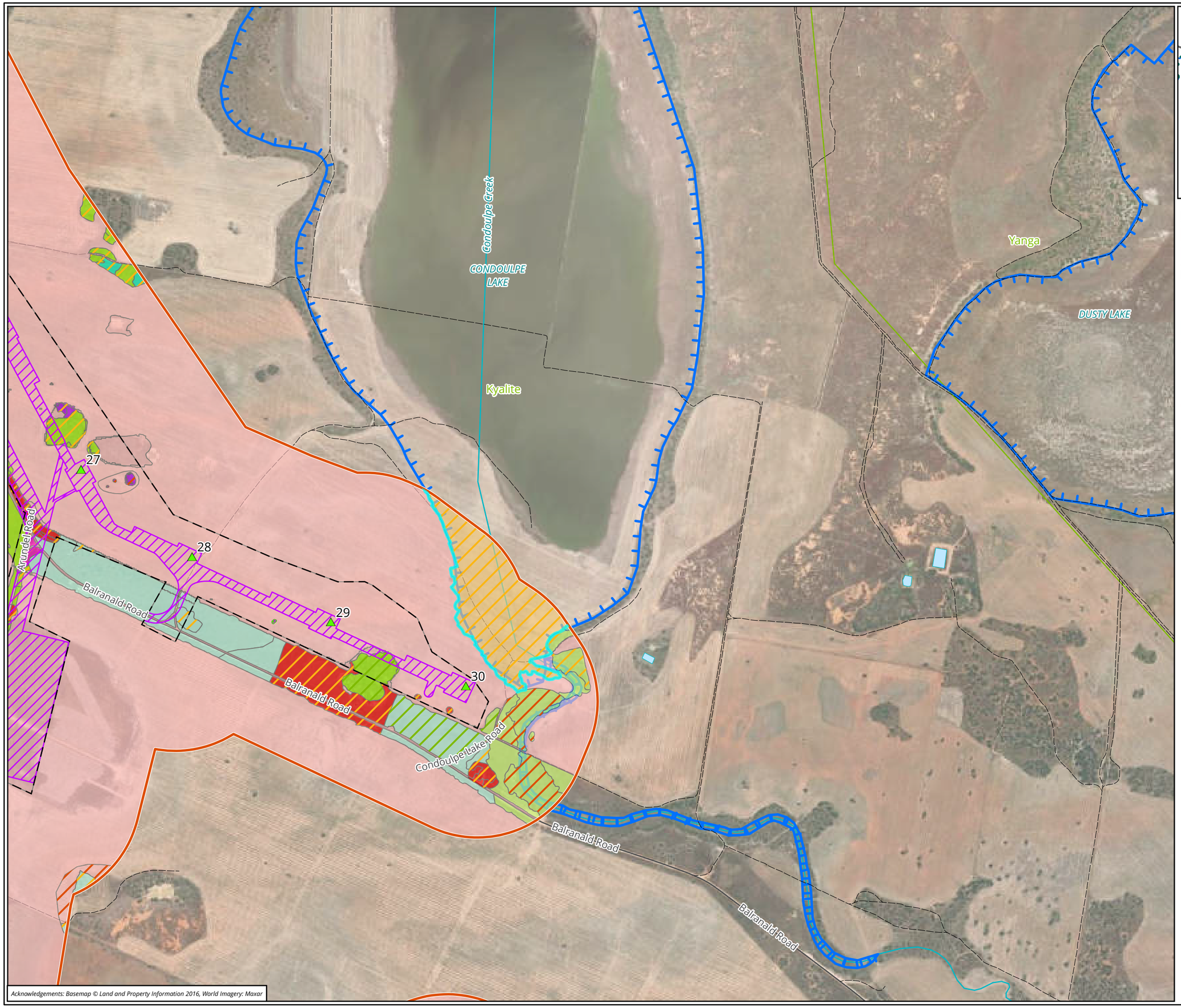
Scale: 1:16,000 @ A3

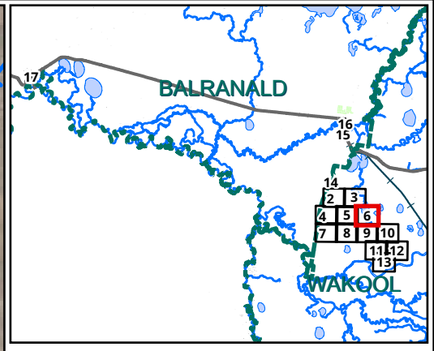
Coordinate System: GDA2020 MGA Zone 54

biosis

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

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





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

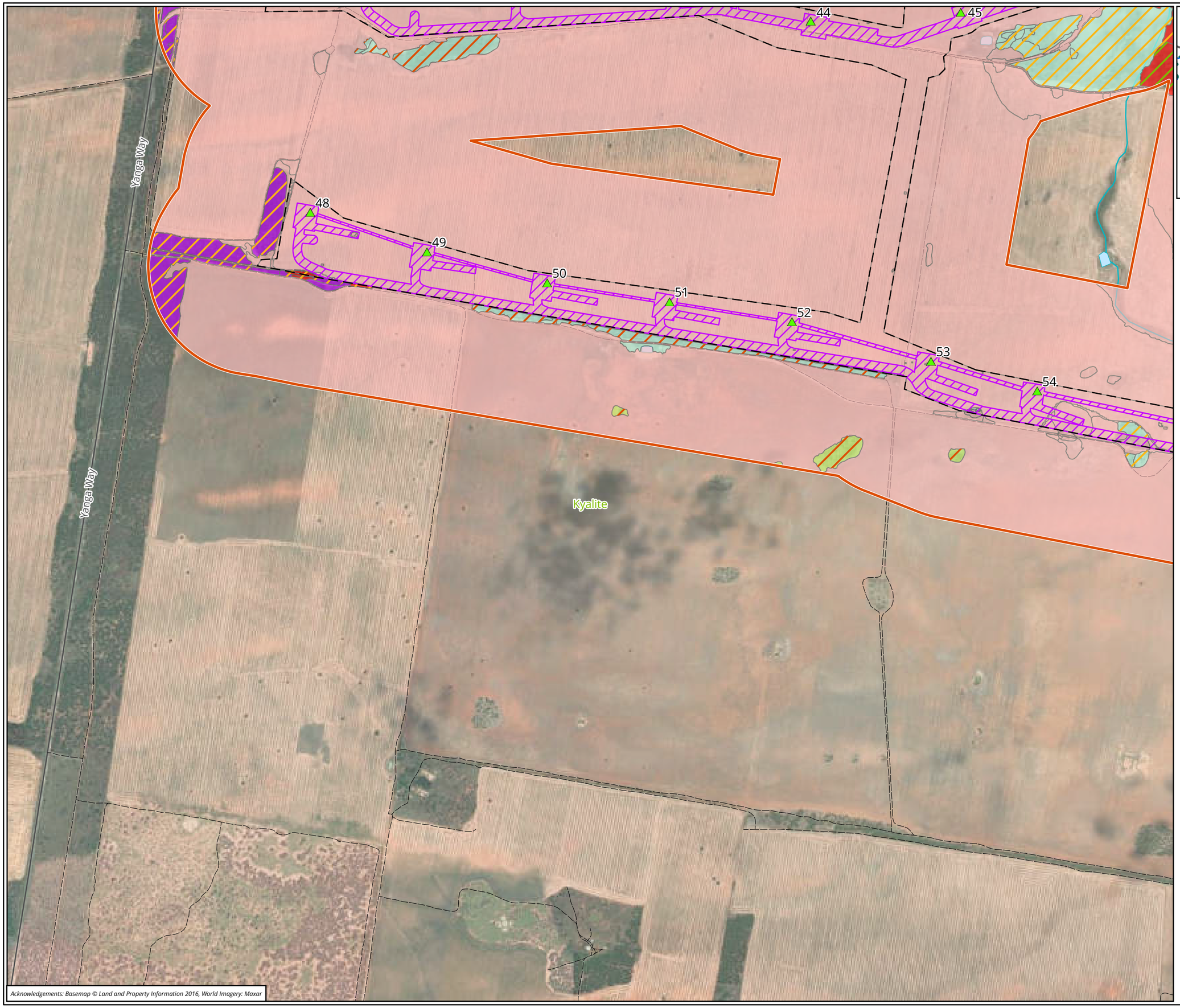
Coordinate System: GDA2020 MGA Zone 54

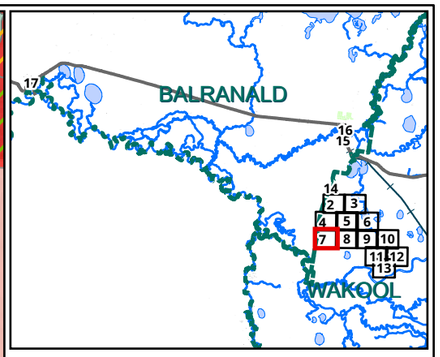
N

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

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





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

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

Figure 6.7 Vegetation within the subject land

0 170 340 510 680

Meters

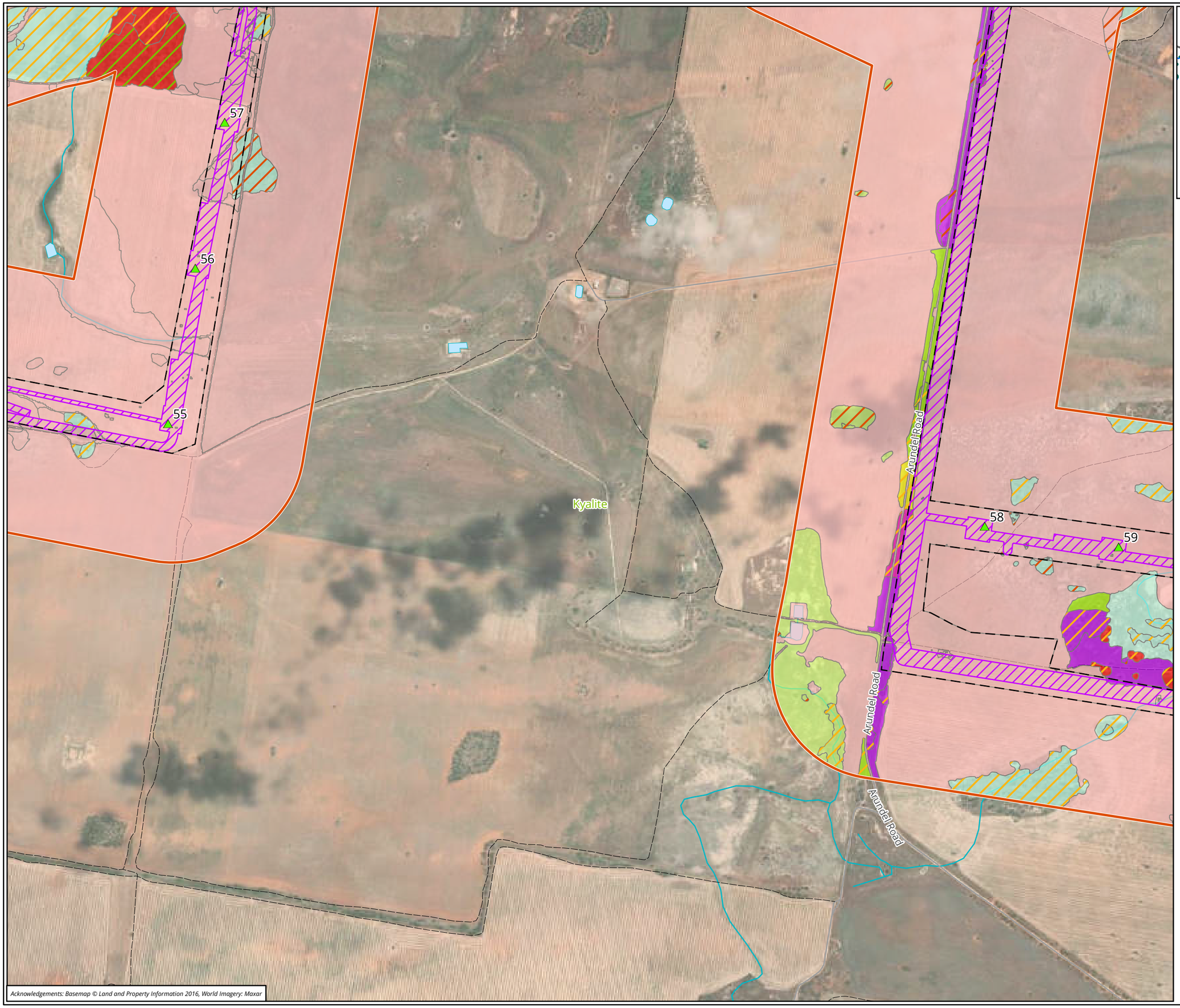
Scale: 1:16,000 @ A3

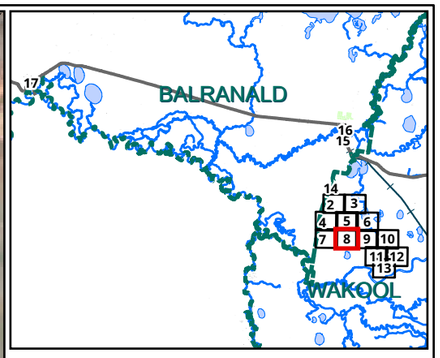
Coordinate System:
GDA2020 MGA Zone 54

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_F6_BiosisVeg





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

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

Figure 6.8 Vegetation within the subject land

0 170 340 510 680

Meters

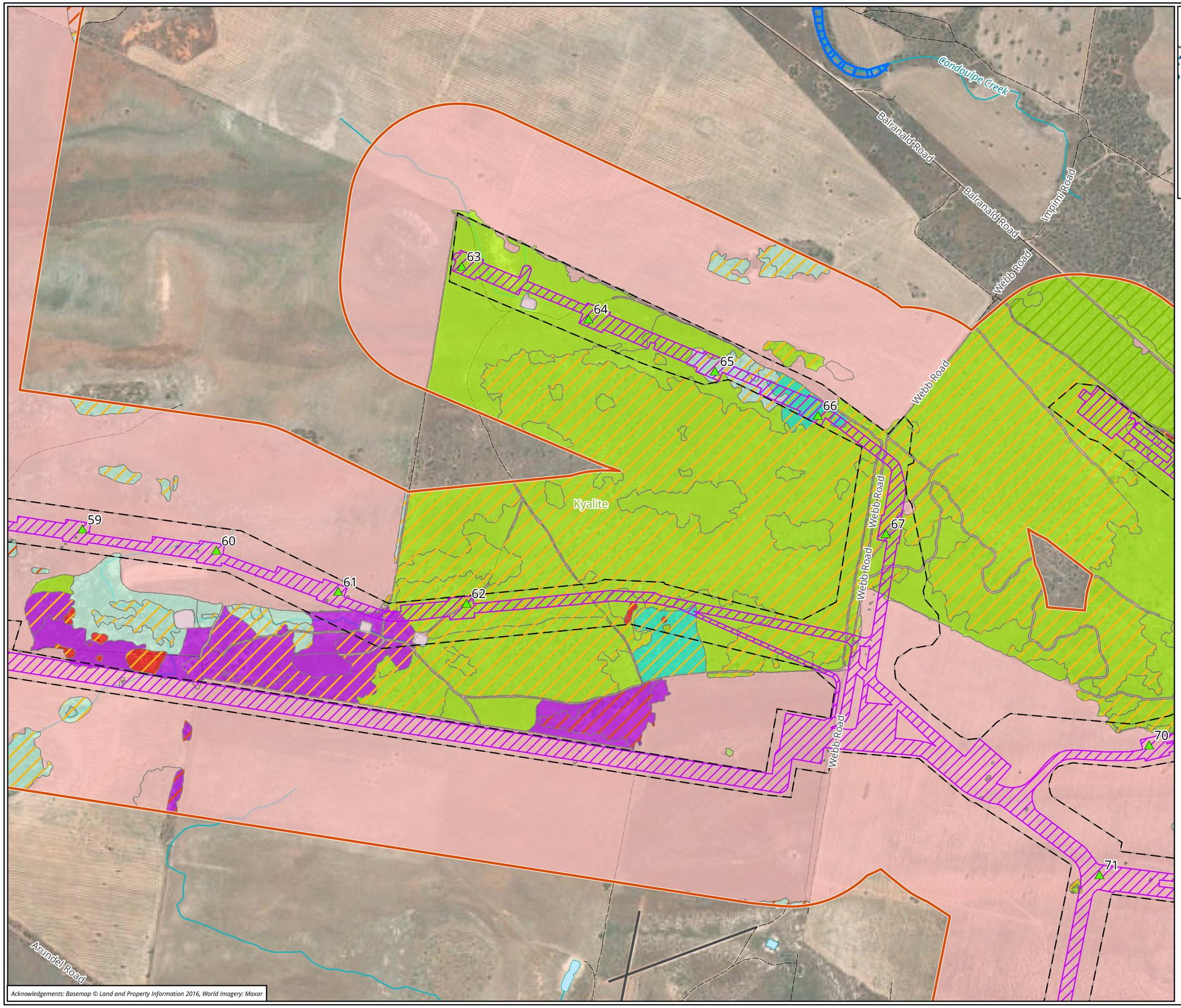
N

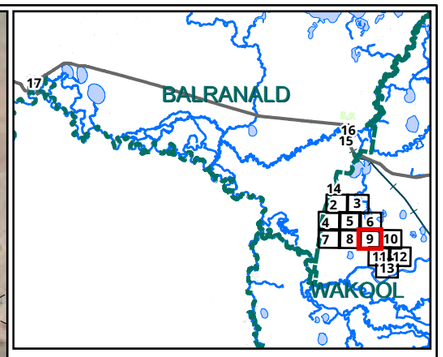
Scale: 1:16,000 @ A3

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 1-10.aprx
Layout: 37502_F6_BiosisVeg





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

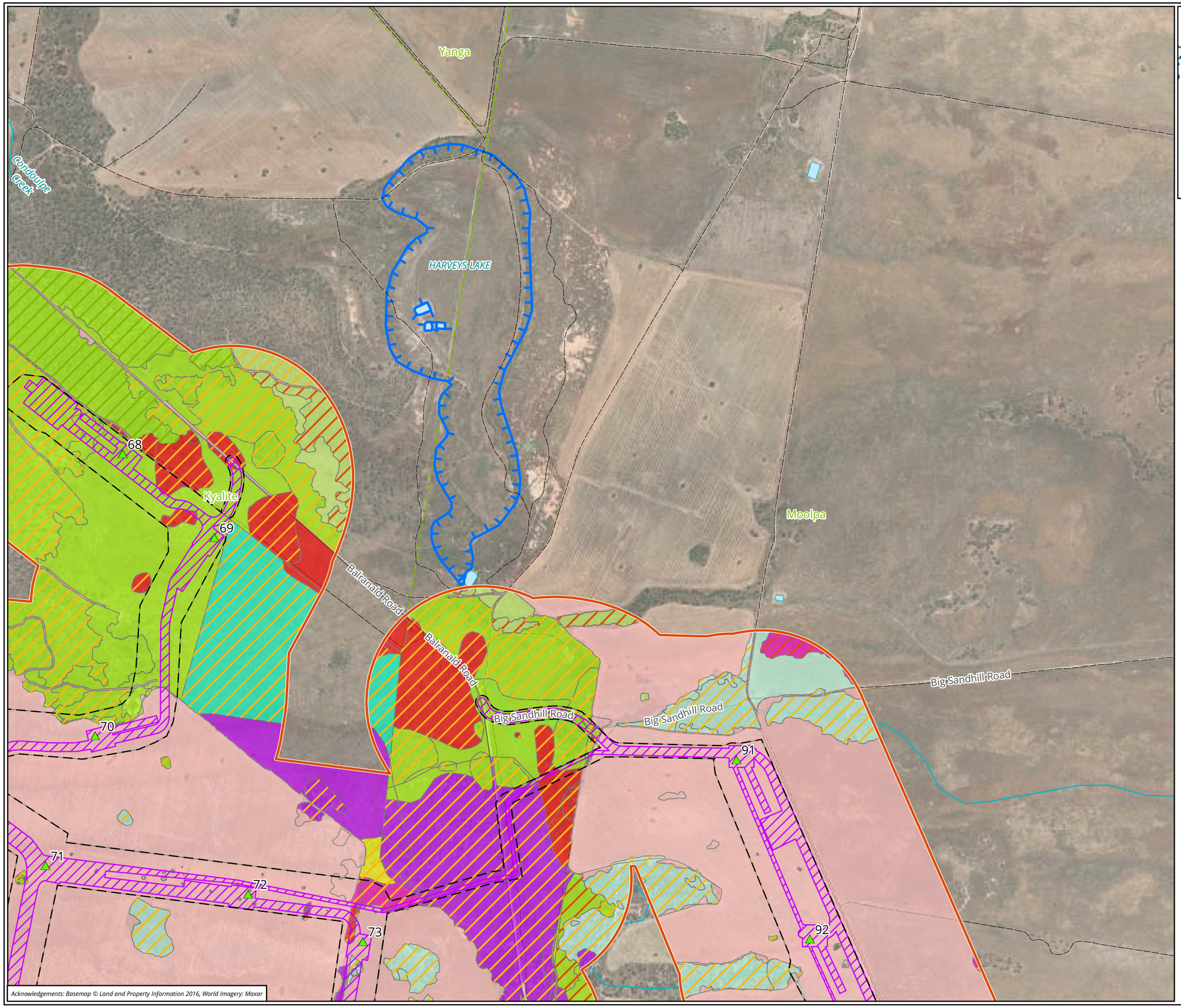
Scale: 1:16,000 @ A3

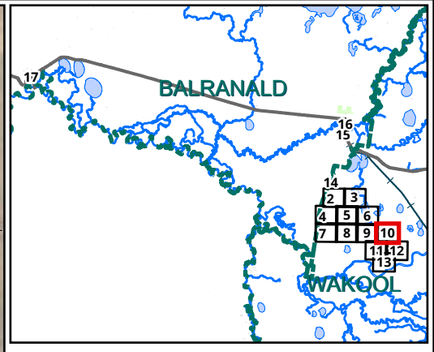
Coordinate System: GDA2020 MGA Zone 54

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_F6_BiosisVeg





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

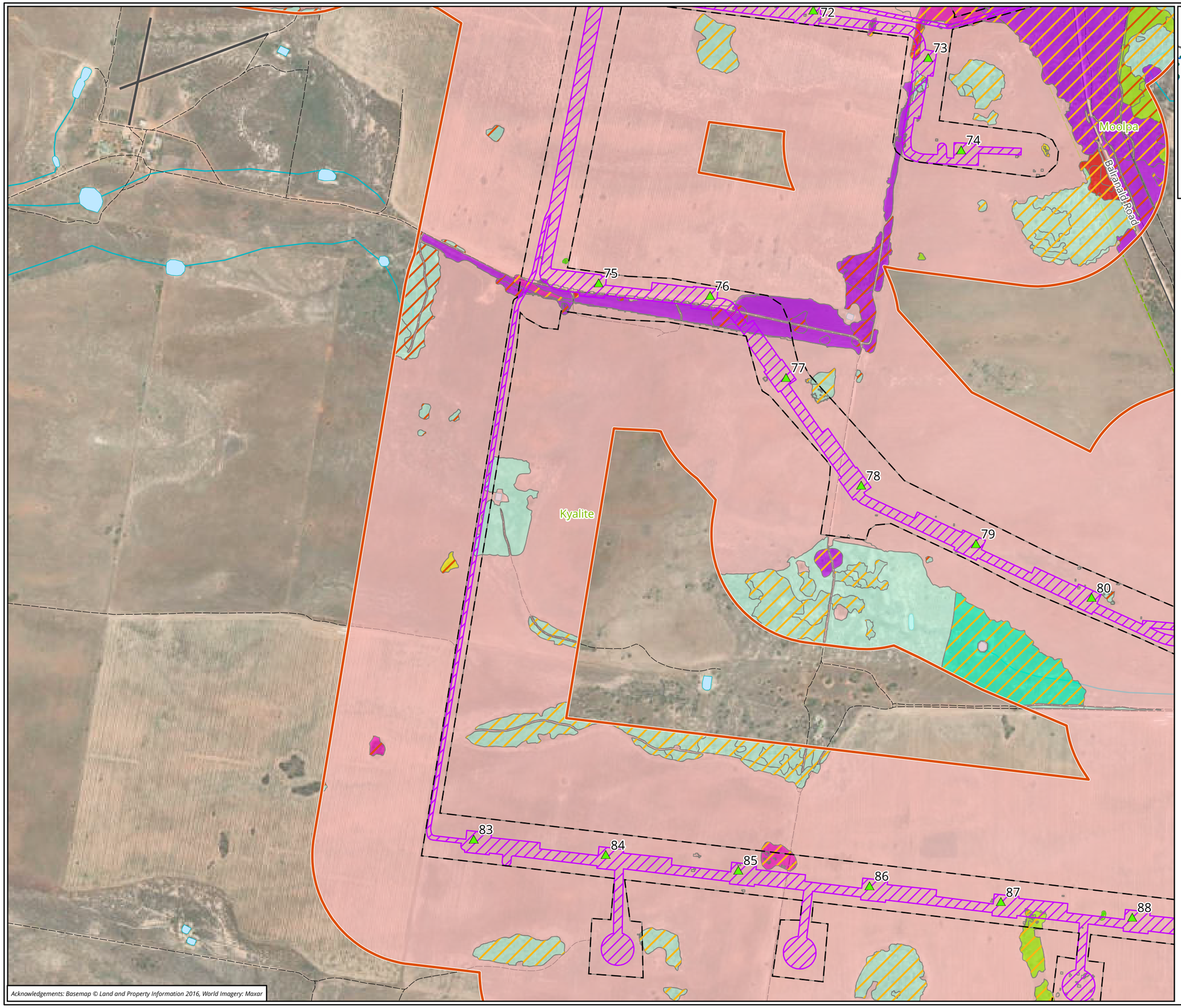
Scale: 1:16,000 @ A3

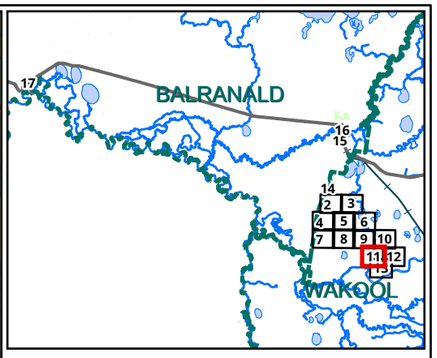
Coordinate System: GDA2020 MGA Zone 54

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_F6_BiosisVeg





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

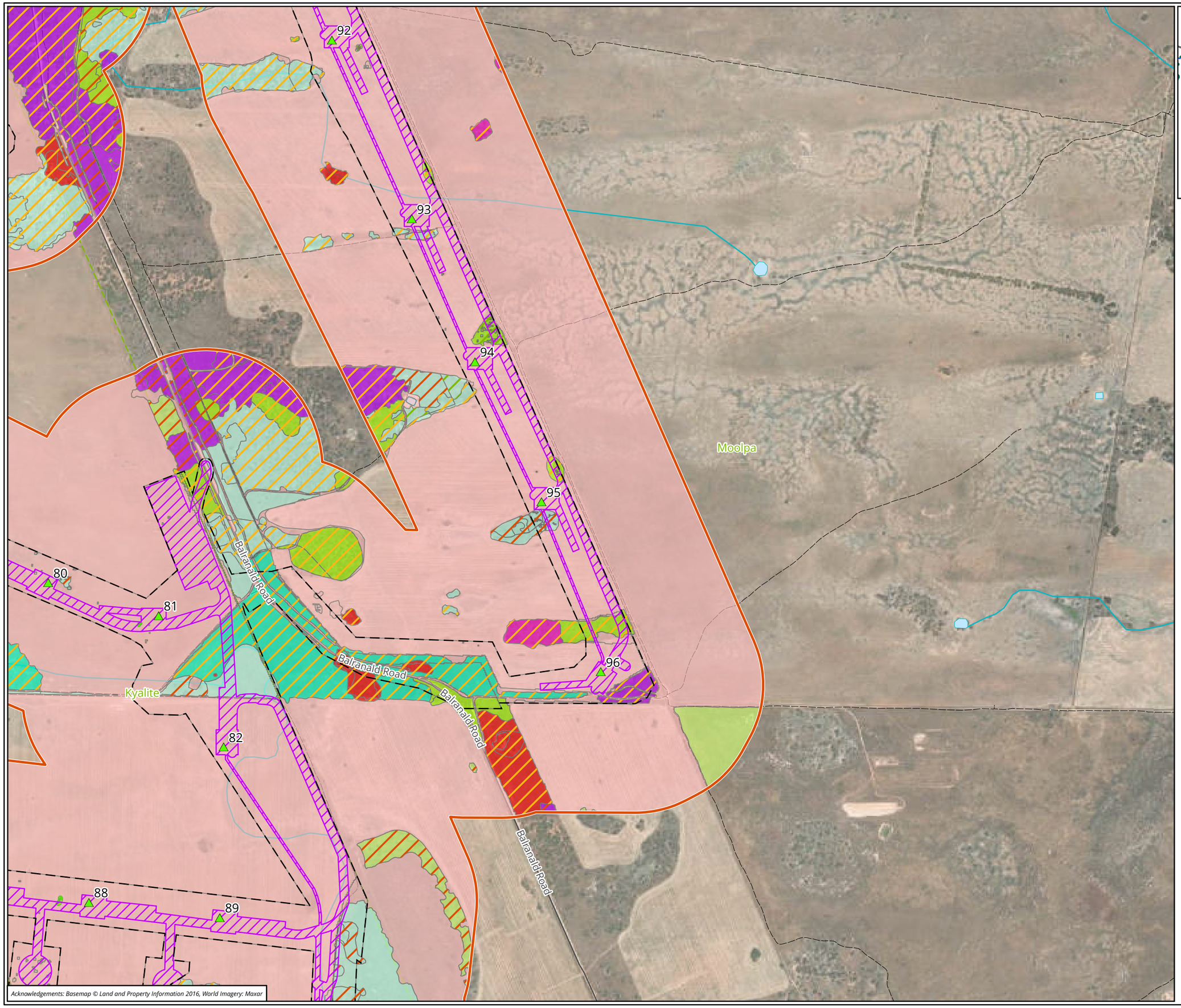
Scale: 1:16,000 @ A3

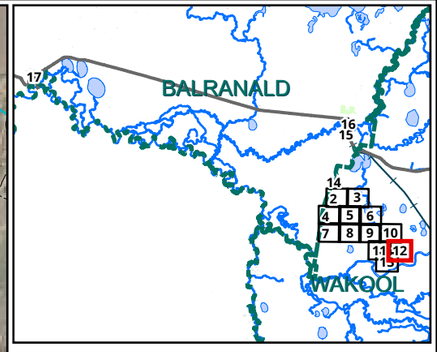
Coordinate System: GDA2020 MGA Zone 54

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_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

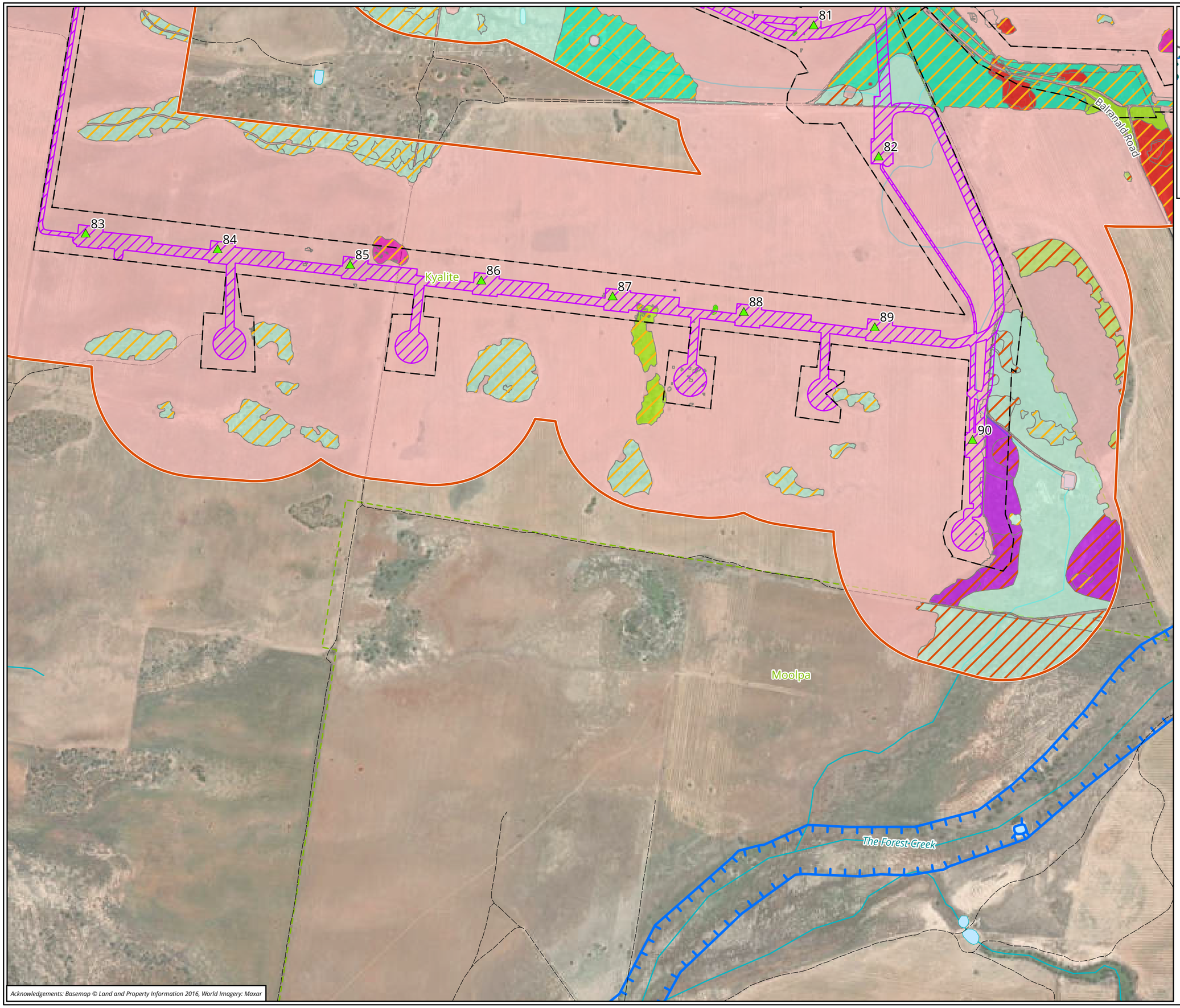
Scale: 1:16,000 @ A3

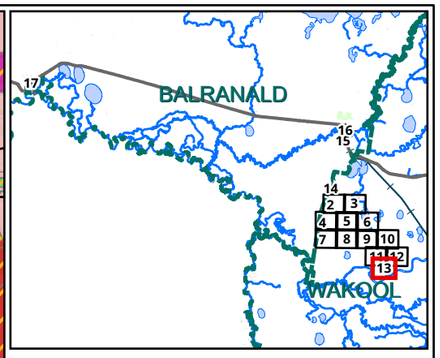
Coordinate System:
GDA2020 MGA Zone 54

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_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

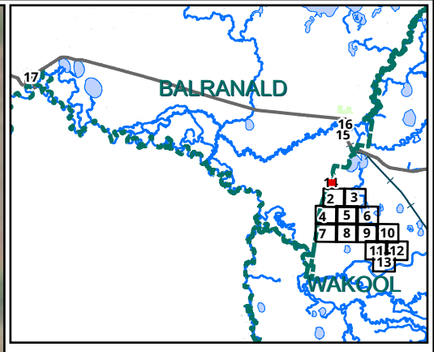
Coordinate System: GDA2020 MGA Zone 54

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

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



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

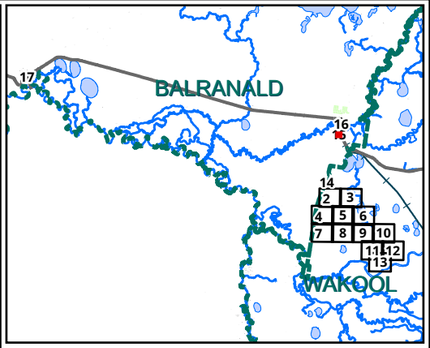
Coordinate System: GDA2020 MGA Zone 54

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

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



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

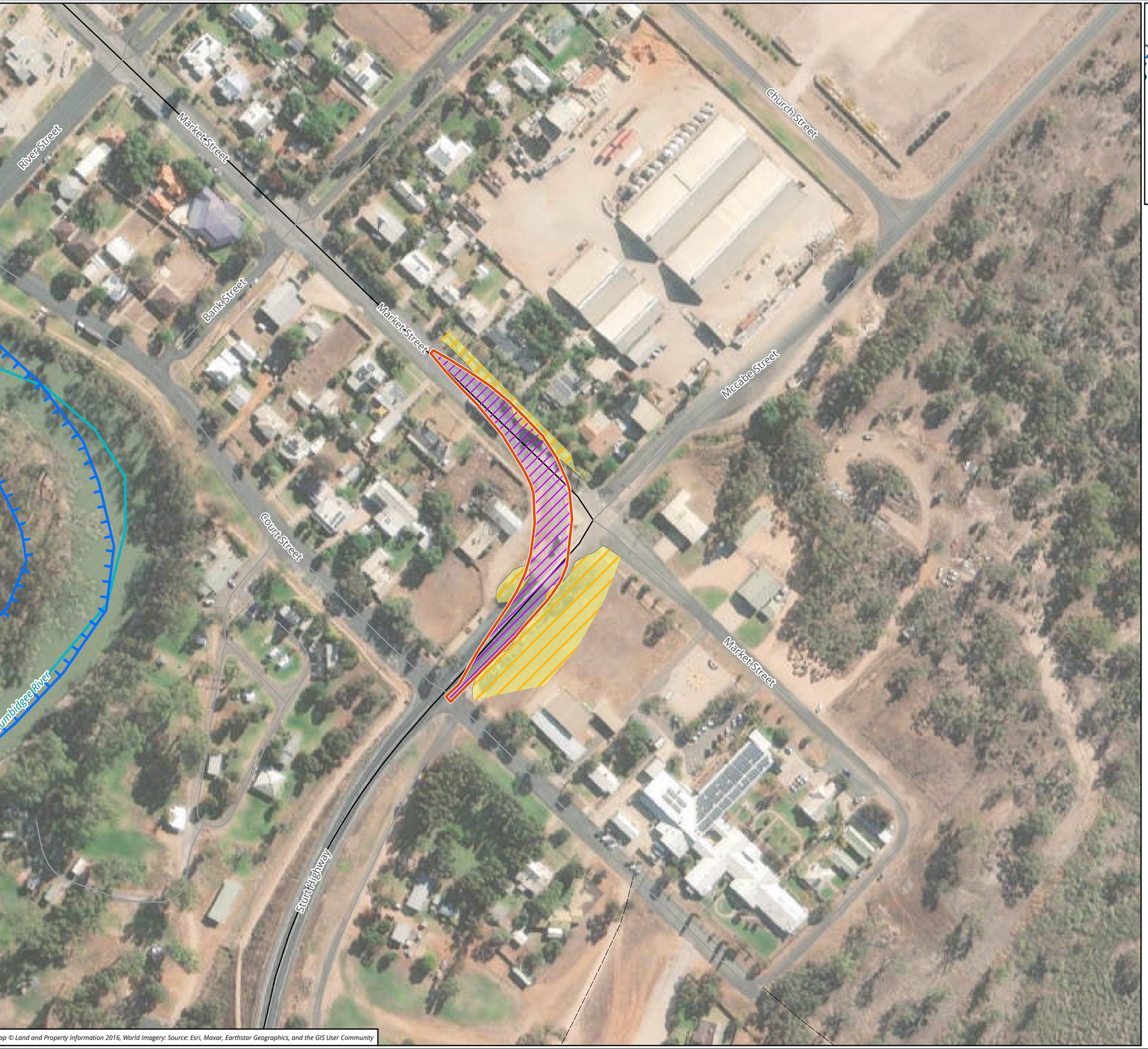
Coordinate System: GDA2020 MGA Zone 54

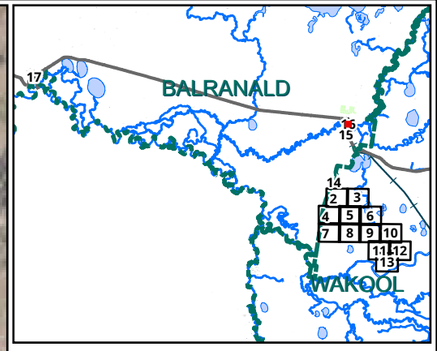
N

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

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





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

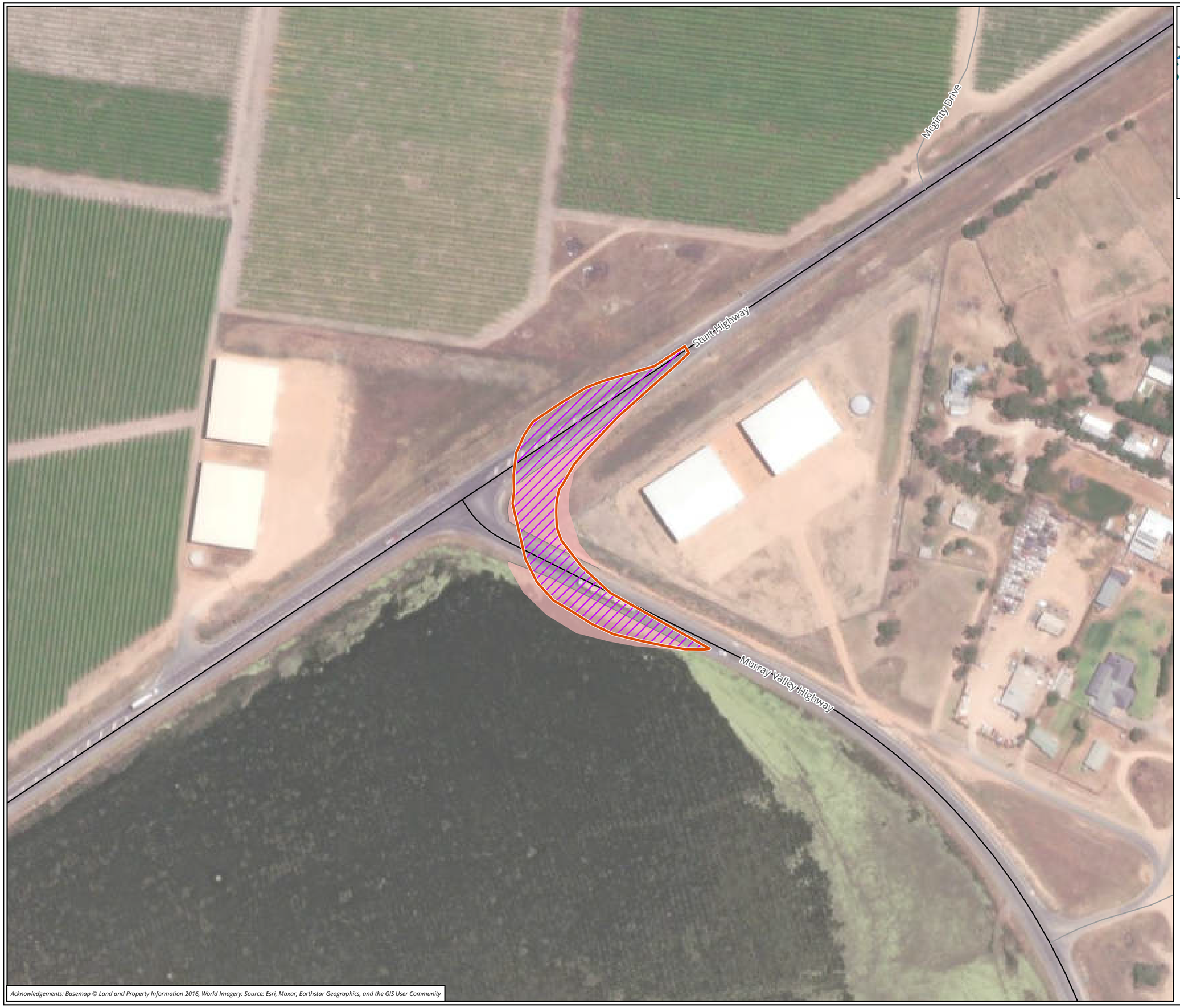
Coordinate System: GDA2020 MGA Zone 54

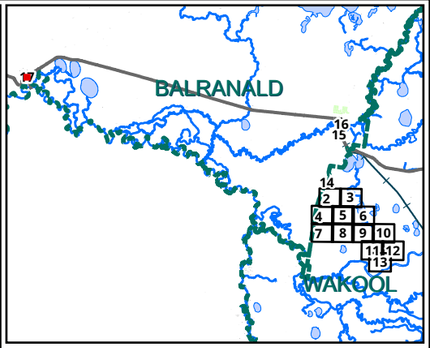
N

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

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





Legend

- Subject land
- Development footprint
- Wind turbine generators

Plant community type

- Exotic / Cropping / Disturbed

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

Figure 6.17 Vegetation within the subject land

0 20 40 60 80

Meters

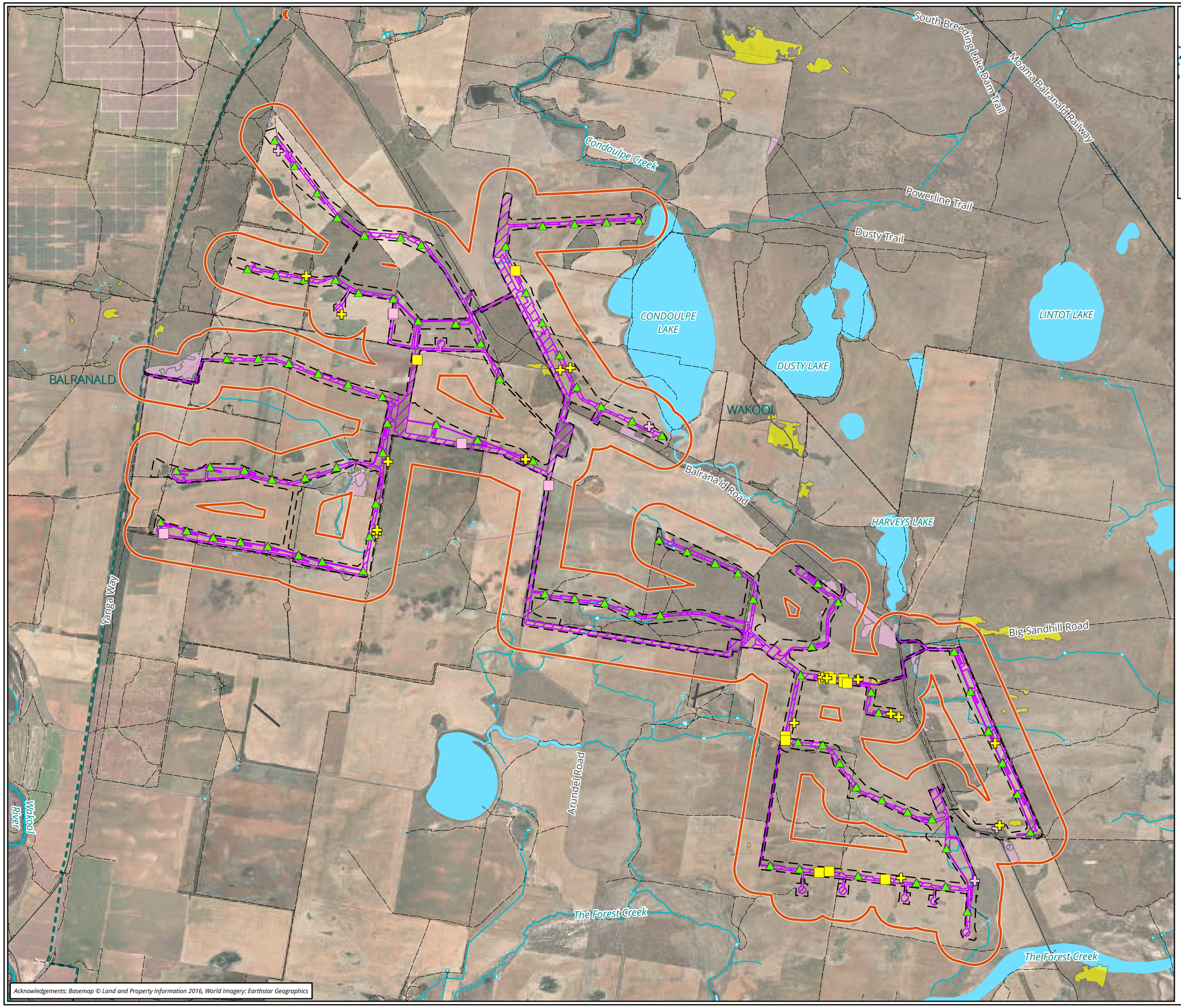
Scale: 1:2,000 @ A3

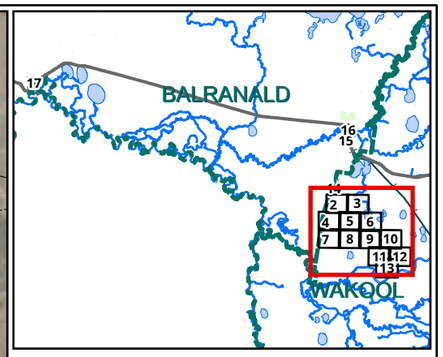
Coordinate System:
GDA2020 MGA Zone 54

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_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

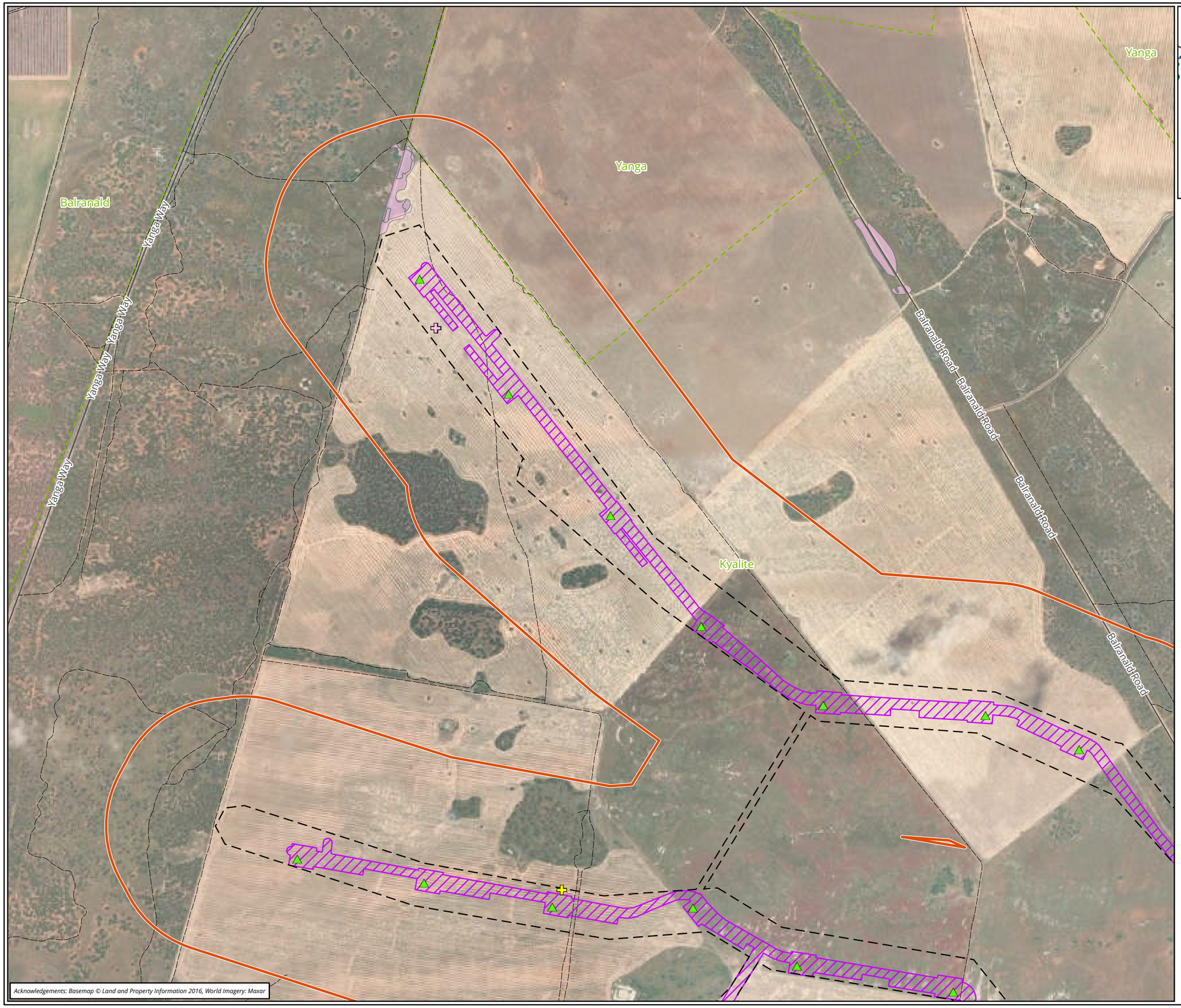
Scale: 1:72,000 @ A3

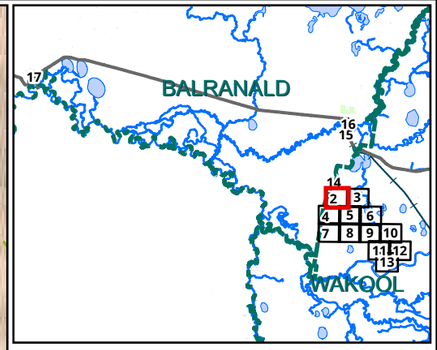
Coordinate System: GDA2020 MGA Zone 54

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_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

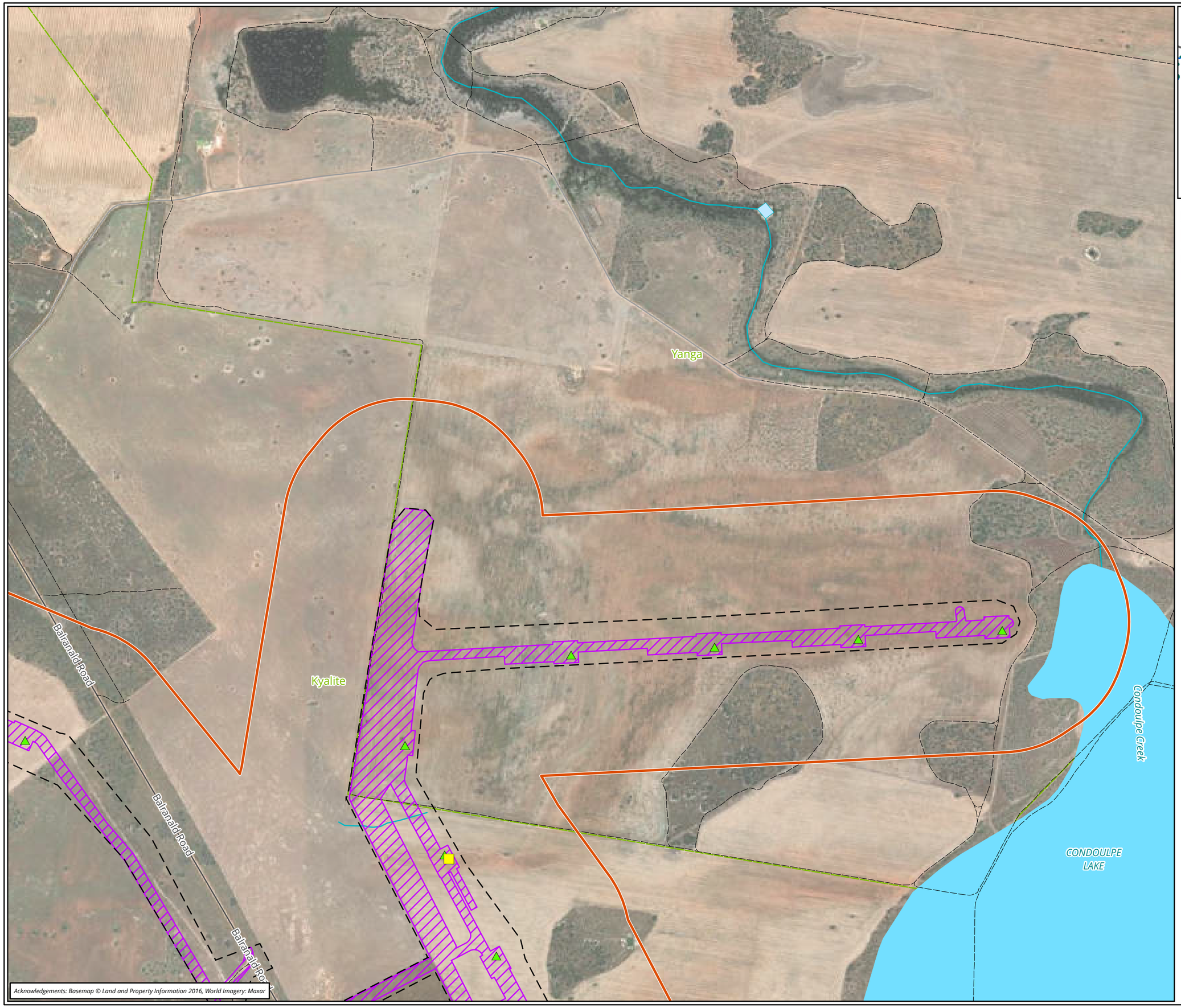
Scale: 1:16,000 @ A3

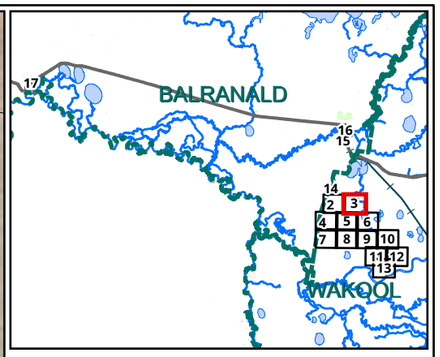
Coordinate System:
GDA2020 MGA Zone 54

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_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

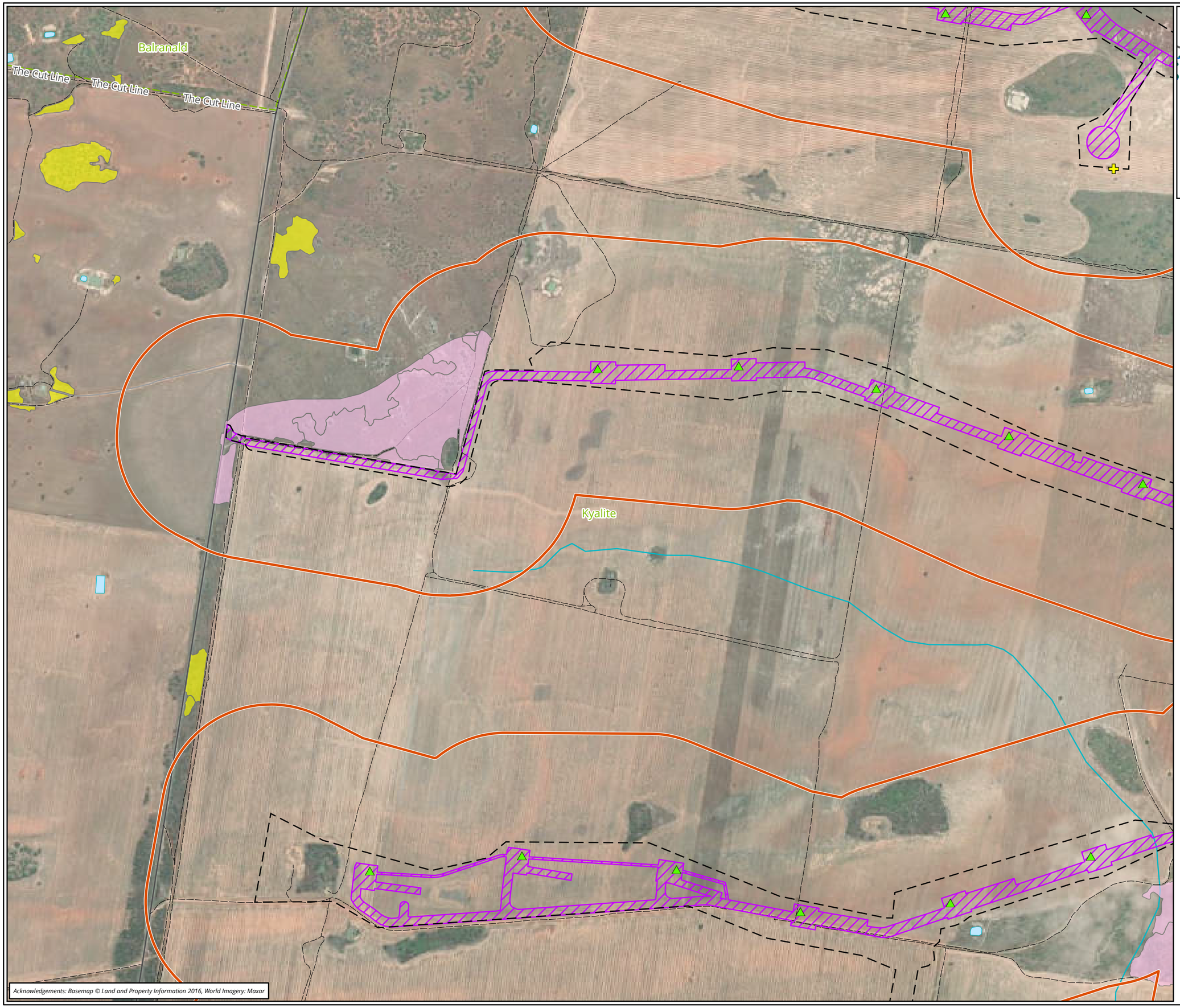
Scale: 1:16,000 @ A3

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_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

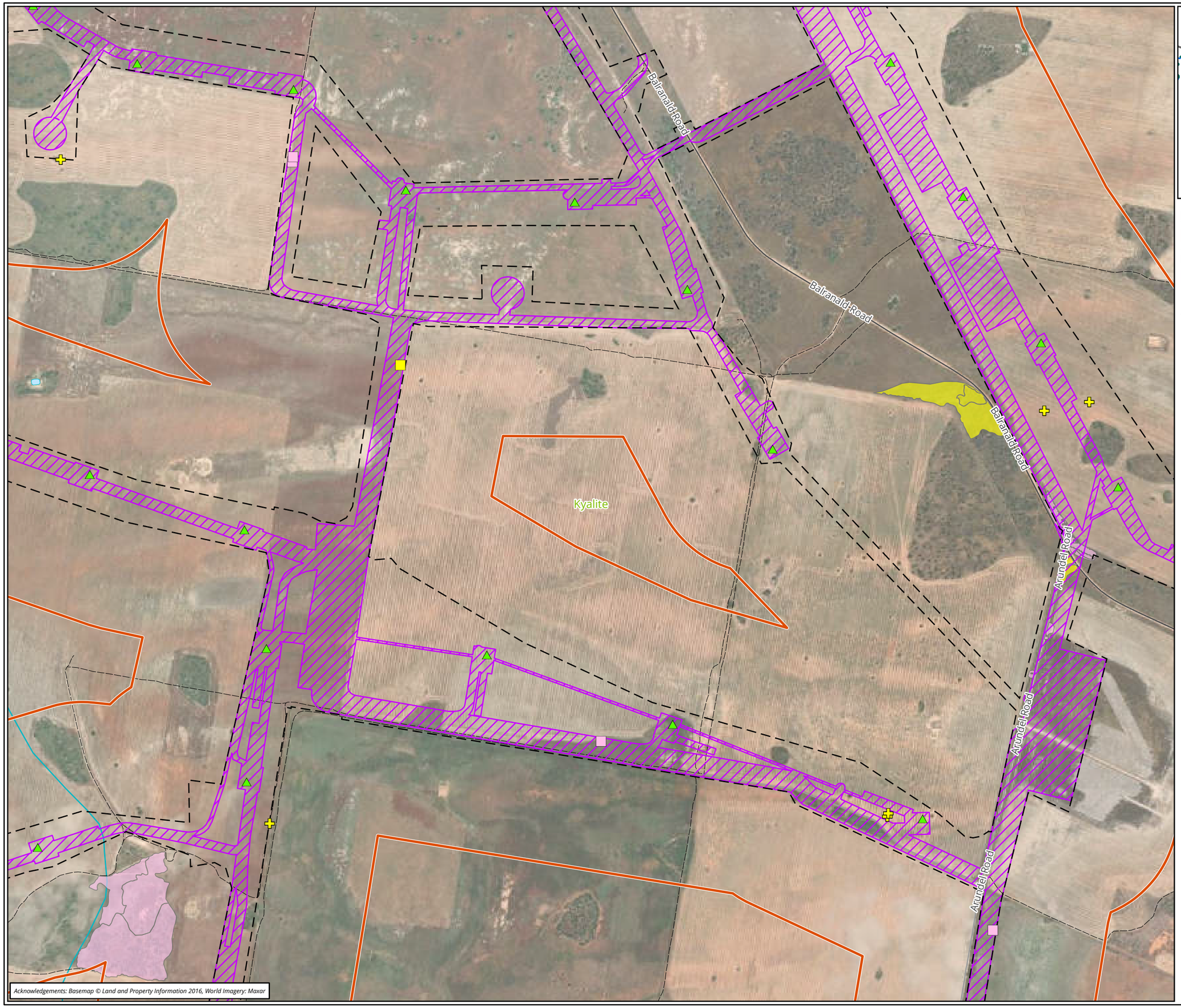
Coordinate System: GDA2020 MGA Zone 54

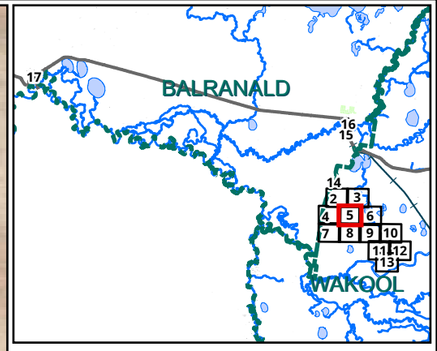
N

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

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





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

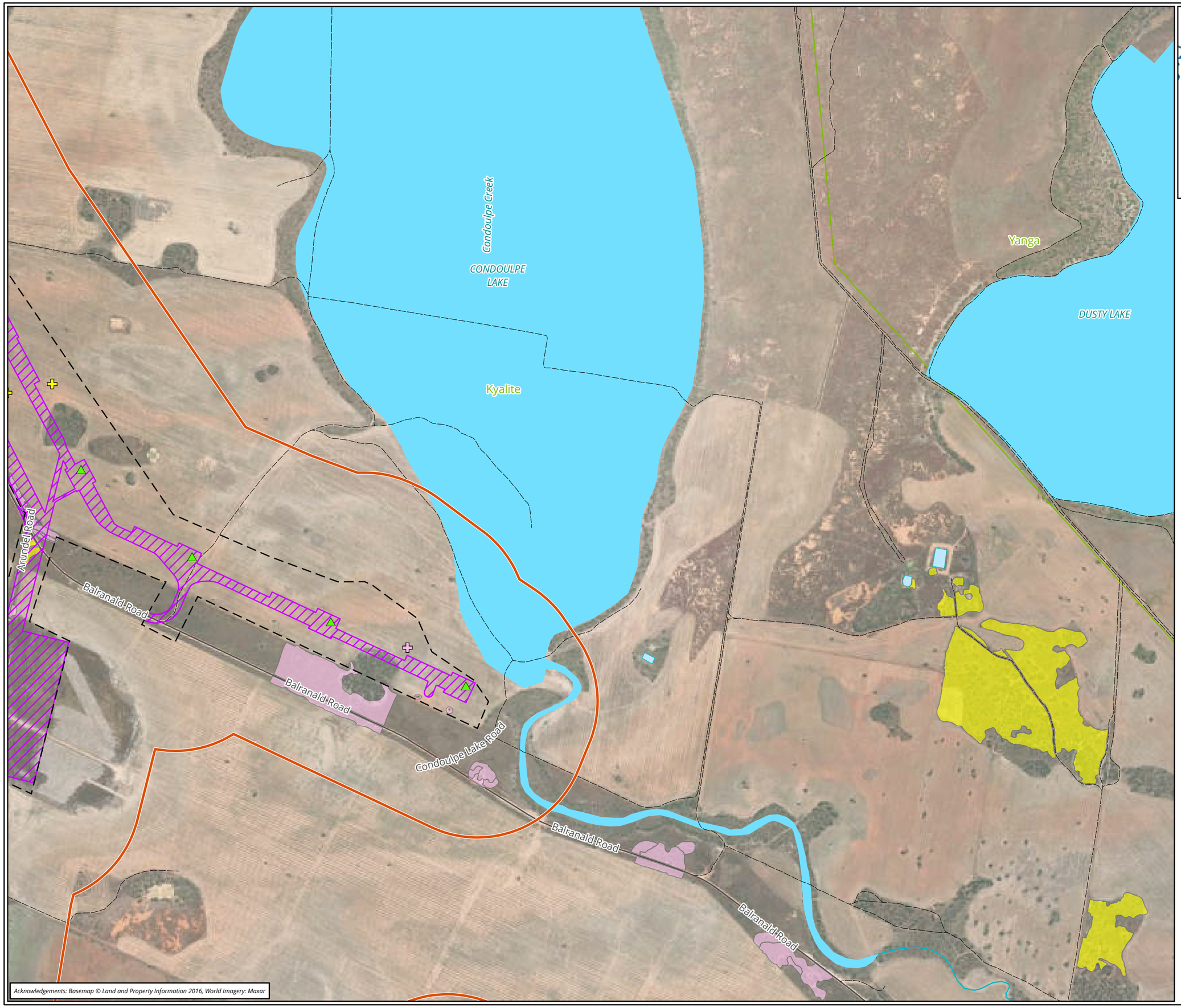
Scale: 1:16,000 @ A3

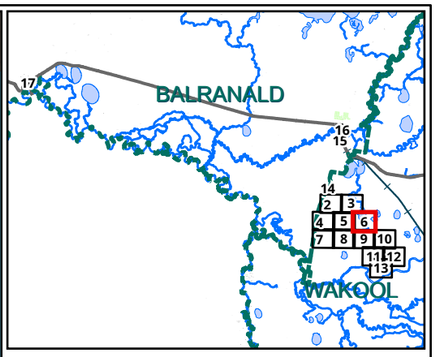
Coordinate System:
GDA2020 MGA Zone 54

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_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

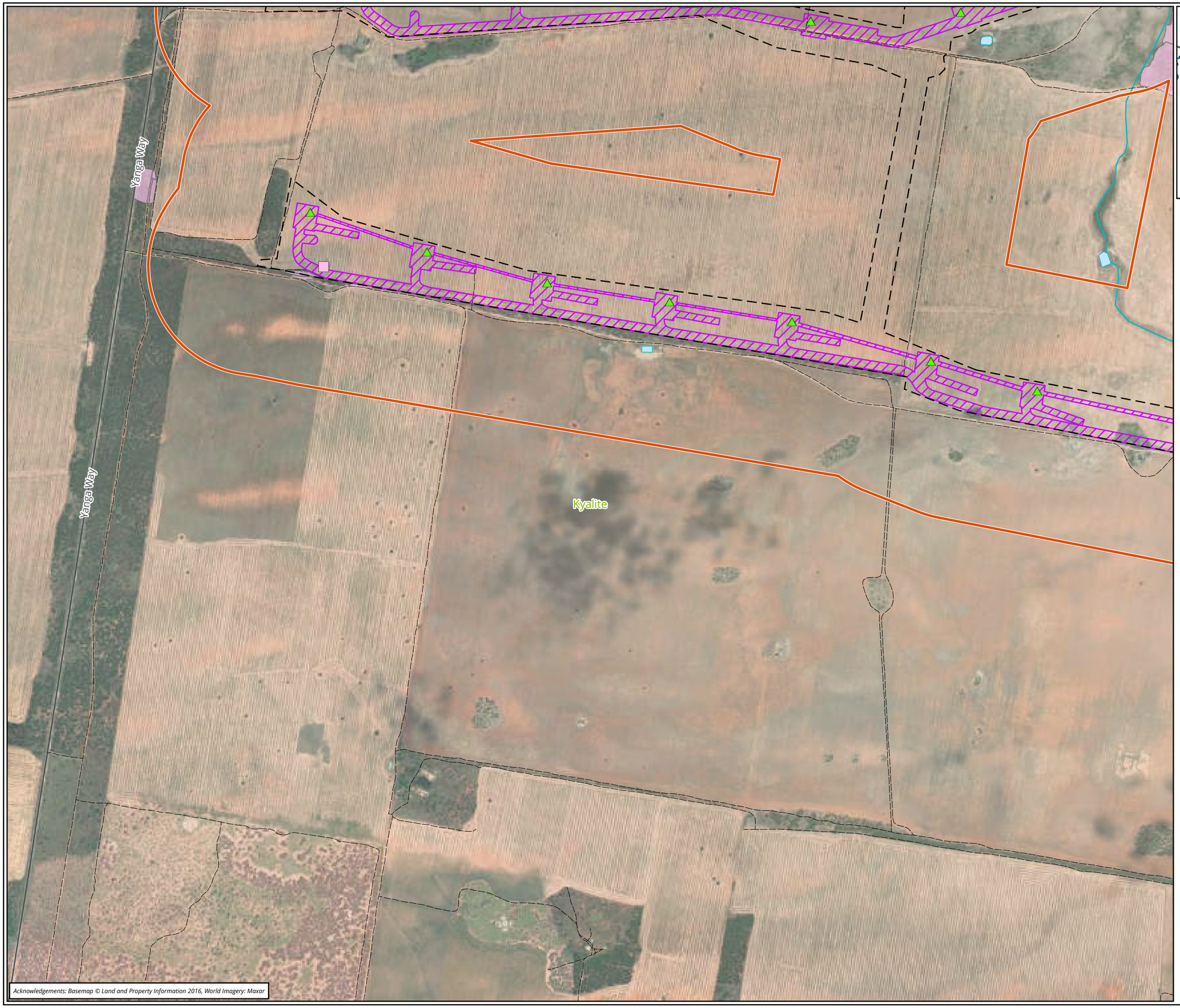
Scale: 1:16,000 @ A3

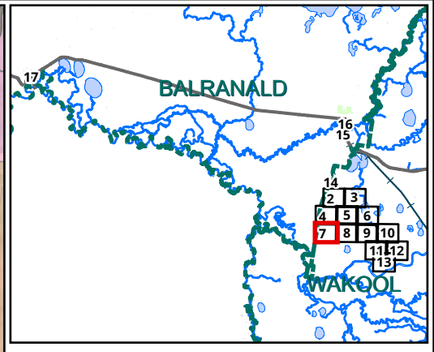
Coordinate System:
GDA2020 MGA Zone 54

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_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

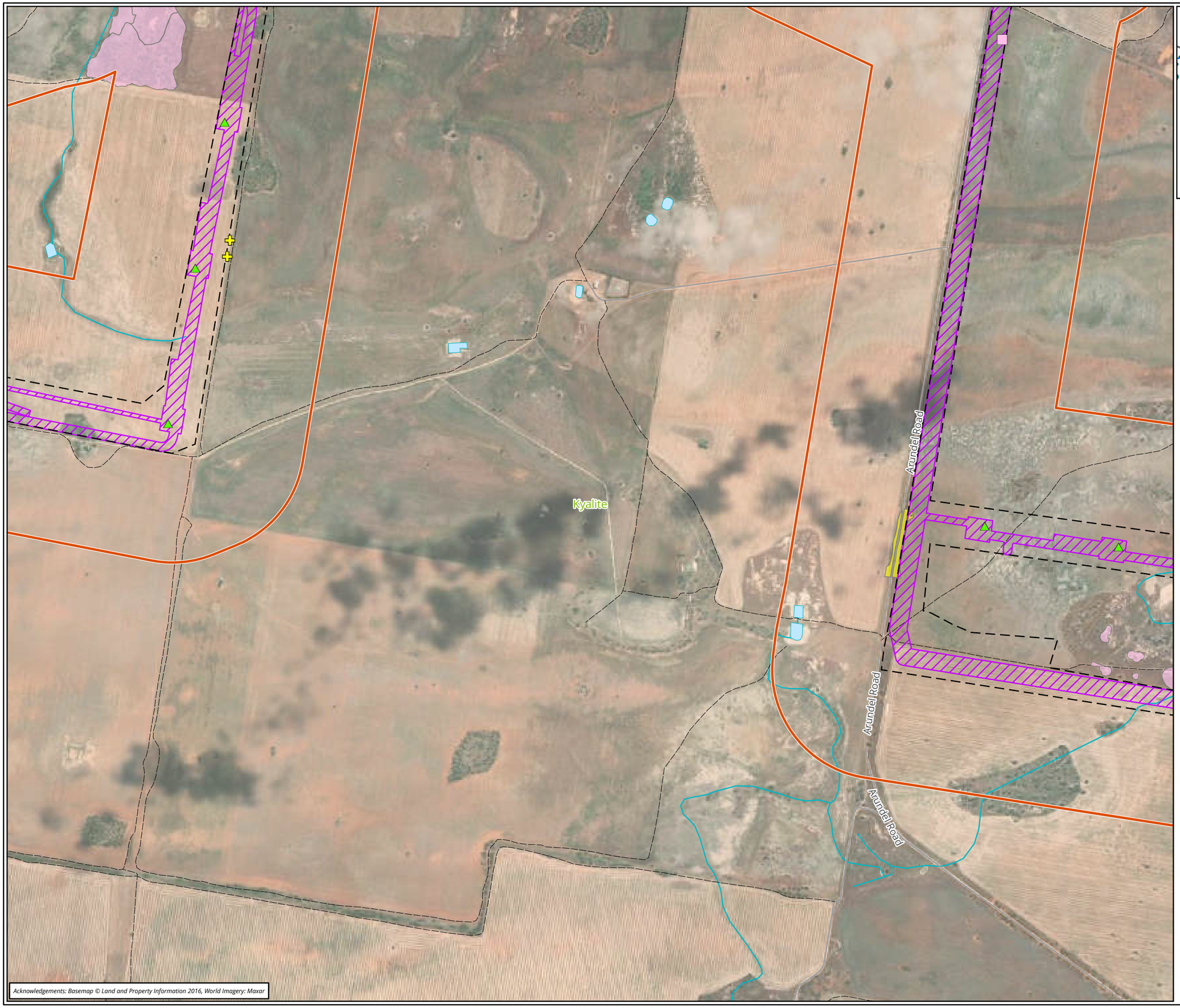
Scale: 1:16,000 @ A3

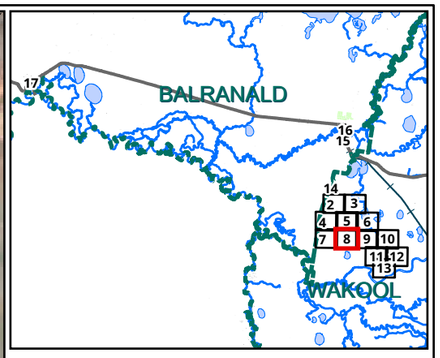
Coordinate System:
GDA2020 MGA Zone 54

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_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

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

Figure 7.8 Threatened ecological communities within the subject land

0 230 460 690

Meters

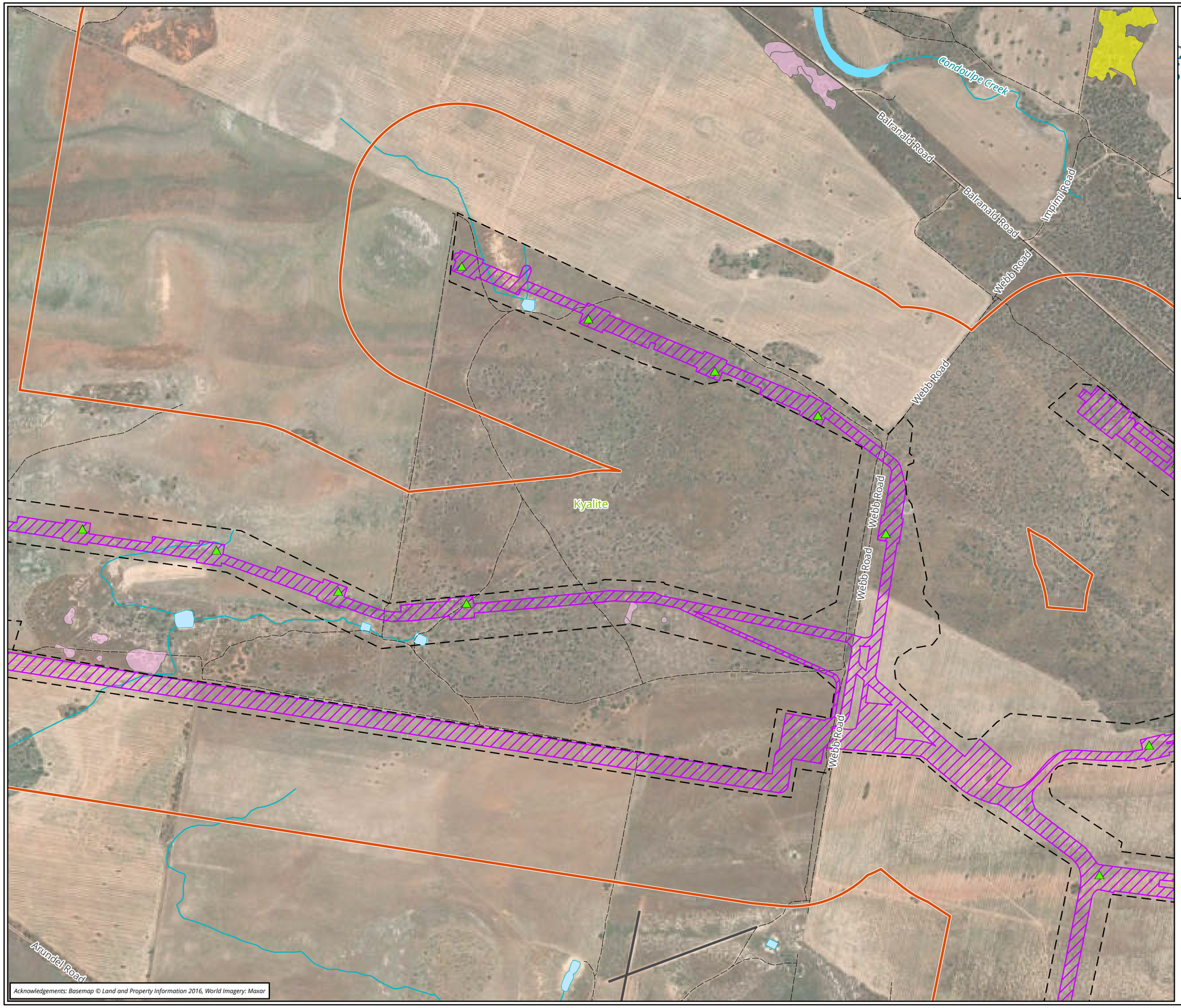
Scale: 1:16,000 @ A3

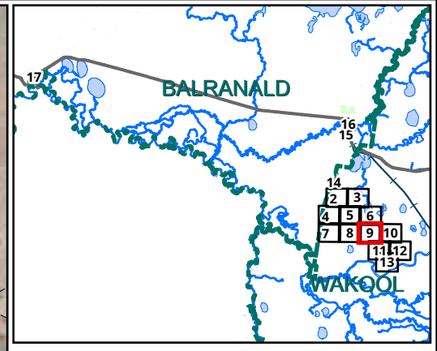
Coordinate System: GDA2020 MGA Zone 54

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_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

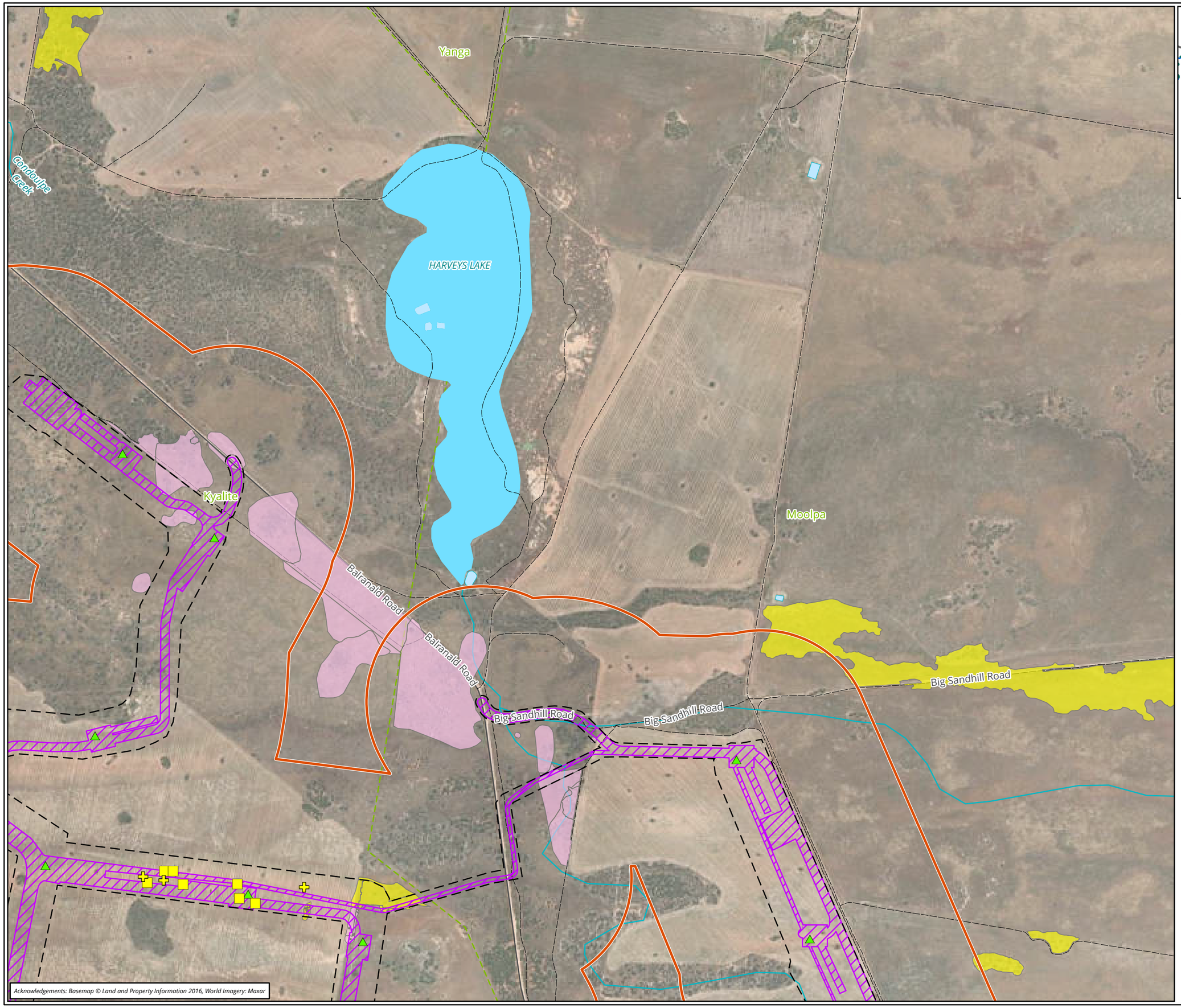
Scale: 1:16,000 @ A3

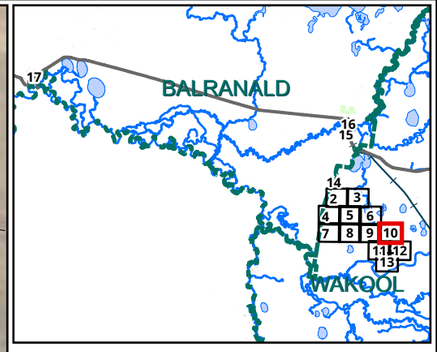
Coordinate System:
GDA2020 MGA Zone 54

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_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

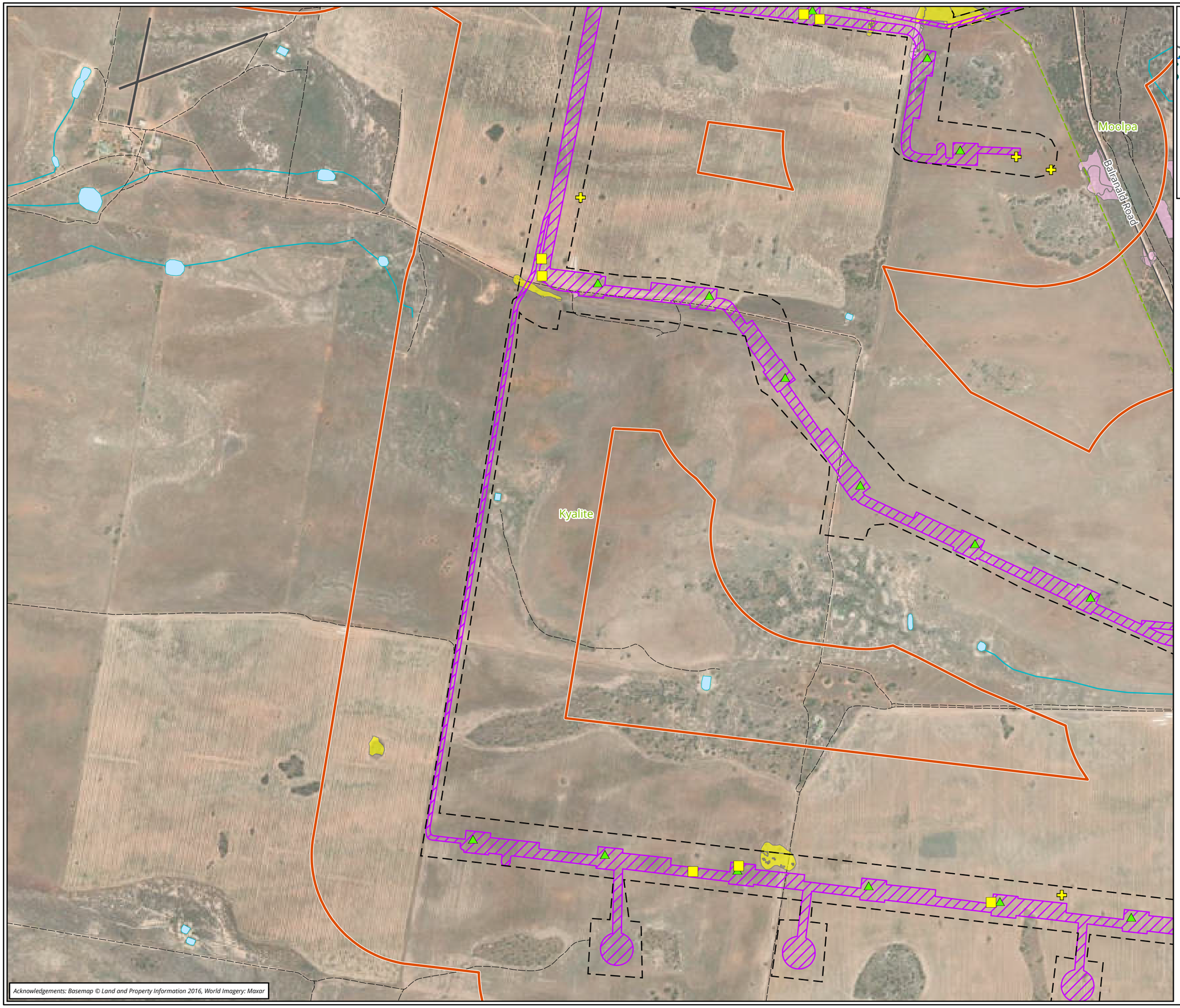
Scale: 1:16,000 @ A3

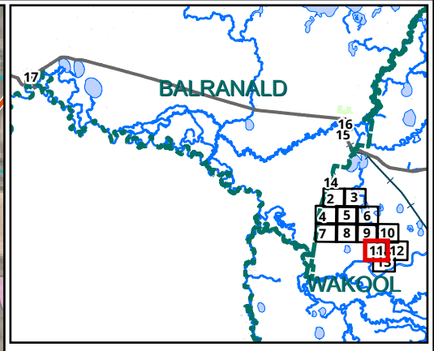
Coordinate System: GDA2020 MGA Zone 54

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_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

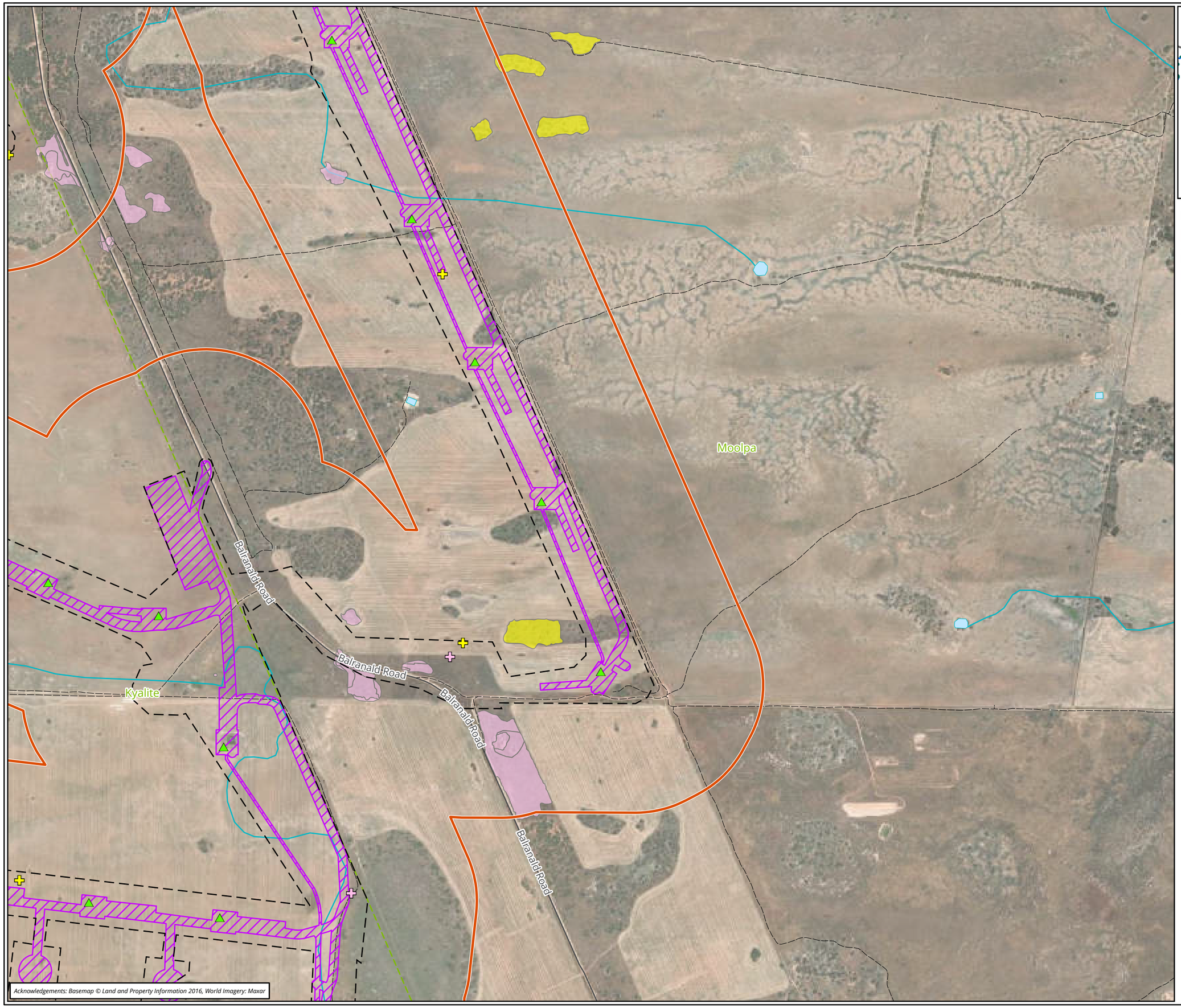
Scale: 1:16,000 @ A3

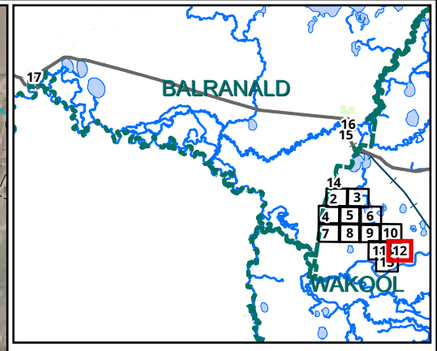
Coordinate System:
GDA2020 MGA Zone 54

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_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

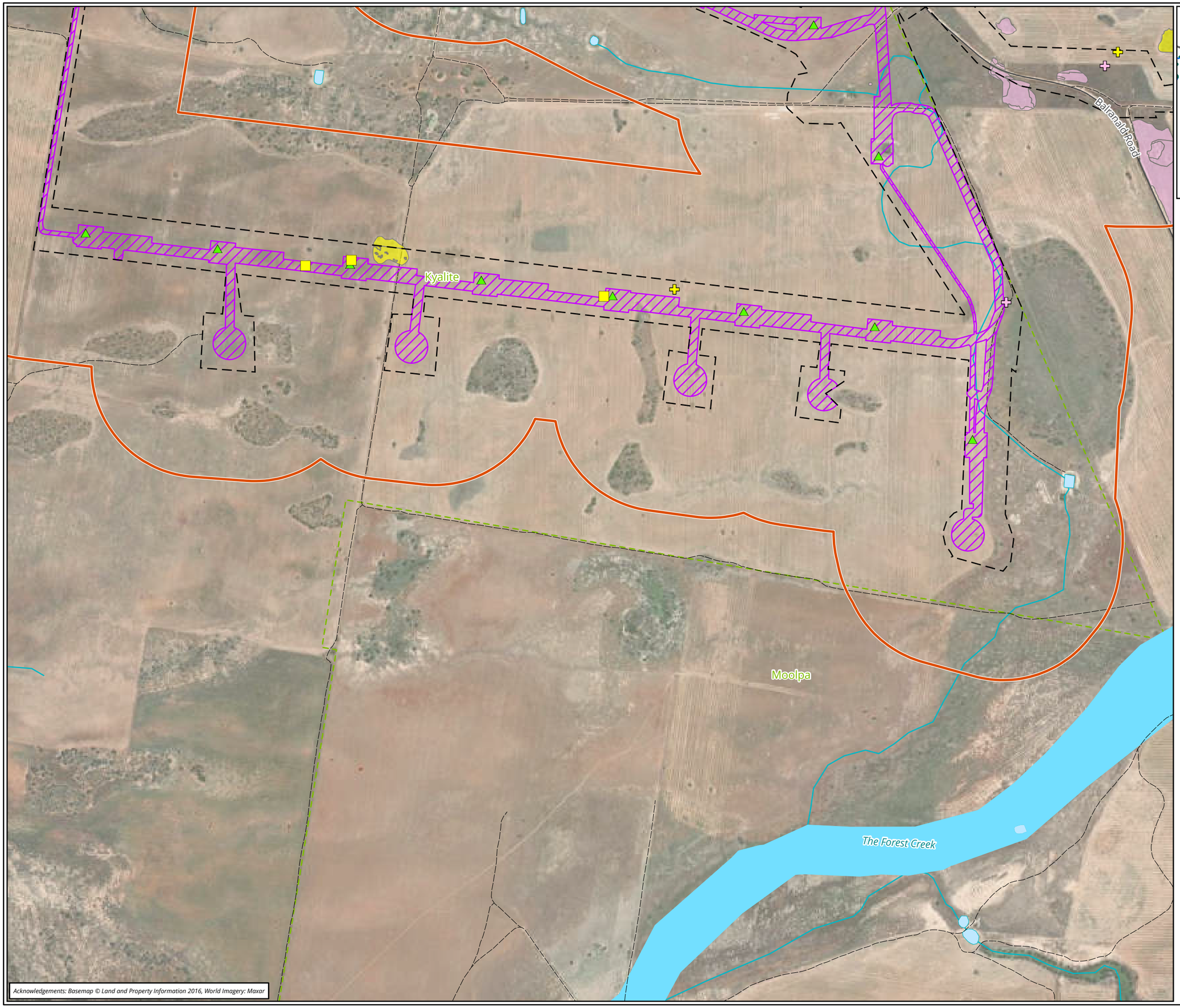
Scale: 1:16,000 @ A3

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_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

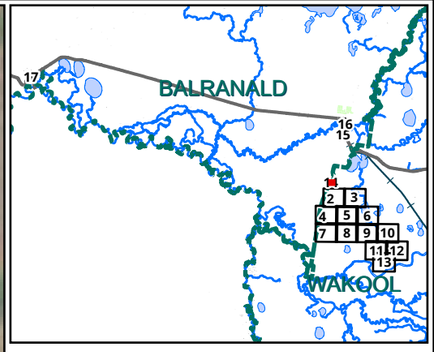
Coordinate System: GDA2020 MGA Zone 54

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

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

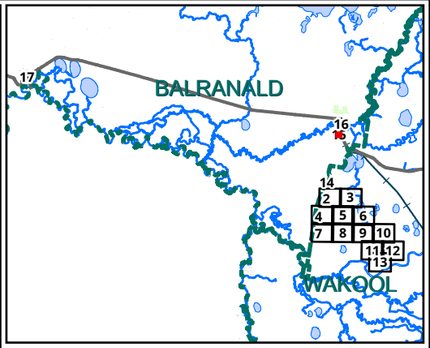
Coordinate System:
GDA2020 MGA Zone 54

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

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 7.15 Threatened ecological communities within the subject land

0 25 50 75

Meters

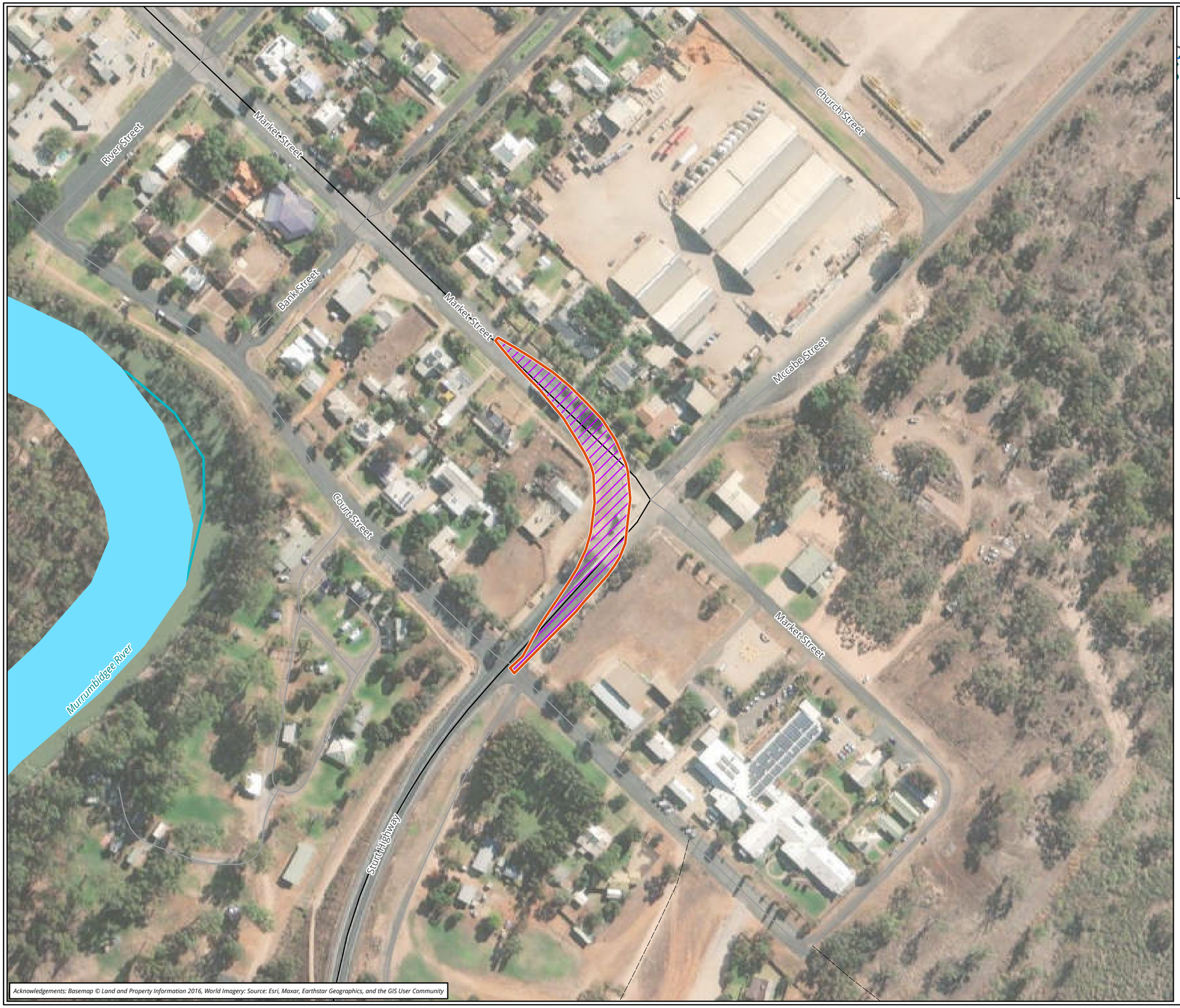
Scale: 1:2,000 @ A3

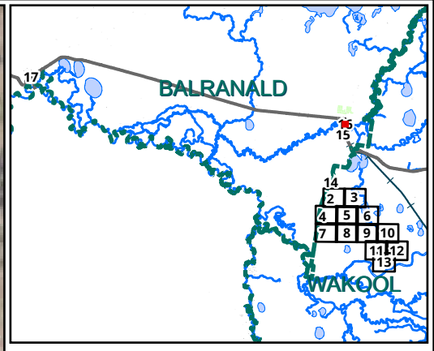
Coordinate System: GDA2020 MGA Zone 54

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_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

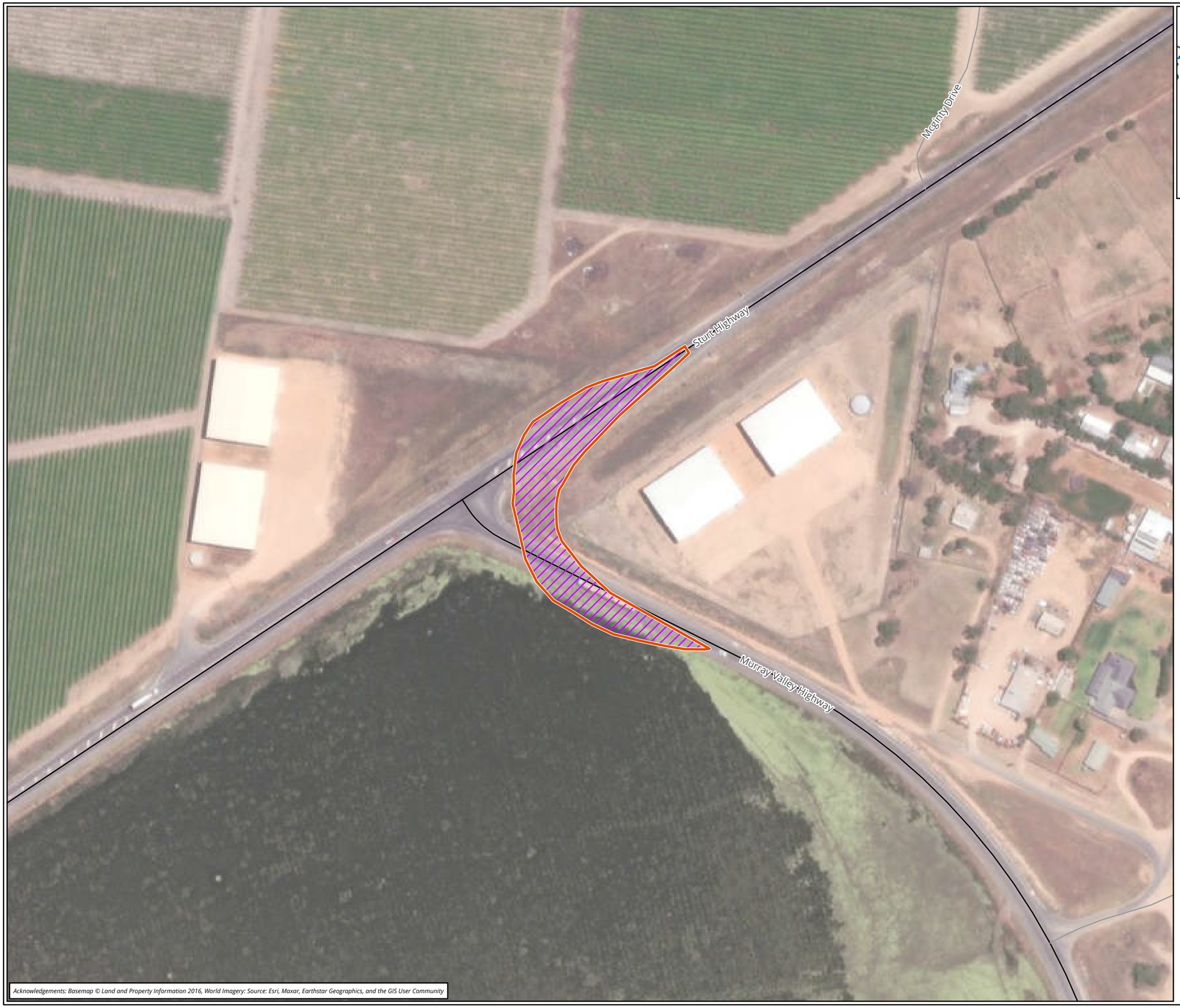
Coordinate System: GDA2020 MGA Zone 54

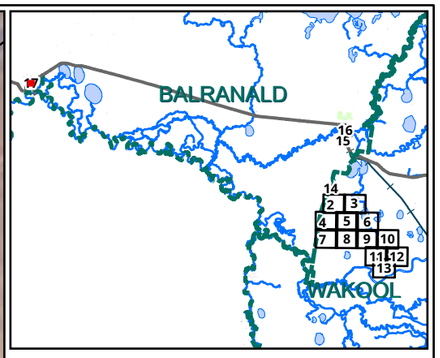
N

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

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 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

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

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

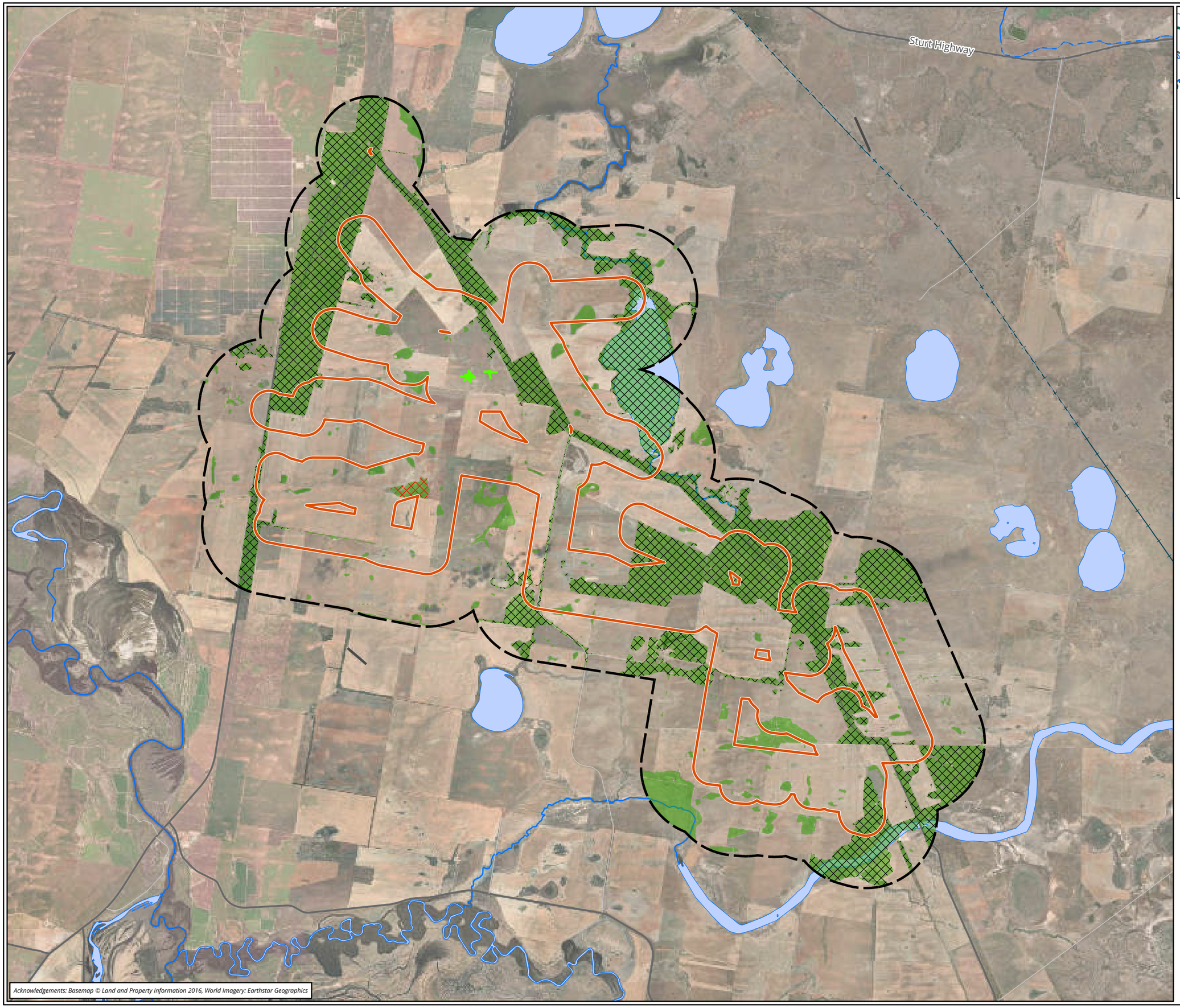
Vegetation within the subject land was assessed and stratified, based on PCT and broad condition state, into vegetation zones in accordance with Section 4.3 of the BAM, and as described in Table 5 to Table 11 above. This resulted in 15 vegetation zones identified within the development footprint. Table 16 describes each of the zones, and provides details on the numbers of BAM floristic plots undertaken in each.

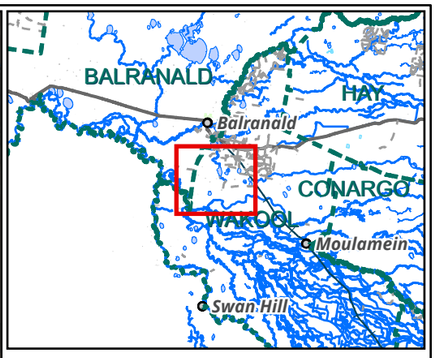
Patch size classes for each vegetation zone present within the subject land were assessed as per Section 4.3.2 of the BAM (DPIE 2020a) using a selection process in ArcGIS. All native vegetation with a gap of less than 100 metres from the next area of native vegetation (or ≤30 metres for non-woody PCTs), 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 16 below.

Table 16 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 17, with locations shown on Figure 9.

Table 17 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 18.

Table 18 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

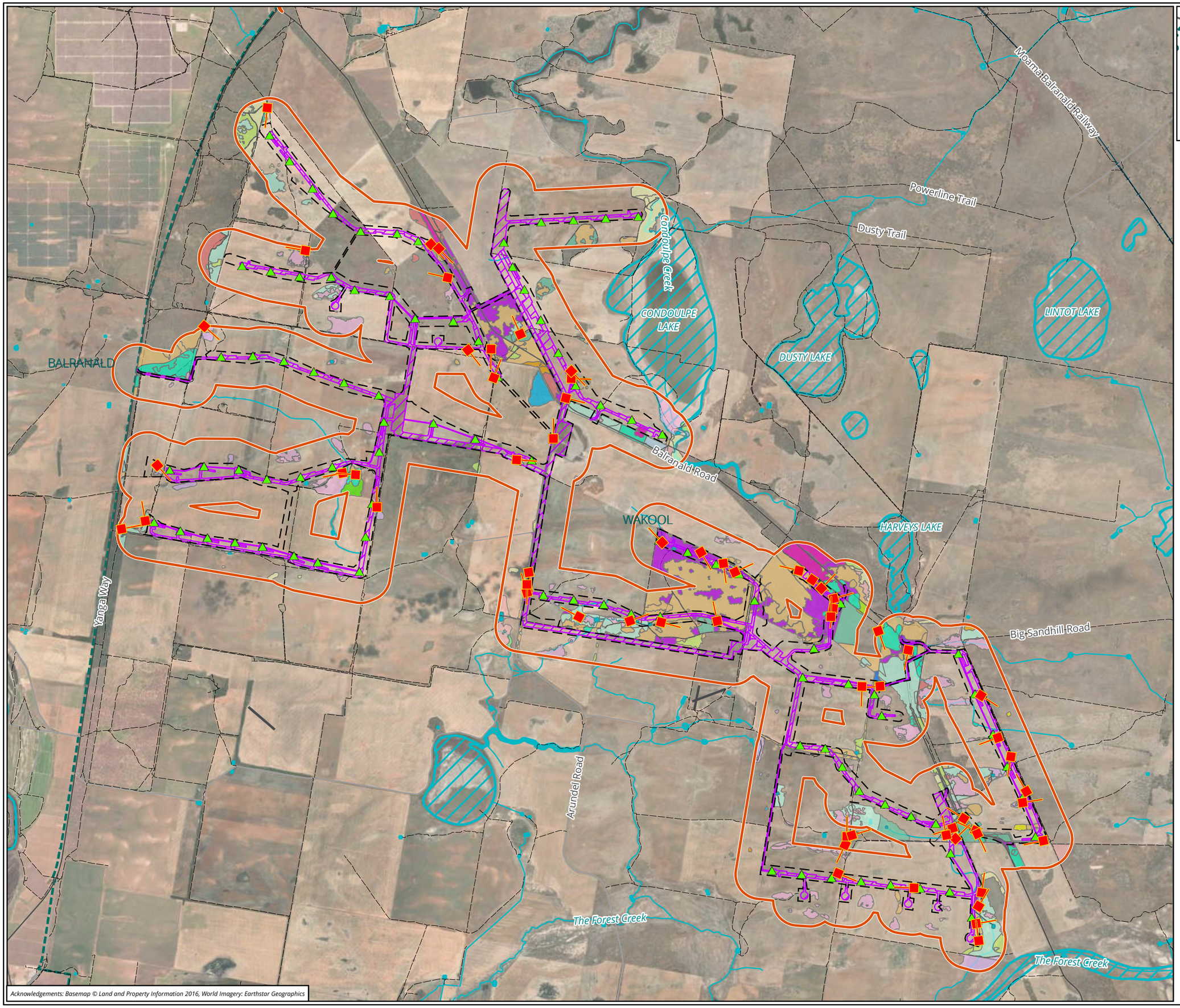
A total of 77 scattered paddock trees have been assessed under Streamlined assessment module – Scattered trees assessment (Appendix B of the BAM) and were entered into the scattered tree assessment module of the BAM-C. Scattered paddock tree were determined to have:

- 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.

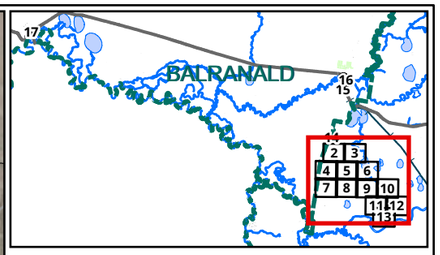
The Streamlined assessment module – Scattered trees assessment was used only to assess the part of the subject land that contained scattered trees. Any proposed clearing of native vegetation that did not meet the definition of scattered trees was assessed in accordance with Section 4 of the BAM (DPIE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



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



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

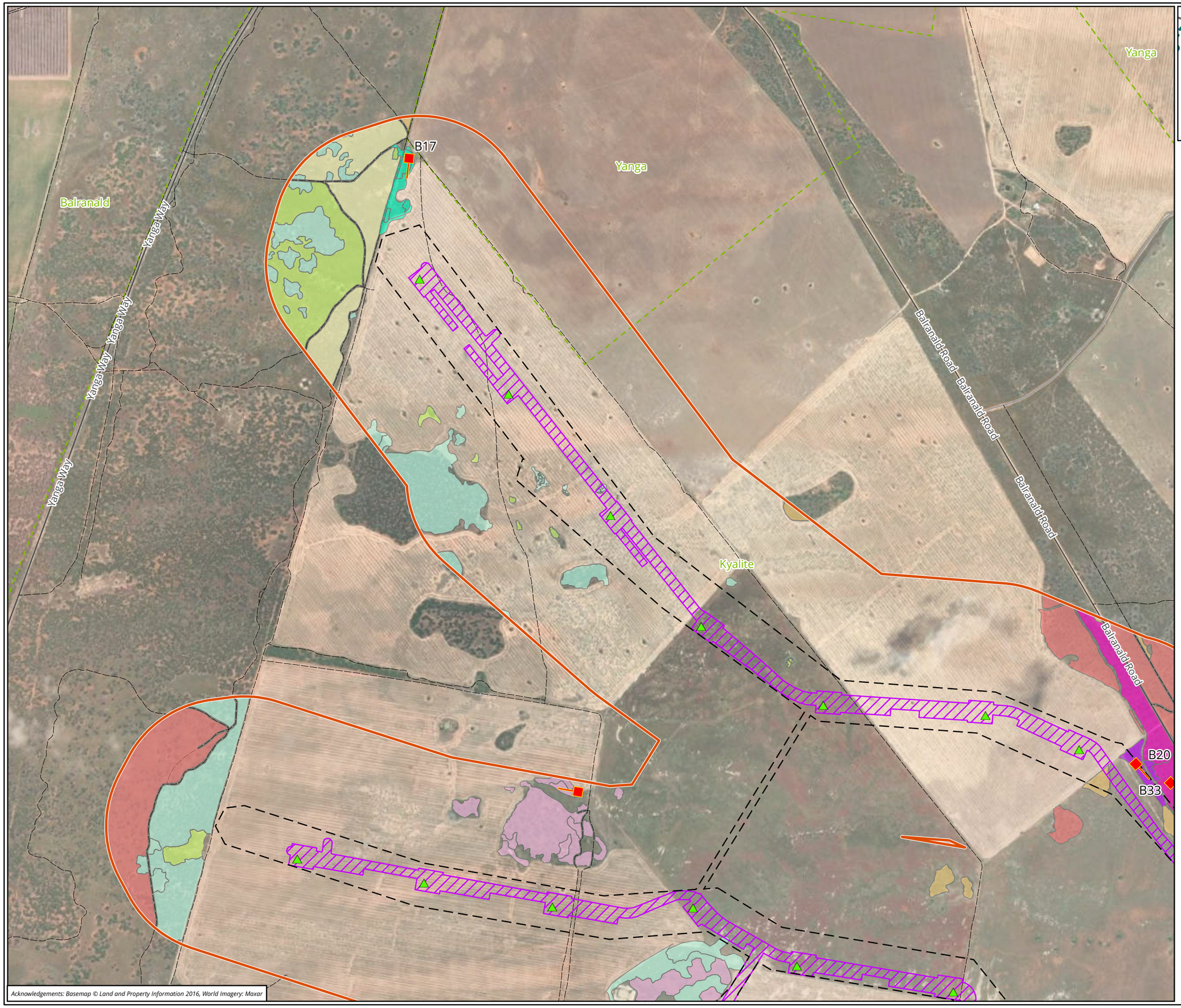
Scale: 1:71,000 @ A3

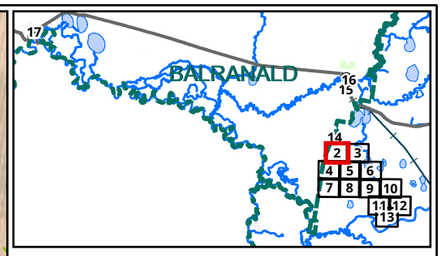
Coordinate System: GDA2020 MGA Zone 54

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_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

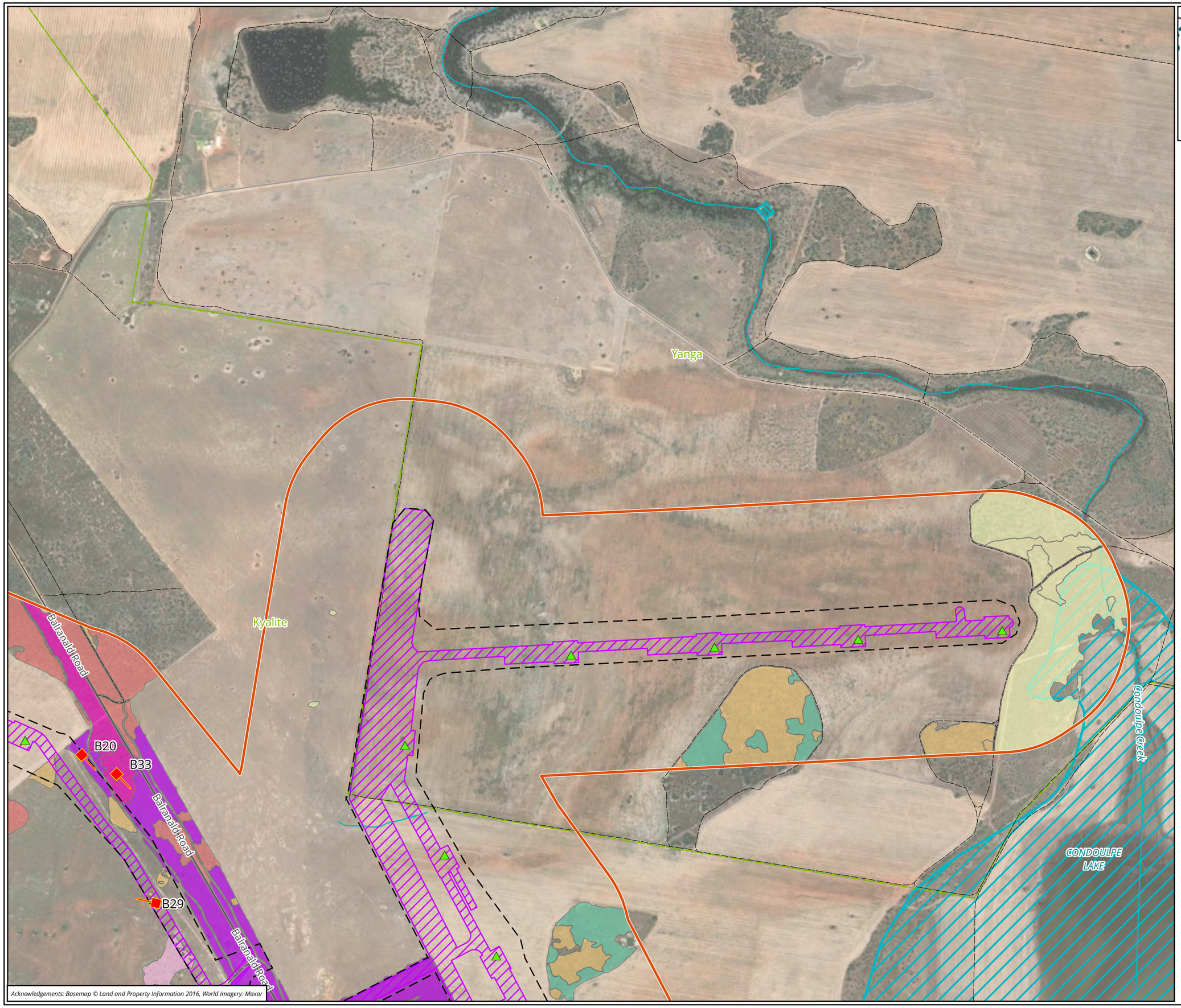
Meters

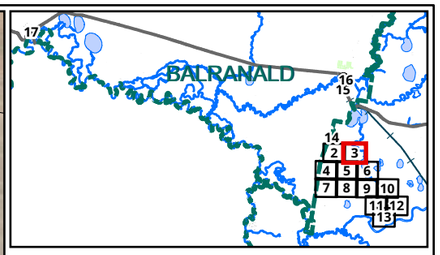
Scale: 1:16,000 @ A3

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
- 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

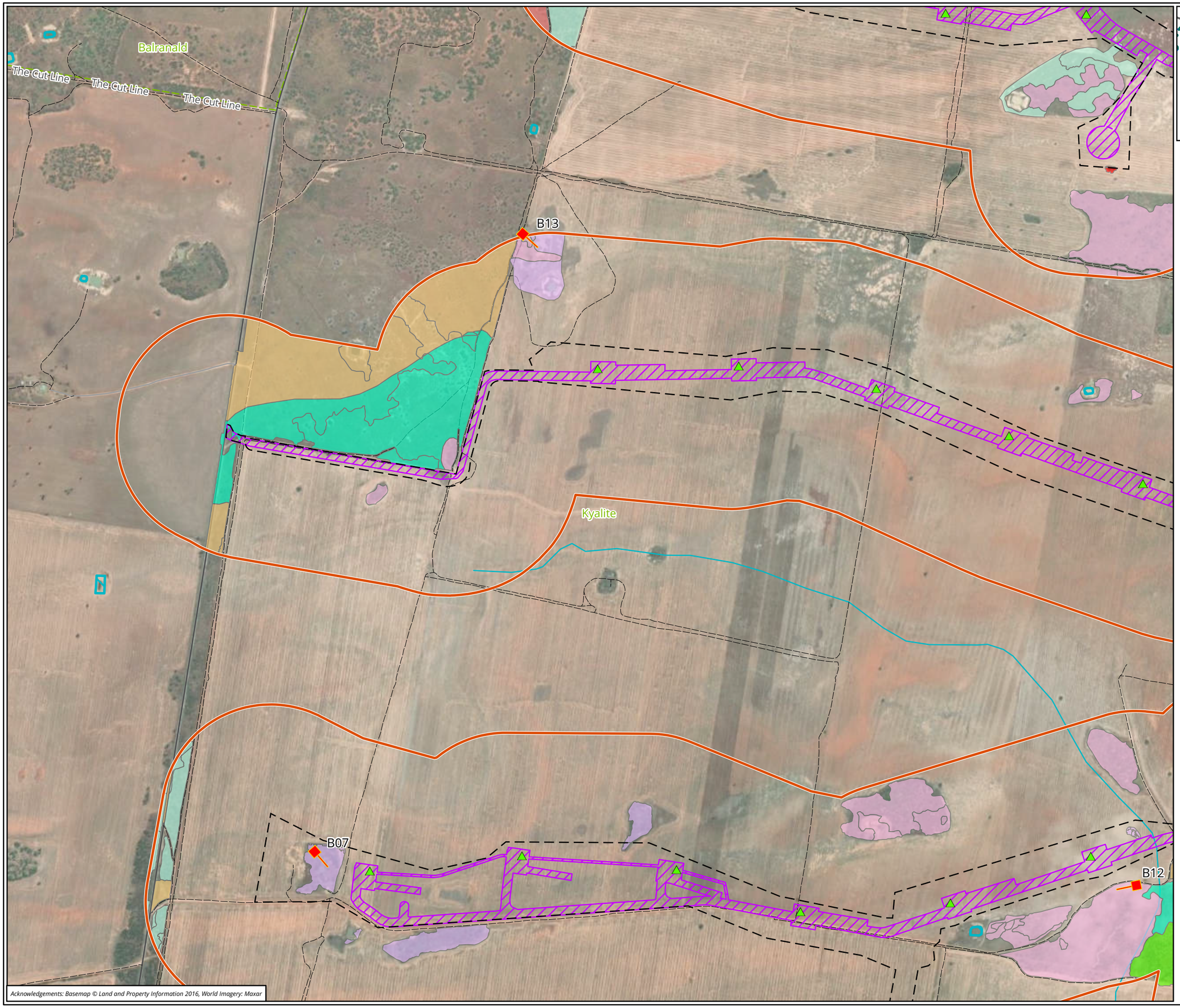
Scale: 1:16,000 @ A3

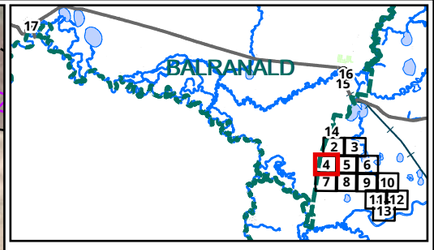
Coordinate System: GDA2020 MGA Zone 54

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_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

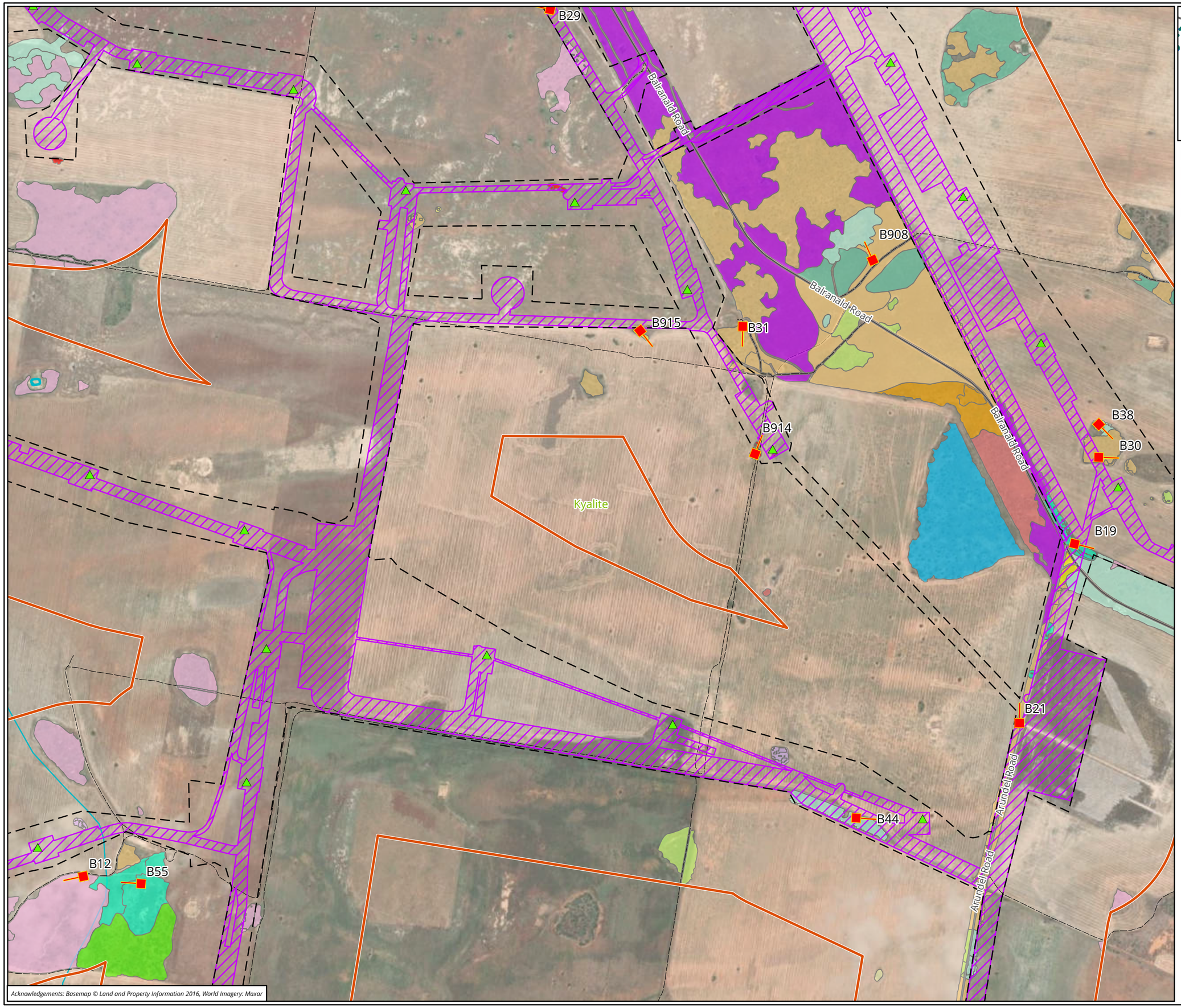
N

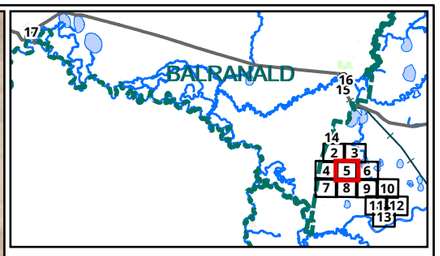
Scale: 1:16,000 @ A3

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

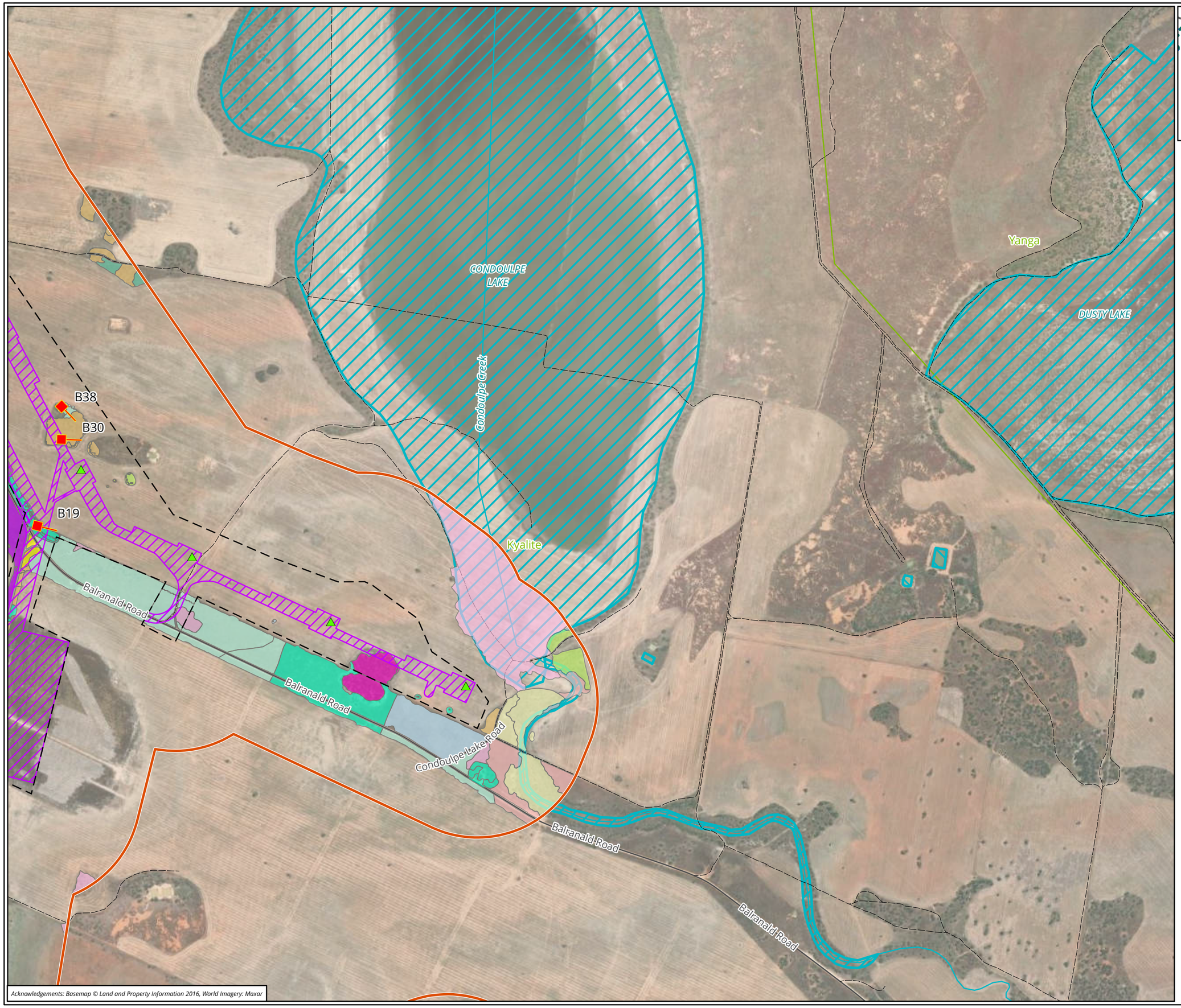
Scale: 1:16,000 @ A3

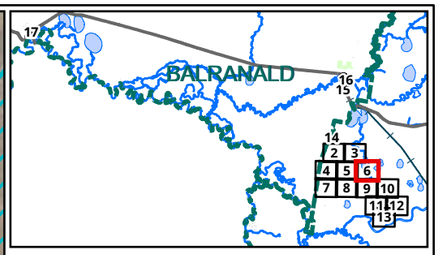
Coordinate System:
GDA2020 MGA Zone 54

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_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

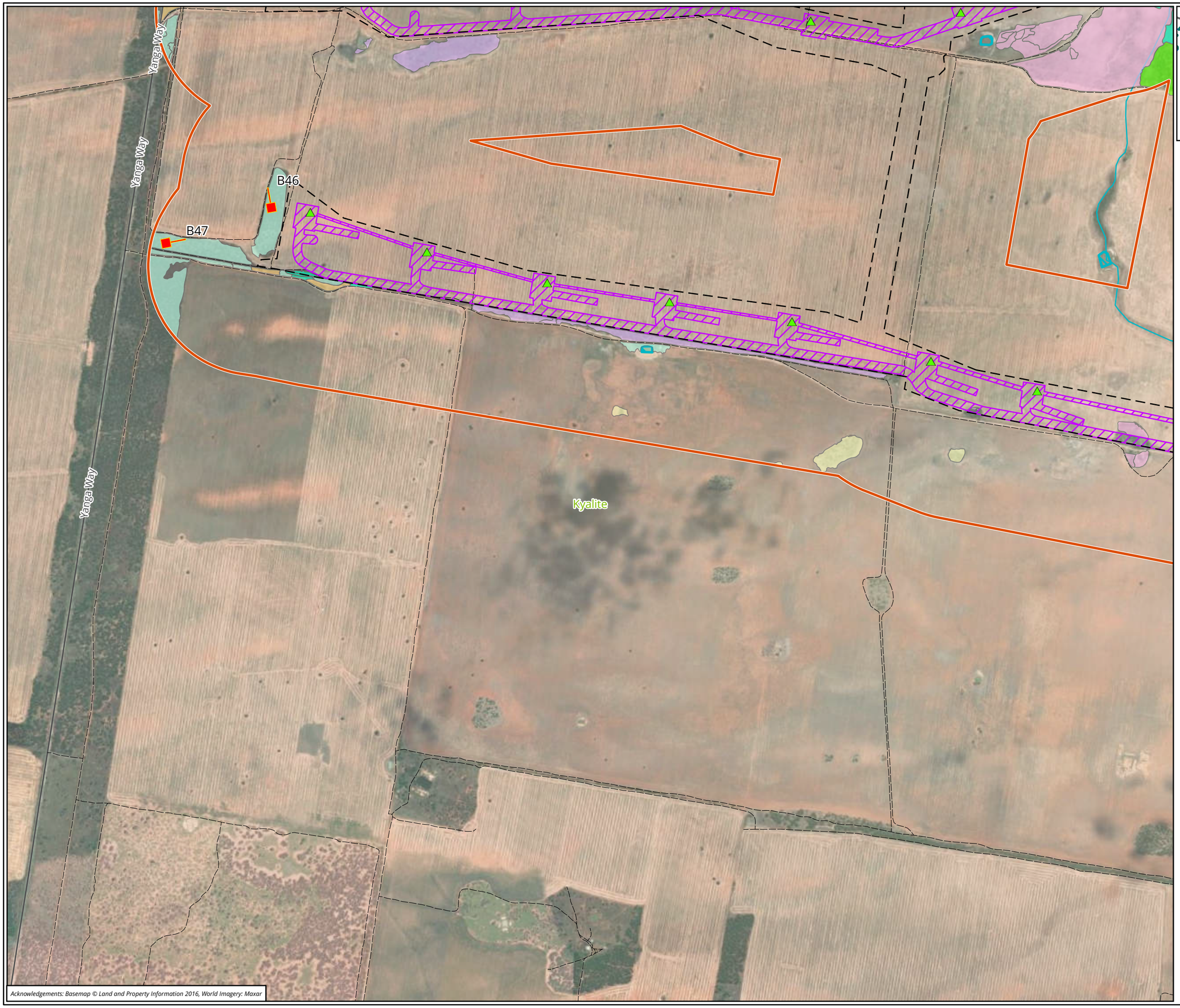
Scale: 1:16,000 @ A3

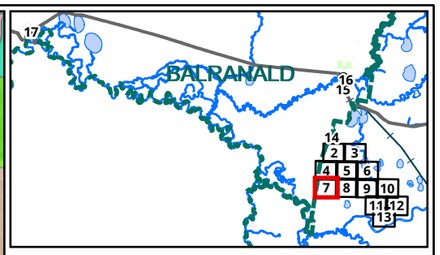
Coordinate System: GDA2020 MGA Zone 54

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 - 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

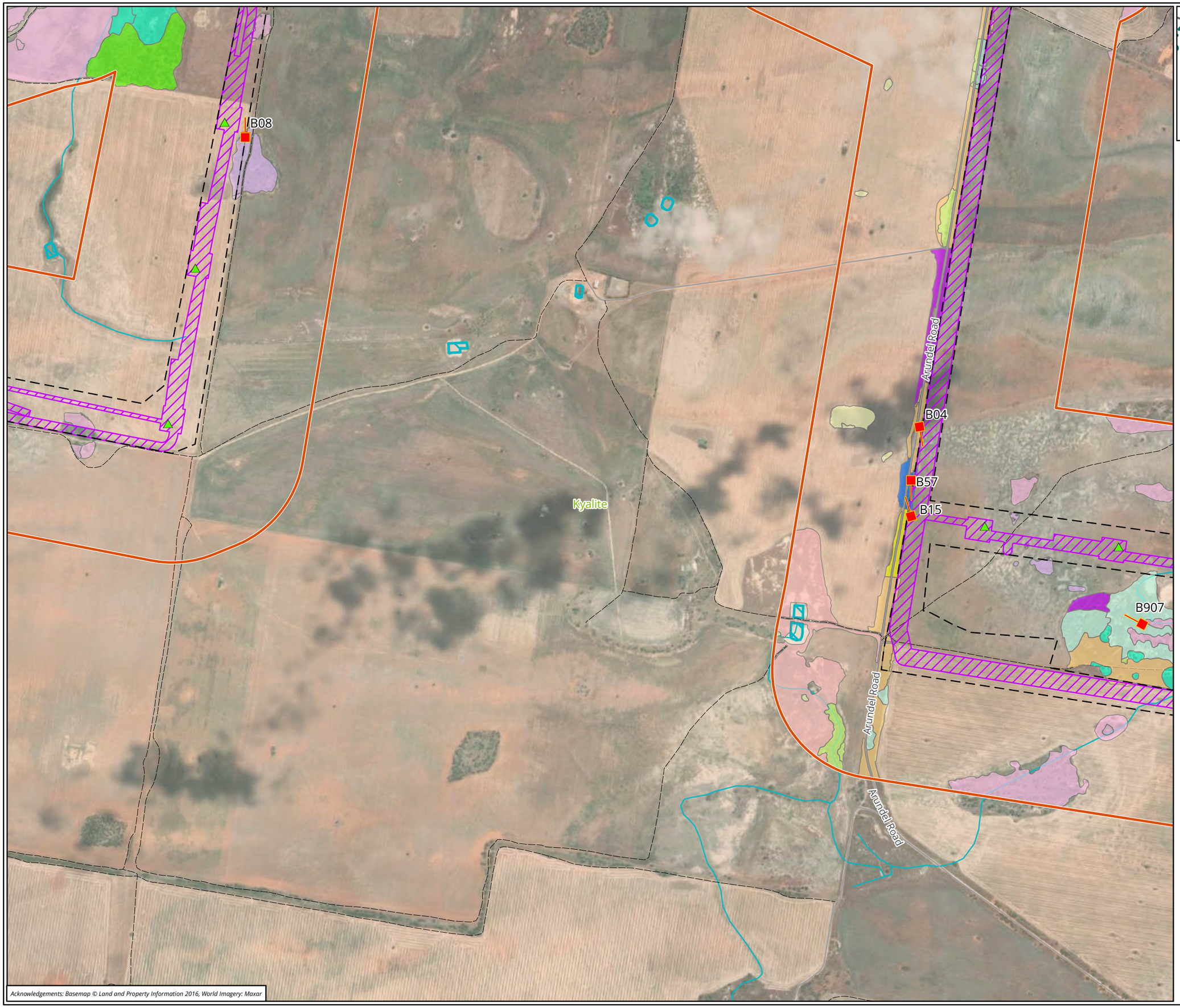
Meters

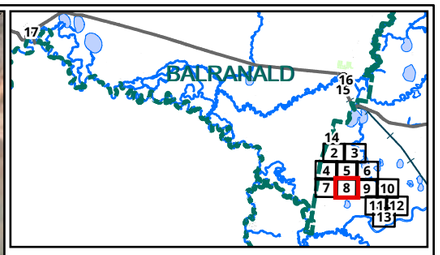
Scale: 1:16,000 @ A3

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

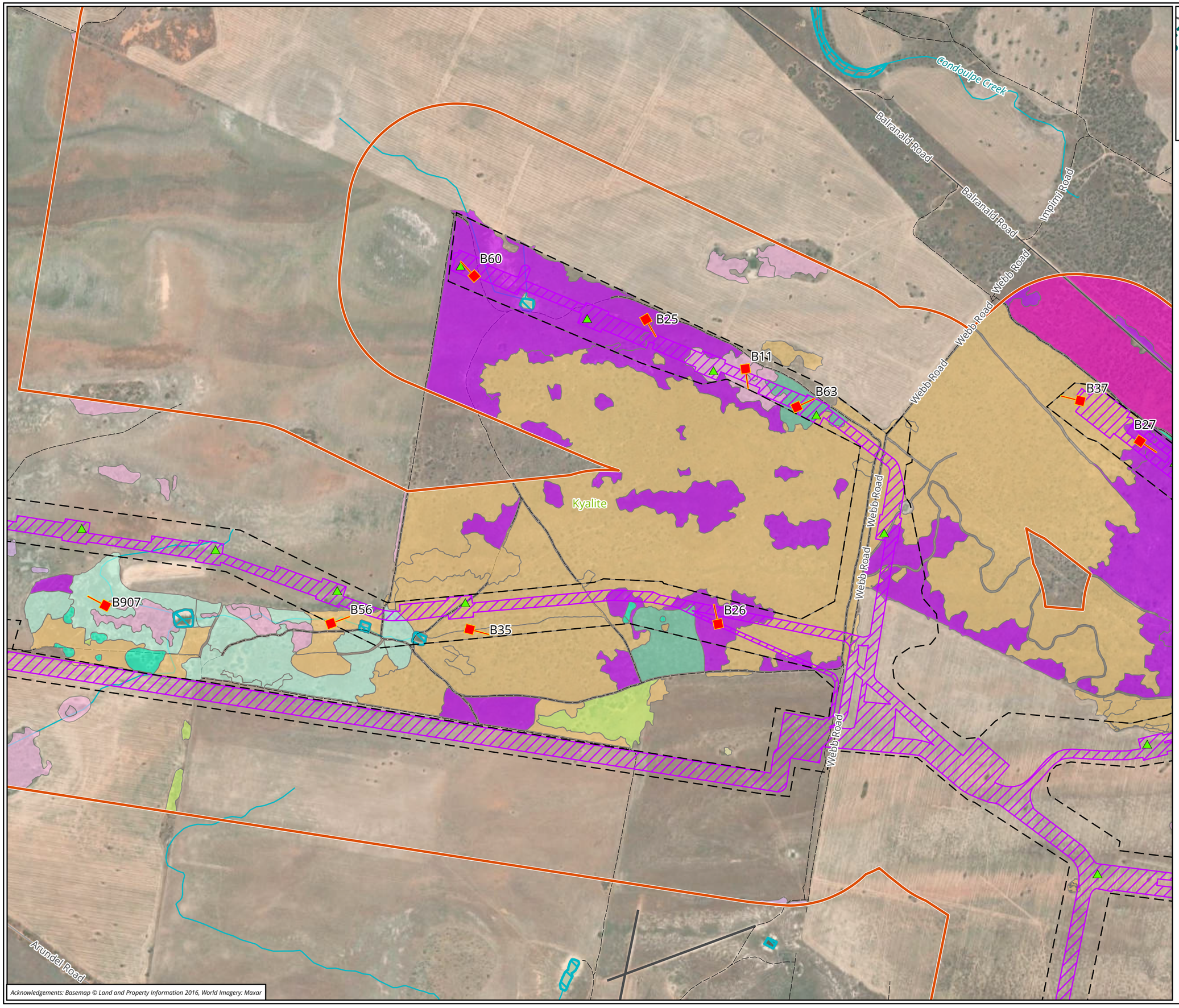
N

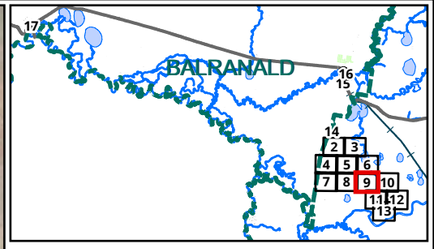
Scale: 1:16,000 @ A3

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
- 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

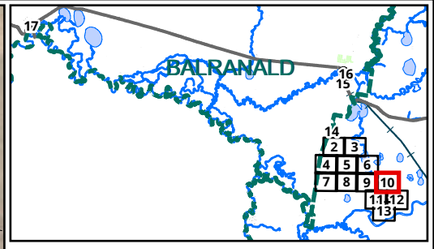
Scale: 1:16,000 @ A3

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_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

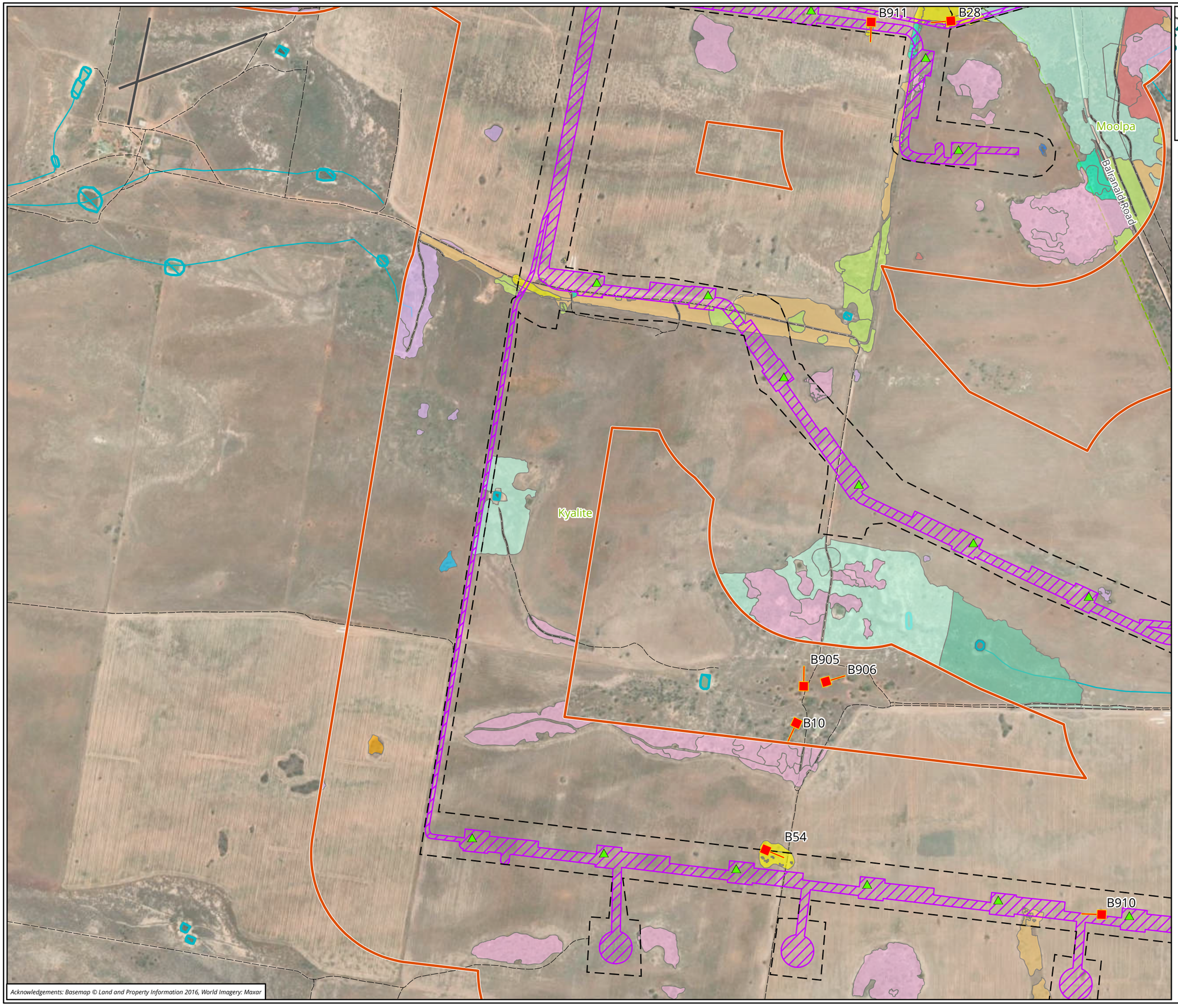
Scale: 1:16,000 @ A3

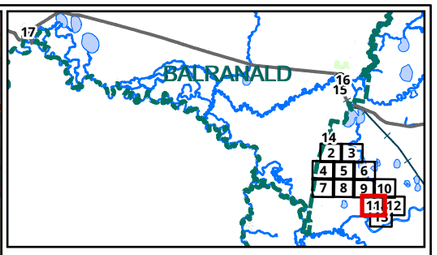
Coordinate System: GDA2020 MGA Zone 54

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_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

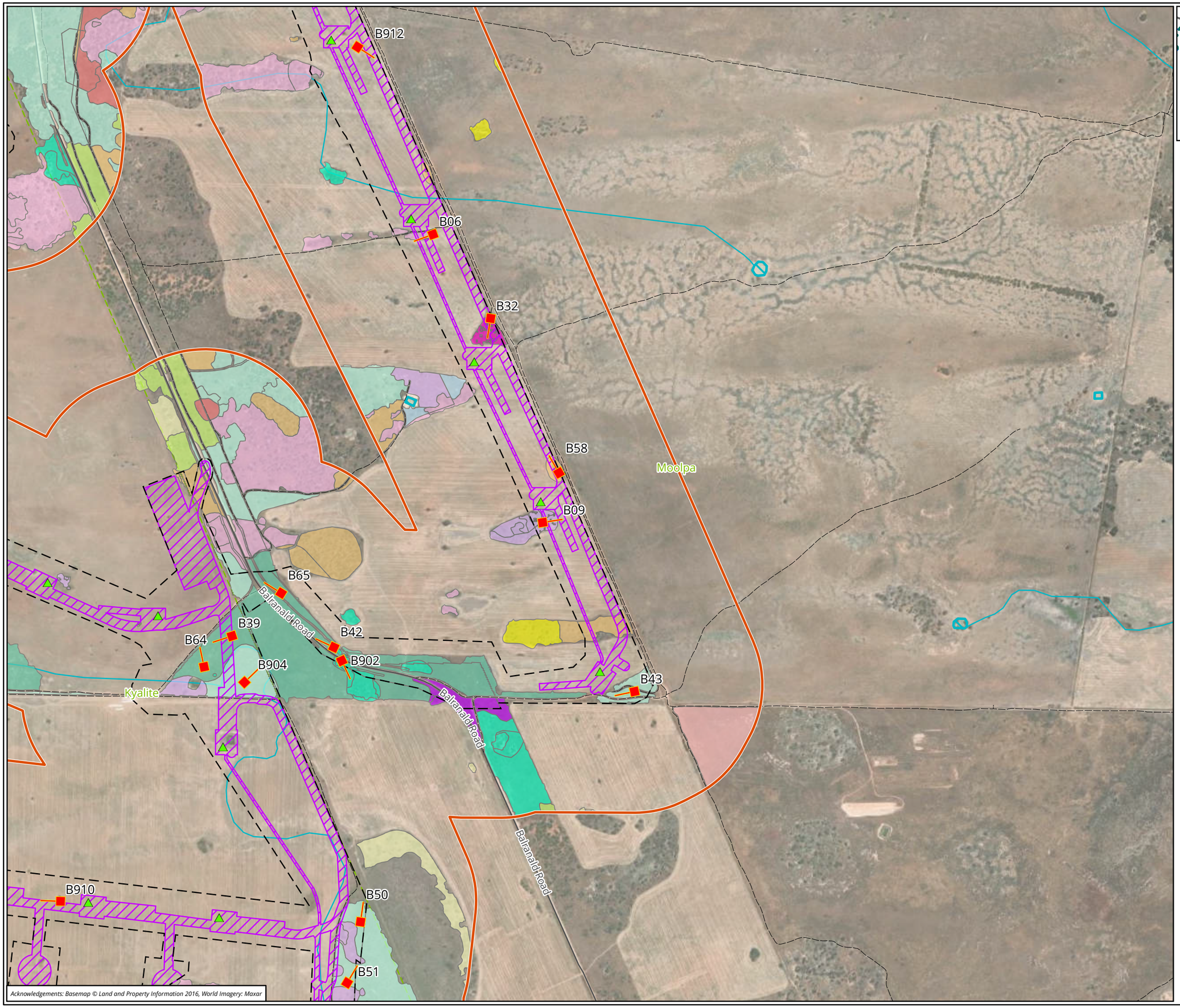
Scale: 1:16,000 @ A3

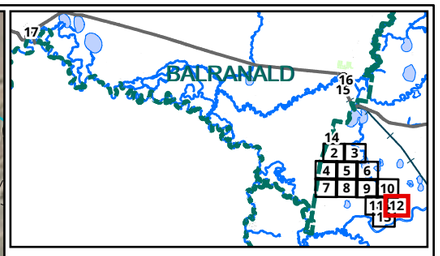
Coordinate System: GDA2020 MGA Zone 54

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_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

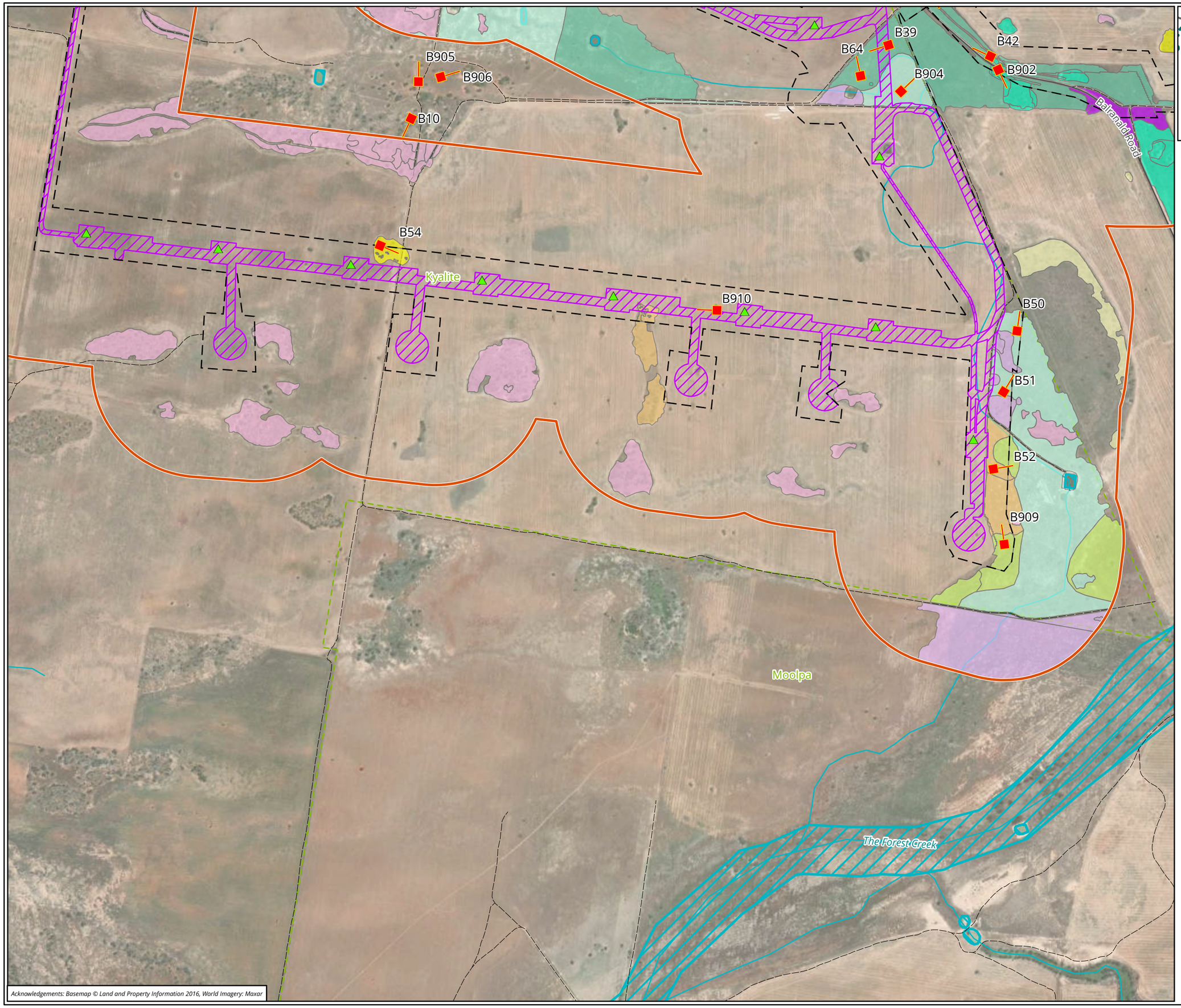
Meters

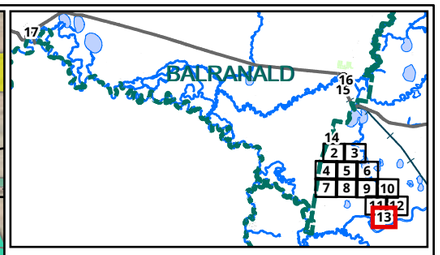
Scale: 1:16,000 @ A3

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
- 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

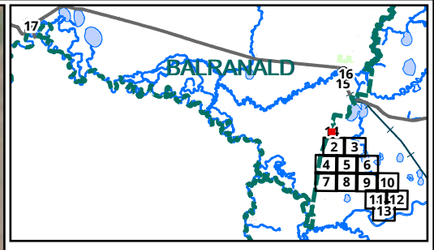
Scale: 1:16,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

Vegetation zones

- 170 - DNG
- 170 - Low

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

Figure 9.14 Vegetation zones and plot locations

0 20 40 60 80

Meters

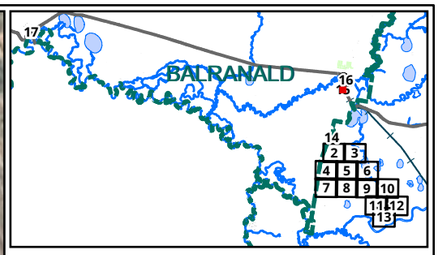
Scale: 1:2,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

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

Figure 9.15 Vegetation zones and plot locations

0 20 40 60 80

Meters

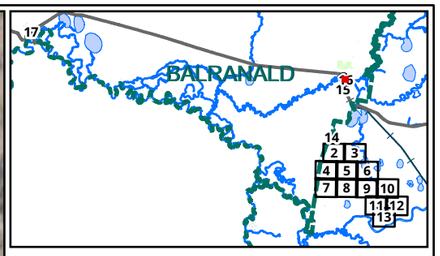
Scale: 1:2,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

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

Figure 9.16 Vegetation zones and plot locations

0 20 40 60 80

Meters

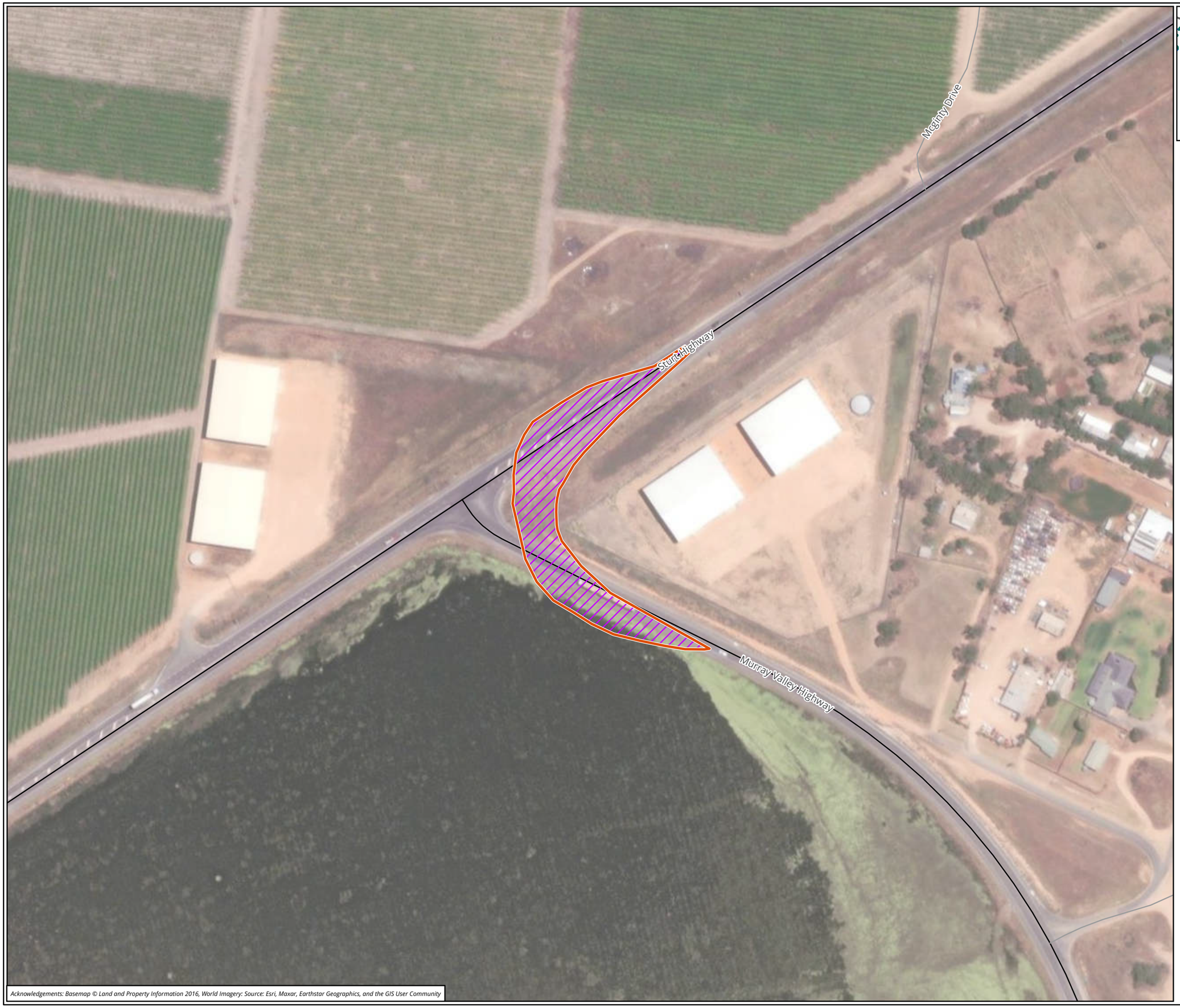
Scale: 1:2,000 @ A3

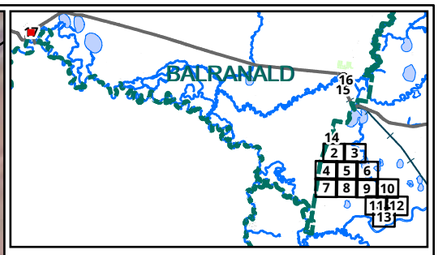
Coordinate System:
GDA2020 MGA Zone 54

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

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

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

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

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 Pink Cockatoo and Regent Parrot.

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.

Pterostylis cobarensis

Potential habitat for *Pterostylis cobarensis* occurs within the subject land in the form of BioNet associated PCT 170 Chenopod sandplain mallee. A detailed assessment was completed for this species to determine if survey is required. Under the NSW profile for this species, the subject land is located within one of the areas

identified as 'known' population. Very few local records of this species occur, with the majority of the species records within NSW occurring in the Pilliga region. The nearest known population occurs north-west of Balranald, near the Mungo State Conservation Area and Mungo National Park, around 70 kilometers from the subject land.

Habitat for this species is defined as including '*eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils.* Habitat that may support this species, including open mallee on sandy-loamy soils, occurs within the subject land. The subject land has regular sheep and cattle grazing present. The habitat assessment found a prolonged history of grazing, with many areas heavily grazed leading to reductions in floristic structure, especially in areas of sandy soils where this species may occur.

Research into this species completed as part of the Saving Our Species Program (NSW DPE 2025) hi-lights that grazing is likely a strong threat to this species, despite its ability to remain underground for prolonged periods. Managed actions include fencing off this species during flowering, where grazing is likely to cause declines. Alongside this, trampling during the flowering period is also noted as detrimental to the species due to compaction of the soil.

The history of grazing and clearing for cropping suggests there is allow likelihood of this species persisting within the subject land.

Further to, and associated with, the grazing history of the subject land, is the generally high level of weed infestation in the understory of the vegetation across the subject land, and in particular PCT 170 providing potential habitat for *Pterostylis cobarensis.* A total of 15 BAM plots were collected with PCT 170 across the subject land, with exotic species common throughout. Exotic species were found to comprise <50 % of the total ground-layer cover in just three plots, exotics comprised 50-65 % total cover in a further four plots, 65-80 % total cover in three plots, and >85 % total cover in five of the 15 plots sampled. Total exotic foliage cover was recorded at >50% in nine of the 15 plots sampled.

BioNet also notes that there appears to be a strong correlation between the species presence and increased moisture levels, based on:

- New rosettes are being produced following soaking autumn and winter rains.
- The species' tendency to grow in sites of litter accumulation and near rocks where run-off is concentrated.
- The majority of plants being located at the bases of larger rock shelves or in crevises between rocks that provide shelter and water accumulation.
- Annual monitoring of a rocky hill within the Macquarie Valley north of Warren has only recorded orchid emergence twice in six years between 2016-2021, with both occasions having significantly above-average rainfall in the season prior to monitoring in October. (BioNet 2024)

As outlined in Section 3.2.4 above, PCT 170 Chenopod sandplain mallee habitat within the subject land does not generally comprise the areas of increased moisture known or expected to support the species. PCT 170 within the subject land occurs as mallee sand dune systems, on elevated landforms shaped by wind, with coarse, well-drained sandy soils that allow water to run off quickly, resulting in drier conditions. These mallee sand dune systems differ from, run-on landscape depressions in hydrology, topography and soil composition, which comprise low-lying areas that collect water and sediments, creating moisture-rich environments with finer clay or loamy soils. Common examples of run-on landscapes include gilgai depressions in vertosol soils, swales between dunes and claypans on floodplains. The parts of the subject land where larger remnants of

PCT 170 occur are mostly associated with mallee dune systems. Run-on areas and more fertile moisture retaining soils have been cleared for cropping but still retain smaller degraded patches of mallee vegetation.

Despite the above information that suggests the subject land supports limited habitat for *Pterostylis cobarensis*, targeted surveys for the species have been completed in October 2023 and October 2024. The results of which are provided in Section 4.3.1 below.

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.
- Burrows that may be used by wombat and indirect evidence such as tracks and scats.

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.

Strong consideration and assessment has been completed regarding the proximity to, and connectivity features associated with the Yanga SCA, Yanga NP and Yanga RP including mapped wetlands, and major watercourses located both north and south of the subject land. Detailed impact assessment alongside avoid and minimise actions have been undertaken (refer to Sections 6 and 7). This has included detailed assessment of local movement corridors for all common and threatened fauna, assessment of local populations and species movements, with a particular focus on avian species at risk of collision impacts. Although many of the habitat features within the subject land, including the seasonal watercourse Condoulpe

Creek and dryland lake, Condoulpe Lake, are not suitable or likely to be utilised outside of major flooding events by waterbirds and migratory birds, these species still have the potential to fly through the subject land.

Additional to this, the woodland habitat within the subject land, connected by a series of TSRs and riparian habitats form a mosaic of features subject to disturbance and fragmentation, that maintains connectivity throughout the landscape between larger core areas of habitat.

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 19 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.

Table 19 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*	Yes
Interior Blind Snake	*Ramphotyphlops endoterus*	-
Jewelled Gecko	*Strophurus elderi*	-

Common name	Species name	Recorded in the subject land
Kultarr	*Antechinomys laniger*	-
Little Eagle	*Hieraaetus morphnoides*	-
Little Pied Bat	*Chalinolobus picatus*	-
Pink 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*	-
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 16, 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:

- Black-eared Miner
  - Species excluded from the Candidate Species list based on BioNet stating 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.
- 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.
- Southern Hairy-nosed Wombat *Lasiorhinus latifrons.*
  - Extensive surveys have been completed across the subject land since 2021. No evidence of burrows that would support wombat, or any other features including potential scats or tracks for this species have been recorded. An assessment of the known population and occurrence of this species was completed. The distribution of BioNet outlines 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 from two BioNet records in NSW both >200 km to the north-west of the subject land. Species is not considered to occur within the subject land.

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.

The subject land is within the 'known' habitat distribution for Painted Burrowing Frog in NSW. Potential habitat exists within the subject land. Surveys for this species are compatible with WHS requirements and site access, where the species emerges with heavy rainfall and flooding, generally > 50 millimetres of rainfall

within 24 hours. With this level of rainfall, the subject land would be inaccessible. As such, presence has been assumed. Further information is provided in Section 4.3.3.

Despite only limited presence of BioNet associated PCTs within the subject land, surveys for Desert Mouse were deemed to require a infeasibly high and extensive trapping method in order to accurately confirm absence of this species. As such, an expert report from the approved Biodiversity Expert list has been prepared (refer Section 4.3.2).

Nocturnal surveys for Crowned Gecko were unable to be completed, and as such the species' presence has been assumed. Further information is provided in Section 4.3.3.

Candidate species credit species considered as part of this assessment, and their associated method of assessment, are listed in Table 20 (flora species) and Table 21 (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 20 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 20 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.
Acacia carneorum	Purple-wood Wattle	All year	October 2024
Atriplex infrequens	A saltbush	November - February	Assumed present

Species name	Common name	Survey period (BioNet)	Method of assessment
Austrostipa metatoris	A spear-grass	October – November	Targeted survey October and December.
Brachyscome papillosa	Mossgiel Daisy	September – November	Targeted survey September and October.
Calotis moorei	A burr-daisy	September – November	Targeted survey September and October.
Cratystylis conocephala	Bluebush Daisy	All year	October 2024
Dodonaea stenozyga	Desert Hopbush	All year	October 2024
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.
Leptorhynchos waitzia	Button Immortelle	September – November	October 2024
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 colutoides	Bladder Senna	All year	October 2024
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 21 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 21 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
Ninox connivens	Barking Owl	All year	Nocturnal bird surveys – February 2023, August 2024
Hamirostra melanosternon **(Breeding)**	Black-breasted Buzzard	September – November	Diurnal bird surveys * - August, November 2021*, July, October 2022* and October 2024.
Burhinus grallarius	Bush Stone-curlew	All year	Nocturnal bird surveys – February 2023, August 2024
Lucasium stenodactylum	Crowned Gecko	January – March, October – December	Presence assumed in all areas of suitable habitat. TBDC states species cannot be reliably surveyed.
Pseudomys desertor	Desert Mouse	March – July, August – December	Expert Report
Hieraaetus morphnoides **(Breeding)**	Little Eagle	August – October	Diurnal bird surveys * - August, November 2021*, July, October 2022* and October 2024.
Neobatrachus pictus	Painted Burrowing Frog	All year	Presence assumed in areas of potential habitat
Lophochroa leadbeateri **(Breeding)**	Pink Cockatoo	September – December	Diurnal bird surveys - November 2021*, October 2022* and October 2024
Lophoictinia isura **(Breeding)**	Square-tailed Kite	September – January	Diurnal bird surveys - November 2021*, October 2022* and October 2024
Haliaeetus leucogaster **(Breeding)**	White-bellied Sea-Eagle	July – December	Diurnal bird surveys * - August, November 2021*, July, October 2022* and October 2024.

* 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 22.

Table 22 Weather observations during targeted flora and fauna surveys (Balranald, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
September threatened flora surveys 2022	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 2022	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 2023	20/02/2023	15.5	39.0	0
	21/02/2023	19.3	36.0	0
	22/02/2023	15.7	35.0	0
	23/02/2023	19.2	32.5	0
March threatened flora surveys 2023	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
August nocturnal bird surveys 2024	26/08/2024	6.6	15.1	0
	27/08/2024	10.3	24.5	0
	28/08/2028	2.9	20.8	0
	29/08/2024	13.3	21.7	0
	30/08/2024	4.1	22.6	0
October diurnal bird survey 2024	15/10/2024	-	18.1	0
	16/10/2024	-0.3	-	0
	17/10/2024	-	21.8	0
	18/10/2024	2.1	26.4	0
October threatened flora 2024	28/10/2024	-	-	0
	29/10/2024	32.5	-	0
	30/10/2024	-	8.6	0

Information from the Australia Government Bureau of Meteorology website and field data collected during surveys.

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 (2021-2022), and targeted flora surveys were completed by NGH 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 22 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 disturbed by tracks, dams, erosions, farm infrastructure and other associated vectors substantially impacting upon the soil profile such as cropped land, and therefore not providing habitat to flora species.

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

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 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).

Of the 12 candidate flora species requiring survey, only two species (*Lepidium monoplocoides* and *Brachyscome papillosa*) have an area of associated PCTs greater than 50 hectares in the development corridor. The remaining ten species require surveys via parallel traverses in accordance with sections 4.1 and 4.2 of the Surveying threatened plants and their habitats (DPIE 2020b). However, given the size of the subject land a modified approach was undertaken for these species, utilising the grid survey approach, combined with parallel traverses, over multiple survey efforts over multiple years, allowing for a survey effort coverage aligned with the requirements of Surveying threatened plants and their habitats (DPIE 2020b).

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 to supplement grid-based searches in September, October and December 2022, March 2023. 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.

Following Agency feedback on the flora survey effort completed during development of the BDRA during the project's EIS phase, additional targeted flora surveys implementing the parallel traverse method were implemented across the development footprint in October 2024. All candidate flora species were targeted during these surveys, and species were grouped by similar growth form and habitat types, to no more than five different species were being targeted during a single transect. This also required some areas to be surveyed twice during this October 2024 period.

Table 23 outlines how species targeted in October 2024 were grouped and surveys completed.

Table 23 October 2024 targeted flora surveys species grouping and transect widths

Group No	Group PCTs	Transect widths (m)	Species	Habitat PCTs	Growth form
1	21, 58, 170	20	*Lasiopetalum behrii*	170	Shrub, >1m
1	21, 58, 170	20	*Santalum murrayanum*	170	Shrub, 3-5m
1	21, 58, 170	20	*Acacia carneorum*	58; 21	Shrub, 2-4m
1	21, 58, 170	20	*Cratystylis conocephala*	58, 170	Shrub, >1m
1	21, 58, 170	20	*Dodonaea stenozyga*	170	Shrub, >1m
2	23, 163, 170	10	*Acacia acanthoclada*	170	Shrub, <1m
2	23, 163, 170	10	*Swainsona pyrophila*	170	Shrub, <1m
2	23, 163, 170	10	*Swainsona colutoides*	23	Shrub, <1m
2	23, 163, 170	10	*Austrostipa metatoris*	170	Grass, <1m
2	23, 163, 170	10	*Calotis moorei*	23, 170	Forb, <1m
2	23, 163, 170	10	*Swainsona sericea*	23	Forb, <1m
3	16, 163, 170	10	*Brachyscome papillosa*	16, 163	Forb, <1m
3	16, 163, 170	10	*Lepidium monoplocoides*	16, 163, 170	Forb, <1m
3	16, 163, 170	10	*Pimelea serpyllifolia* subsp. *serpyllifolia*	170	Forb, <1m
3	16, 163, 170	10	*Pterostylis cobarensis*	170	Orchid, <1m

Group No	Group PCTs	Transect widths (m)	Species	Habitat PCTs	Growth form
3	16, 163, 170	10	*Solanum karsense*	16	Forb, <1m
3	16, 163, 170	10	*Leptorhynchos waitzia*	170	Forb, <1m

October 2024 surveys were undertaken, with reference to the groups and species outlined in the table above, in the following manner:

- PCTs supporting habitat for species in 'Group 1' were surveyed via parallel traverse separated by 20 m across the project's development footprint.
- PCTs supporting habitat for species in 'Group 2' were surveyed via parallel traverse separated by 10 m across the project's development footprint.
- PCTs supporting habitat for species in 'Group 3' were surveyed via parallel traverse separated by 10 m across the project's development footprint.
- Patches of PCT 170 within the development footprint were subject to multiple repeat searches to ensure that each species group was sufficiently sampled.

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 20).

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.

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 24) 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 or 20 metres depending on the target species, were undertaken throughout the development footprint when grid-based searches were less suitable, such as in linear areas or small isolated patches, and throughout the entire footprint in October 2024.
- 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 following the methods prescribed in the relevant BAM guidelines *Surveying threatened plants and their habitats* (DPIE 2020b) were completed for all target species within the development footprint.

A combination of the following efforts ensured a comprehensive survey effort across the development footprint, as well as substantia areas of the border development corridor, and ensured conclusions made around the presence/absence of species are robust and justified:

- 15-19 November 2021: Parallel traverses separated by 20 m (maximum) within 140 point survey locations, each 0.8 ha in area.
- 26-30 September 2022: 270 grid points searched, 40 metre x 40 metre in area, plus 10 metre wide parallel traverses between 90% of grids.
- 24-27 October 2022: 165 grid points searched, 40 metre x 40 metre in area, plus 10-metre-wide parallel traverses between 90% of grids.
- 5-9 December 2022: Parallel traverses at known locations of Bitter Quandong and *Austrostipa metatoris,* and incidentally throughout the development footprint and development corridor with BAM plot collection.
- 29-31 March 2023: 119 grid points searched, 40 metre x 40 metre in area, plus 10-metre-wide parallel traverses between 90% of grids.
- 28-31 October 2024: Parallel traverses, separated by either 10 m or 20 m throughout all areas of potential habitat within the development footprint.

All targeted flora surveys were completed during the targeted species' survey periods as detailed in BioNet.

Atriplex infrequens requires survey between November and February, and as such was unable to be subject to the above listed targeted survey effort. Therefore presence of the species has been assumed. Further detail is provided below.

Survey personnel and relevant experience

Targeted flora surveys were undertaken by the Biosis ecologists listed in Table 24. 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 24 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 seven years' experience undertaking threatened flora surveys throughout Victoria and semi-arid NSW with a strong knowledgebase of the flora present within the subject land.
Nicholas Lloyd	Botanist	Over three years' experience undertaking targeted flora surveys in NSW and Victoria, combined with an academic background in botany and ecology.
Todd Horton	Botanist	Over three years' experience undertaking targeted flora surveys in NSW, combined with previous experience in semi-arid landscapes in south-eastern Australia.
Michael Bodnarcuk	Graduate botanist	Over two years' experience undertaking targeted flora surveys in NSW and VIC.
Cassandra Kalafatakis	Graduate botanist	Over two years' experience undertaking targeted flora surveys in NSW and VIC.

Results

Table 25 provides a summary of the results of the targeted flora surveys completed, survey effort and results are illustrated on Figure 10.

Table 25 Summary of targeted flora survey effort and results

Species name	Common name	Survey period (BioNet)	Surveyed Nov 2021	Surveyed Sept 2022	Surveyed Oct 2022	Surveyed Dec 2023	Surveyed Mar 2023	Surveyed Oct 2024	Recorded / assumed present	Impacts
Acacia acanthoclada	Harrow Wattle	August – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Acacia carneorum	Purple-wood Wattle	All year	Yes	Yes	Yes	Yes	Yes	Yes	**Not recorded** - sufficient survey coverage	Nil
Atriplex infrequens	A saltbush	November - February	Yes	No	No	Yes	No	No	**Assumed present** – insufficient survey coverage following Nov 2021 and Dec 2023 surveys	14.34 ha
Austrostipa metatoris	A spear-grass	October – November	Yes	No	Yes	No	No	Yes	**Recorded** – impacts avoided	Nil
Brachyscome papillosa	Mossgiel Daisy	September – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Calotis moorei	A burr-daisy	September – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Cratystylis conocephala	Bluebush Daisy	All year	Yes	Yes	Yes	Yes	Yes	Yes	**Not recorded** - sufficient survey coverage	Nil
Dodonaea stenozyga	Desert Hopbush	All year	Yes	Yes	Yes	Yes	Yes	Yes	**Not recorded** - sufficient survey coverage	Nil
Lasiopetalum behrii	Pink Velvet Bush	All year	Yes	Yes	Yes	Yes	Yes	Yes	**Not recorded** - sufficient survey coverage	Nil
Lepidium monoplocoides	Winged Peppercress	September – December	Yes	Yes	Yes	Yes	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Leptorhynchos waitzia	Button Immortelle	September – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil

Species name	Common name	Survey period (BioNet)	Surveyed Nov 2021	Surveyed Sept 2022	Surveyed Oct 2022	Surveyed Dec 2023	Surveyed Mar 2023	Surveyed Oct 2024	Recorded / assumed present	Impacts
Pimelea serpyllifolia* subsp. *serpyllifolia	Thyme Rice-Flower	July – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Pterostylis cobarensis	Greenhood Orchid	October	No	No	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Santalum murrayanum	Bitter Quandong	All year	Yes	Yes	Yes	Yes	Yes	Yes	**Recorded** – impacts avoided	Nil
Solanum karsense	Menindee Nightshade	September – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Swainsona colutoides	Bladder Senna	All year	Yes	Yes	Yes	Yes	Yes	Yes	**Not recorded** - sufficient survey coverage	Nil
Swainsona pyrophila	Yellow Swainson-pea	September – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil
Swainsona sericea	Silky Swainson-pea	September – November	Yes	Yes	Yes	No	No	Yes	**Not recorded** - sufficient survey coverage	Nil

As outlined in above, the subject land it considered to support limited habitat for *Pterostylis cobarensis*, and the species presence has been discounted following targeted surveys in October 2022 and October 2024.

BioNet states that new rosettes are produced following soaking autumn and winter rains, and that annual monitoring of a rocky hill within the Macquarie Valley north of Warren has only recorded orchid emergence twice in six years between 2016-2021, with both occasions having significantly above-average rainfall in the season prior to monitoring in October.

Rainfall preceding October 2022 was well above average during April, May and August, and at or below average for June and July, with substantial rainfall occurring also in September and through October (BOM 2024). Based on these rainfall totals, it could be expected that site conditions for the species would be suitable, if present. No evidence of the species, including rosettes were recorded. Furthermore it should be noted that no orchids (including rosettes) were recorded during any floristic data collection during the overall project.

Rainfall preceding the October 2024 surveys was generally below average, with only May rainfall being recorded above the expected average, according to BOM data. However it is known that *Pterostylis cobarensis* did flower in the region in 2024, and it is known to have been generally dry throughout the broader region, similar to the subject land. Again it can be inferred that conditions were suitable on site for the species to flower (if present), based on confirmation of flowering elsewhere in the region, despite the lack of above average rainfall. Plants have been recorded flowering, albeit poorly, in average to dry seasons (Copelandi, L & Backhouse 2022), and again no evidence of *Pterostylis cobarensis* was recorded within the subject land.

Austrostipa metatoris surveys were undertaken by experienced and qualified botanists, led by Georgina Zacks, a botanist with over six years' botanic identification experience and Callan Wharfe with over 15 years' botanic identification experience. *Austrostipa metatoris* samples were collected under Biosis' Scientific Licence and pressed. These samples were re-assessed, and species re-confirmed by Matthew Looby, a highly skilled Principal Ecologist (Botanist) with over 20 years' experience undertaking botanic identification. The samples were not sent to the National Herbarium of New South Wales, the samples of *Austrostipa metatoris* contained the key diagnostic features for this species, allowing for accurate identification.

Nocturnal birds

Survey method and effort

Targeted survey was undertaken for Bush Stone-curlew and Barking Owl in February 2023 and August 2024, with incidental surveys also completed for Masked Owl and Plains Wanderer in February 2023. Survey initially comprised targeted habitat assessment and hollow-bearing tree mapping within wooded areas of the subject land that occur within patches of Black Box woodland, Black Oak woodland and Mallee vegetation. It is noted that Barking Owl is only associated with Black Box woodland PCTs (PCT 13, 15, 16) in the TBDC, and not Black Oak or Mallee dominated vegetation (i.e. PCTs 57, 58, 170), however these areas were sampled to ensure a suitably broad range of possible habitats were surveyed for both tree-hollows and targeted nocturnal surveys, and ensure both potential breeding and forage habitats were sampled.

Suitable tree hollows (> 20 centimetre diameter, >4 metres above the ground) are noted as the BAM habitat constraint for Barking Owl, and thus where these features are absent, the species' presence can be discounted. Suitable hollows were found to be highly limited within the development corridor and surrounds, with just two potential breeding hollows recorded from a total of 257 hollow-bearing trees mapped. Potential breeding hollows are considered trees within TBDC associated PCTs (in this case Black Box trees), with hollows meeting the required height and diameter parameters, and not occupied by other fauna (i.e. Barn

Owls, Owlet-nightjars, parrots, etc., which were recorded in a number of trees). The density of potential breeding trees for Barking Owls is therefore estimated to be very low within woodland patches across the subject land (<1% of total hollow-bearing trees recorded).

Nocturnal surveys were repeated over eight replicate nights for Bush-stone Curlew and Barking Owl, and included:

- Habitat searches.
- Call playback and detection in suitable habitat for Bush-stone Curlew, including a 30-second call playback, followed by four minutes and 30 seconds of listening (conducted three times per site per evening). The survey guidelines do not specify the number of replicate nights of survey recommended, however in this case, four nights of survey were undertaken to align with the owl surveys.
- Spotlighting through suitable habitat for Bush Stone-curlew.
- Flushing vegetation (opportunistic) for Bush Stone-curlew.
- Call playback and detection in suitable habitat for Barking Owl, including an initial 10-minute listening period, followed by a 15 minute call playback and listening period (composed of 15 seconds of call playback and 30 seconds of listening, repeated 20 times) per species; plus a final 15 minute listening and spotlighting period following the survey.

A total of eight survey sites were sampled within the larger and higher condition woodland patches across the subject land, with a total of 40 replicate surveys completed. Six sites were sampled six times, with two sites sampled twice, with the reduced sampling effort resulting from access constraints.

Survey locations were strategically placed at a minimum distance of approximately 2 kilometres apart, ensuring that all suitable habitat within the subject land was targeted (Figure 10). Spotlighting surveys were conducted for Plains Wanderer during the February survey period in the vicinity of the call playback survey locations, in open grassy / woodland vegetation, representing the largest areas of most intact and grassy habitat that could potentially support the species.

A summary of survey effort is outlined below in Table 26.

Table 26 Barking Owl and Bush Stone-curlew replicate surveys

Survey site	Habitat	Dates surveyed	Replicates per nights	Total replicates
1	Higher condition patch of Black Box woodland / wetland	26-Aug-24	2	6
		27-Aug-24	1	
		28-Aug-24	2	
		29-Aug-24	1	
2	Black Oak woodland within large intact patch along Yanga Way	22-Feb-23	1	6
		23-Feb-23	1	
		26-Aug-24	1	
		27-Aug-24	1	
		28-Aug-24	1	
		29-Aug-24	1	

Survey site	Habitat	Dates surveyed	Replicates per nights	Total replicates
3	Mallee woodland within large intact patch along Yanga Way	22-Feb-23	1	2
		23-Feb-23	1	
4	Black Oak woodland within intact patch along Balranald Road	22-Feb-23	1	2
		23-Feb-23	1	
5	Higher condition patch of Black Box woodland / wetland along Condoulpe Creek	26-Aug-24	1	6
		27-Aug-24	2	
		28-Aug-24	1	
		29-Aug-24	2	
6	Black Oak woodland within large intact patch in centre of subject land	20-Feb-23	1	6
		21-Feb-23	1	
		26-Aug-24	1	
		27-Aug-24	1	
		28-Aug-24	1	
		29-Aug-24	1	
7	Black Oak woodland within intact patch along Balranald Road	20-Feb-23	1	6
		21-Feb-23	1	
		27-Aug-24	1	
		28-Aug-24	2	
		29-Aug-24	1	
8	Higher condition patch of Black Box woodland / wetland	20-Feb-23	1	6
		21-Feb-23	1	
		26-Aug-24	1	
		27-Aug-24	1	
		28-Aug-24	1	
		29-Aug-24	1	

It is acknowledged that three of the sites were subject to two replicate survey over a single night. However, this is not considered a major constraint or limitation to the survey effort as replicate surveys were separated by no less than four hours if repeated on a single night.

Justification of survey method and effort

Survey was undertaken in accordance with methodology outlined in the TBDC (NSW DCCEEW 2025), the NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004) and Survey guidelines for Australia's threatened birds (DEWHA 2010a).

A total of approximately 1390 hectares of woodland / mallee vegetation (excluding DNG areas), providing potential habitat for Barking Owl, occurs within the broader subject land, with impacts occurring to approximately 33 hectares of these vegetation types. The TBDC states that call playback stations are to be evenly distributed within areas of up to 1000 hectares of suitable habitat at a density of 1 station for 100 hectares, with each station requiring six replicate surveys. When considering the BAM habitat constraint for Barking Owl as requiring tree hollows > 20 centimetre in diameter, >4 metres above the ground, and the noted scarcity of suitable trees recorded (<1% of all tree hollows recorded), suitable habitat as defined in the TBDC is substantially less than the total 1390 hectares of wooded vegetation present with the subject land.

As outlined above, a total of eight survey sites were sampled within the larger and higher condition woodland patches across the subject land, with a total of 40 replicate surveys completed. This sampling density would be sufficient for slightly less than 700 hectares of suitable habitat, based on the TBDC requirements of 1 station for 100 hectares. Due to the very low density of suitable tree hollows for Barking Owl (the species' BAM habitat constraint), it cannot be concluded that more than 50 % of the 1390 hectares of woodland / mallee vegetation within the subject land could be considered 'suitable habitat'. As such 40 replicate surveys completed across eight nights and two seasons, is more than sufficient to meet the TBDC survey requirements for the species.

Timing of survey

Nocturnal bird survey was undertaken in February 2023 and August 2024, 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 (February). These surveys were also completed in accordance with required timing for Barking Owl and Masked Owl.

Survey personnel and relevant experience

Nocturnal bird surveys were undertaken by the Biosis ecologists outlined in Table 27, survey effort is illustrated on Figure 10.

Table 27 Targeted nocturnal bird survey personnel and relevant experience

Staff member	Position	Relevant experience
Caragh Heenan	Senior Zoologist	Six years' experience conducting threatened fauna surveys within NSW.
Yonina Eizenberg	Zoologist	Five years' experience conducting threatened fauna surveys within NSW.
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 28 provides a summary of the results of the nocturnal bird surveys completed.

Table 28 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 – 20-23 February 2023 • 2 nights call-playback and spotlighting across 3 survey locations – 26 – 29 August 2024	Not recorded during surveys	N/A
Pedionomus torquatus	Plains Wanderer	• 4 nights spotlighting across 6 survey locations • 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 – 20-23 February 2023 • 4 nights call-playback and spotlighting across 6 survey locations – 26 – 29 August 2024	Not recorded during surveys	N/A
Tyto novaehollandiae	Masked Owl	• 4 nights call-playback and spotlighting across 6 survey locations – 20-23 February 2023	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. Further targeted breeding habitat surveys were completed by Biosis in October 2024, detailed below.

Bird utilisation surveys follow a systematic, repeatable, survey method, replicated over multiple seasons and are thus aligned with the requirements of the various relevant guidelines for determining presence / absence of the target species with a given study area. Further justification of effort is provided below.

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 29 below.

Table 29 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 per point over two years and around 960 minutes, or 160 hours, of targeted diurnal bird surveys per point (Nature Advisory 2023a). A total of 640 replicates over 9,600 minutes (160 hours) of targeted diurnal bird surveys were undertaken across the subject land.

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 Guidelines for detecting birds listed as threatened under the EPBC Act (Commonwealth of Australia 2010).

The lists of species requiring targeted surveys in accordance with the BAM, and for which BUS is a suitable method to determine presence / absence includes the following:

- Australian Bustard
- Black-breasted Buzzard
- Little Eagle
- Pink Cockatoo
- Square-tailed Kite
- White-bellied Sea-Eagle

The TBDC only provides specific guidance on surveys targeting the presence breeding activity from the above species (with the exception of Australian Bustard). Therefore required survey effort for presence/absence surveys a more aligned with the requirements of NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004), or the Commonwealth Survey guidelines for Australia's threatened birds (Commonwealth of Australia 2010) which prescribe surveys effort for the EPBC Act parrots and raptors including; Baudin's black cockatoo, Carnaby's black cockatoo, Glossy black cockatoo (Kangaroo Island), Red-tailed black cockatoo (south-eastern), Regent parrot (eastern), Superb parrot, Swift parrot, Tasmanian Wedge-

tailed Eagle, and Christmas Island goshawk, considered transferable to the target parrot and raptor species listed above.

NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004) prescribe Area Searches and Point Counts as suitable survey methods for determining presence / absence of target species from a site. Bird utilisation surveys are a combination of these two methods, and combine surveys over a series of pre-determined points, for pre-determined period of time (20 minutes). The Guidance (DEC 2004) notes that it has been shown that 3 x 20 minute censuses of a 2 hectare block revealed only 53 % of the species present while 3 x 60 minute searches revealed 90.4 % of species (Loyn 1968). Thus the longer the total time period spent undertaking surveys, the greater the number of species that can expected to be recorded.

Commonwealth survey guidelines specify that suitable survey methods for parrots include; Area searches or transects in suitable habitat in and around the study area, with detection by sightings, calls or foraging signs, as well as transects by vehicle in suitable open, expansive habitat, with detection by sighting.

Commonwealth survey guidelines specify that suitable survey methods for raptors include; Observation from vantage points to detect soaring species over suitable habitat, with detection by sightings, area searches on foot in suitable habitat in and around the study area, with detection by sightings, calls and signs of occupancy, transect surveys by vehicle within extensive study areas looking for flying or perched birds and nests.

Commonwealth survey guidelines list minimum survey effort to determine presence / absence, for areas of habitat up to 50 hectares in area, for the following transferrable species as:

- Baudin's black cockatoo
  - Targets searches of food and nest trees: 8 hours over 4 days
  - Land-based area searches or line transects: 12 hours over 6 days
- Carnaby's black cockatoo
  - Targeted searches: 8 hours over 4 days
  - Land-based area searches or line transects: 12 hours over 6 days
- Glossy black cockatoo (Kangaroo Island)
  - Targeted searches of food and nest trees: 20 hours over 4 days
  - Land-based area searches or line transects: 5 hours over 1 days
- Red-tailed black cockatoo (south-eastern)
  - Targeted searches of food and nest trees: 20 hours over 10 days
  - Area searches or transect surveys: 16 hours over 8 days
- Regent parrot (eastern)
  - Targeted searches: 12 hours over 4 days
  - Area searches: 12 hours over 4 days
- Superb parrot
  - Targeted searches: 12 hours over 4 days
  - Area searches or transect surveys: 12 hours over 4 days

- Swift parrot
  - Targeted searches: 20 hours over 8 days
  - Area searches or transect surveys: 20 hours over 8 days
- Tasmanian Wedge-tailed Eagle:
  - Area searches or transect surveys: 20 hours of surveys over 10 days
- Christmas Island goshawk
  - Area searches: 20 hours of surveys over 4 days

The total BUS effort completed for the project equates to approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches.

This level of effort far exceeds the minimum requirements outlined for the above species, even when effort is scaled up from the prescribed 50 hectare area, to the larger areas of potential habitat within the project's development footprint, development corridor and subject land.

As such, where any of the target bird species were not recorded during BUS sufficient survey has been completed to confirm absence from the subject land in accordance with both NSW Threatened Biodiversity Survey and Assessment Guidelines (DEC 2004) and Commonwealth Survey guidelines for Australia's threatened birds (Commonwealth of Australia 2010).

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 30.

Table 30 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.
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 31 below provides a summary of the results of the diurnal bird surveys completed.

Table 31 Summary of diurnal bird survey method and results

Species Name	Common name	Survey method and effort	Survey results	Species Polygon (ha)
Ardeotis australis	Australian Bustard	• Diurnal ecological surveys undertaken by Biosis, Nature Advisory and NGH Consulting. • 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. • A total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches	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 • Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May 2021 and February, April 2022 • Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021 • Large conspicuous raptor, whose presence on site would reliably have been detected. • A total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches	Not recorded during surveys either during or outside breeding season. 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 • Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, August 2021 and February, April, July 2022 • Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021 • Large raptor, whose presence on site would reliably have been detected (at a minimum) during targeted diurnal bird surveys. • A total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches	Not recorded during surveys either during or outside breeding season. The species is considered not to occur within the subject land in any more than a transient occasional basis.	N/A

Species Name	Common name	Survey method and effort	Survey results	Species Polygon (ha)
Hieraaetus morphnoides	Little Eagle	• Diurnal surveys undertaken by Nature Advisory during breeding season: August 2021 and October 2022 • Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, November 2021 and February, April, July 2022 • Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021 • Large conspicuous raptor, whose presence on site would reliably have been detected. • A total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches	Not recorded during surveys either during or outside breeding season. The species is considered not to occur within the subject land in any more than a transient occasional basis.	N/A
Lophochroa leadbeateri	Pink Cockatoo	• Diurnal surveys undertaken by Nature Advisory during breeding season: November 2021 and October 2022 • Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, August 2021 and February, April, July 2022 • Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021 • 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. • A total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches	Species recorded on multiple occasions both during and outside breeding season. 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 • Diurnal surveys undertaken by Nature Advisory outside breeding season: February, May, August 2021 and February, April, July 2022 • Diurnal ecological surveys undertaken by Biosis throughout 2022 and early 2023, and ecological surveys undertaken by NHG Consulting in November 2021 • Large conspicuous raptor, whose presence on site would reliably have been detected. • A total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches	Not recorded during surveys either during or outside breeding season. The species is considered not to occur within the subject land in any more than a transient occasional basis.	N/A

Pink Cockatoo

Further to the information provided in Table 31 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, during the main survey campaign for the project, 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 in February 2023, 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 Pink Cockatoo were recorded by NHG Consulting in November 2021.

Additional hollow-tree surveys were completed alongside raptor nest surveys in October 2024, with further details provided below.

Habitat polygons are further described in Section 4.3.3 below.

Candidate raptor species

Target raptor species have not been recorded within the subject land during breeding season. This includes 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.

Despite this, further assessment of potential nests were completed in October 2024, during breeding season for the target raptor species, following feedback from CPHR on the EIS BDAR (Biosis 2024). Further details are provided below.

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.

Diurnal birds – Additional breeding surveys

Targeted surveys for breeding activity of threatened raptors (Black-breasted Buzzard, Little Eagle, Square-tailed Kite, White-bellied Sea Eagle) alongside other non-threatened raptors (e.g., Wedge-tailed Eagle) were completed in October 2024 to supplement presence/absence surveys completed during BUS (as outlined above). Surveys were completed across the subject land, with a primary focus on areas:

- Within 300 m from turbine blade tips for all raptor species.
- Within 500 m from turbine blade tips, and within one km of a major waterbody for White-bellied Sea Eagle.
- Within a broader search area of 500 m from turbine blade tip for raptors generally.

The targeted survey effort focussed on the presence stick nests within the areas outlined above, as well as near-constant surveys for the presence of the target species either in flight, in trees, or particularly in nests. All nests were recorded, with general size (small, medium large) noted and detail recorded if the nest was active/non active. If the nest was active, the species in use of the nest was identified.

Diurnal surveys for Pink Cockatoo, including tree-hollow surveys, were completed concurrently with stick nest surveys for raptor surveys. All occurrence of Pink Cockatoo were recorded, with flight direction and any signs of breeding activity recorded.

Survey method

Raptors

Survey method for breeding raptors included traversing all areas of native wooded vegetation, on foot, within the buffer areas outlined above (equivalent to the target species' "breeding habitat buffers" as prescribed in the TBDC) searching for suitable trees and stick nests. Surveys included searches for:

- Living or dead large old trees within suitable vegetation AND the presence of a male and female of the target species.
- Living large old trees within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest within tree canopy (White-bellied Sea-Eagle only).
- Any adult bird with nesting material.

- An individual on a large stick nest in the top half of the tree canopy.
- Pairs displaying (soaring, diving, engaging in chases, or a male observed calling in flight with a female begging from tree).
- Adults observed duetting within breeding period.

Pink Cockatoos

Pink Cockatoos have been determined as likely to be breeding within the subject land. Due to the widespread nature of the records of the species and potential nesting trees across the subject land, the survey effort required to suitably refine potential breeding trees, down to actual nest trees, was determined infeasible, and areas of potential habitat, that could not be discounted as breeding habitat, were determined to be potential breeding habitat.

Surveys completed in October 2024 targeted the presence of Pink Cockatoos within the subject land, with the species being recorded on a number of occasions, with mainly foraging activity recorded, however one pair were recorded in the western portion of the subject land, near Yanga Way. Surveys targeted evidence of breeding, however insufficient evidence was able to be recorded to conclusively exclude areas as breeding habitat, or confirm an actual nest tree.

Survey effort

October 2024 raptor nests and Pink Cockatoo breeding surveys were completed over 4 days, by two senior zoologist staff, over a total of 80 person hours.

This survey is additional to the total of approximately 160 hours, over 47 days, across 8 seasons and 2 years of targeted / area / fix point searches completed for BUS.

Justification of survey method effort and results

The following points justify the survey effort completed, and the conclusions that the target raptor species are not utilising the subject land for breeding.

- All potential habitat was surveyed for nests within 300-500 m of a turbine location.
- Surveys were completed in breeding season.
- None of target raptor species were recorded.
- Target raptor species have already been shown to be absent from subject land by BUS.
- No evidence was recorded of:
  - Living or dead large old trees within suitable vegetation AND the presence of a male and female of the target species.
  - Living large old trees within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest within tree canopy (White-bellied Sea-Eagle only).
  - Any adult bird with nesting material.
  - An individual on a large stick nest in the top half of the tree canopy.
  - Pairs displaying (soaring, diving, engaging in chases, or a male observed calling in flight with a female begging from tree).
  - Adults observed duetting within breeding period.

- No juveniles were recorded.

As multiple surveys, over different season and years, have now been completed, the following TBDC requirements for White-bellied Sea Eagles has also been met.

Due to the similarities in nest structure and use of the same nests by White-bellied Sea Eagles and Wedge-tailed Eagles, where a nest is observed without a bird present, searches for prey remains/feathers below the structure should be undertaken. The differing diets of both species and distinctive adult feathers, should provide evidence of nest use, however; where prey items/feathers are absent, repeat visits to the nest until a bird is observed should be undertaken

The incidental/targeted surveys for Pink Cockatoo completed alongside the raptor survey added additional data to aid in population analysis, behavioural use (foraging and breeding) within the subject land and movement pathways.

Timing of survey

Additional targeted surveys were completed in the appropriate breeding window for Little Eagle, Square-tailed Kite and White-bellied Sea Eagle, during October 2024. The survey window was also appropriate for breeding of Pink Cockatoo, however the species has already been identified as resident and likely to be breeding within the subject land.

Survey personnel and relevant experience

Diurnal bird surveys were undertaken by the Biosis ecologists outlined in Table 32, survey effort is illustrated on Figure 10.

Table 32 Targeted diurnal bird survey personnel and relevant experience

Staff member	Role	Relevant experience
Wyn Russell	Senior Zoologist	5 years' experience conducting threatened fauna surveys within NSW and Victoria, with an academic background in fauna research.
Rachael Moore	Zoologist	5 years' experience conducting threatened fauna surveys within NSW.

Results

A total of 222 stick nests were recorded within the subject land, including 86 small stick nests (5-30cm), 117 medium stick nests (30 – 50cm), 13 large and six extra large stick nests greater than 50cm in diameter, with the vast majority seen to not be in use, and no juvenile raptors were recorded. Extra large nests are attributed to, and contained evidence of previous use by Wedge-tailed Eagle. Medium and large nests have the potential to be utilised by other larger raptor species such as Black Kite or Whistling Kite. Small and medium nests are found to be in use by Noisy Miner, Australian Magpie and Nankeen Kestrel.

Nine additional records, representing 13 individuals, of Pink Cockatoo were observed. Three occurrences were of one or two individuals flying past around 5-15 metres in height. Two sightings observed individuals resting in trees, these trees did not support hollows. Two individuals were observed resting in a tree, this pair flew north before circling back to the same tree. No hollows were observed in this tree. Several individuals were observed flying north through the subject land. One individual was observed flying east through the subject land. One individual was observed foraging within *Callitris sp.*.

Table 33 provides a summary of the results of the diurnal bird surveys completed.

Table 33 Summary of diurnal breeding period survey effort and results

Species name	Common name	Survey effort	Survey results	Species Polygon (ha)
Hamirostra melanosternon **(Breeding)**	Black-breasted Buzzard	• 4 days raptor surveys and stick nest surveys 15 - 18 October 2024	• Species, or evidence of the species, not identified.	NA species not considered to occur
Hieraaetus morphnoides **(Breeding)**	Little Eagle	• 4 days raptor surveys and stick nest surveys 15 - 18 October 2024	• Species, or evidence of the species, not identified..	NA species not considered to occur
Lophochroa leadbeateri **(Breeding)**	Pink Cockatoo	• 4 days incidental surveys targeting this species behaviour within subject land when found during raptor survey 14-18 October 2024	• Multiple individual birds observed. • Behaviour and flight paths recorded to be utilised within Stage 2 Impact assessment	• 37.4 ha of Associated PCTs in all condition states where they occur within 200m of a confirmed nest tree OR within 200m of potential (unsurveyed) habitat.
Lophoictinia isura **(Breeding)**	Square-tailed Kite	• 4 days raptor surveys and stick nest surveys 14-18 October 2024	• Species, or evidence of the species, not identified.	NA species not considered to occur
Haliaeetus leucogaster **(Breeding)**	White-bellied Sea Eagle	• 4 days raptor surveys and stick nest surveys 14-18 October 2024	• Species, or evidence of the species, not identified.	NA species not considered to occur

Photo 7 Male Pink Cockatoo recorded in October 2024 in mallee woodland vegetation

Microbats

Microbat surveys have been undertaken by Nature Advisory and Biosis 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 (summer and spring) to characterise the microbat fauna using the subject land. Furthermore, Nature Advisory completed three microbat surveys in 2022 (autumn, winter, spring).

As part of the ongoing work for the project, Biosis has completed additional microbat surveys in summer 2025 and will also complete surveys in autumn and winter 2025. This will bring the overall microbat survey effort into line with the 8 seasons over 24 months requirement for BBUS for proposed wind farm projects.

Additional to the above, Biosis will complete 12 months of at-height survey. Spring 2024 and summer 2025 have been completed with additional deployments scheduled for autumn and winter 2025.

Survey timeframes and data analysed for the assessment is summarised Table 34 below.

Table 34 Nature Advisory microbat survey effort

Season	Dates	No. nights	Detector nights	Detector model
Nature Advisory				
Summer 2021	22 Feb – 27 Feb 2021	6 consecutive nights	36	Songmeter (ZC)
Spring 2021	2 Nov – 30 Nov 2021	24-29 consecutive nights (location dependent)	130	Songmeter (ZC)
Autumn 2022	27 Apr – 02 Mar 2022	6 consecutive nights	11	Songmeter (ZC)
Winter 2022	11 Jul – 16 Jul 2022	6 consecutive nights	24	Songmeter (ZC)
Spring 2022	3 Oct – 6 Oct	3 consecutive nights	17	Songmeter (ZC)
Biosis				
Summer 2025	20/21 Jan – 03 Feb 2025	13/14 consecutive nights (location dependent)	186	Anabat Swift (FS)
Autumn 2025	TBC	-	-	
Winter 2025	TBC	-	-	
Biosis - Paired met mast detectors (at-height and ground-level)				
Spring 2024	15 Oct-30 Oct 2024	15 consecutive nights	15	Anabat Swift (FS)
Summer 2025	21 Jan – 2 Feb 2025	13 consecutive nights	13	Anabat Swift (FS)

Nature advisory 2021

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).

Nature Advisory 2022

A total of six automated bat recorders (Song Meters ®) were deployed during each survey at ground level only. Survey locations replicated existing locations surveyed within 2021. 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. Data was not recorded from one of the devices within spring 2022. Data was not recorded from three of the devices within autumn 2022.

Data collected by Nature Advisory in 2022 was analysed by Biosis using Anabat Insight (version 2.0.8, licensed), Titley Scientific.

Biosis 2024 - 2025

Met mast surveys with paired units at-height and ground level were completed in spring 2024 and summer 2025. Summer 2025 surveys have also been completed across the remainder of the subject land. Autumn and winter 2025 survey effort is yet to commence, and will be completed at the met-mast and across the site more broadly, and will follow the method and effort outlined below.

A total of 12 bat recorders were placed throughout the subject land, replicating the six locations previously surveyed by Nature Advisory in 2021 – 2022, alongside six additional sites aimed at collecting a larger sample of microbat activity data across the habitats suitable for microbats.

The site was stratified into habitat types likely to be relevant to bats using desktop analysis to allocate survey points across the site in representative habitats. Stratification was associated with vegetation structure and diversity, with modified land assumed to provide little structural or floristic (and insect) diversity and woodland habitats likely to contain the highest structural and floristic diversity and therefore be more highly utilised by bats. The habitat was broadly stratified into three habitat types:

- Open (cropped)
- Open (DNG)
- Semi-cluttered (open woodland)

Habitat of each sampling point is shown in Table 35.

Table 35 List of sampling sites and associated habitat unit and type.

Microbat survey point	Habitat type
MM_Ground	Open (cropped)
MM_Height	Open (cropped)
Bat_1	Open (DNG)
Bat_2	Semi cluttered (open woodland)
Bat_3	Open (cropped)
Bat_4	Open (cropped)
Bat_5	Open (DNG)
Bat_6	Open (DNG)
Bat_7	Semi cluttered (open woodland)
Bat_8	Open (cropped)
Bat_9	Semi cluttered (open woodland)
Bat_10	Open (DNG)
Bat_11	Semi cluttered (open woodland)
Bat_12	Semi cluttered (open woodland)

Data was collected at ground level (between 1-3 metres above the ground), with calls recorded from dusk until dawn using ultrasonic recorders fitted with omnidirectional microphones. Default settings for trigger, sensitivity, sampling rate and minimum / maximum frequency will be used. Each time a bat flies past the detector, its call is recorded as a digital file (defined here as a 'pass') that is saved directly onto a memory card in the detector unit. Units will be set on trigger mode to record at night. Files are recorded in full spectrum format (.wav) on Anabat Express, and/or Anabat Swift devices.

Units are located to allow space in front and around the microphone to minimise echoes from hard surfaces, call attenuation from surrounding vegetation, and ensure adequate flight space around the microphone. Representative images of detector deployments are provided below.

Plate 2 Detector with raised microphone an edge of Black Oak woodland patch

Plate 3 Detector in open paddock habitat

Plate 4 Tree-mounted detector in Mallee woodland

Plate 5 Ground-level detector paired with met mast unit

Data collected by Biosis over summer, autumn and winter 2025 will result in a total of eight deployments sampling all seasons over a greater than 24 month period, when combined with existing Nature Advisory data.

Data was also collected at height from the established met mast, with a paired unit also deployed at ground level to allow comparisons of bat activity and species composition. Data has been collected in spring 2024 and summer 2025 with additional deployments planned for autumn and winter 2025.

To collect data at height (c.70 metres above ground level) an ultrasonic detector is mounted securely to a pulley system installed on the met mast located within the north-western portion of the subject land. The results of the at-height data will be incorporated into this BDAR and the final BBAMP.

Data has been analysed using Anabat Insight (version 2.0.8, licensed), Titley Scientific.

Known species geographic distributions (Churchill 2008, AusBats 2025) has been used to generate a list of species with potential to occur at the site. Species identification has been guided by the probability of occurrence at the site based on distribution, database records obtained from NSW BioNet and known habitat values at each detector point and across the site more broadly. Species at the edge of their distribution range are included as potential species at the site given that bats are likely under surveyed in the region and records may not reflect true distribution.

Files not containing bat calls (noise files) are filtered out using a standard “allbats” filter in Anabat Insight and not included in further analysis (trash files).

Custom decision trees are used to sort remaining files into likely species and species groups based on call parameters such as characteristic frequency, slope, duration and time between calls. Calls are then identified by visually comparing the spectrogram and call characteristics (e.g., characteristic frequency and call shape) with reference calls, descriptions from available reference materials (Reinhold et al. 2001, Pennay, Law, & Reinhold 2004), calls validated by other experts, and other site data.

A call (pass) has been defined as a sequence of five or more consecutive pulses of similar frequency and shape. Identification has not been attempted for sequences with less than five defined consecutive pulses (unless for readily identifiable species such as the White-striped Freetail-bat *Austronomus australis*). Similarly, sequences containing multiple bats or pulses with irregular frequency and / or shape (non

search-phase calls) have not been used to identify species. Calls with less than five pulses have been excluded from further analysis and not included in metrics of bat activity.

The focus of call analysis has been to generate a list of species present, particularly threatened species. Analysis of individual species activity is beyond the scope of the assessment, given the number of files recorded. Once a species is positively identified, it is marked as present. Species identification is therefore not attempted for all files recorded. Files that are manually reviewed are tagged so that the proportion of files reviewed can be tracked.

Where a threatened species is not recorded through the decision tree, additional checks are used to improve confidence that a false negative was not recorded including target frequency filters and manual review. If the volume of data is considered too great for manual review, threatened species are conservatively included as a species group at the site.

Due to variability in the quality of calls and difficulty in distinguishing some species a conservative approach will be taken when analysing calls and assigning an identification. The identification of each call will be assigned a confidence rating (Duffy et al. 2000) as summarised in Table 36 below.

Table 36 Call identification confidence ratings

Identification	Description
Almost certain	Diagnostic call characteristics present, consistent with descriptions in reference material and / or reference calls.
Possible	Highly likely the call represents a particular species, but call lacks enough detail (e.g., call quality) to be definite or similarities with other species of similar call type or frequency limits identification certainty and/or there is a limited number of sequences to be confident in species presence.
Species Group	Call characteristics (e.g., frequency, shape) are indicative of a number of species or call lacks sufficient detail (e.g., call quality, diagnostic features) that would allow identification to species level.
Not Detected	Of the data analysed, no calls were attributable to this species.

A detailed description of the methods is provided in Appendix 10.

Justification of survey method and effort

Nature Advisory

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 2018) 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).

Biosis

Survey will be undertaken with reference to the following guidelines:

- 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method (OEH 2018).

- Survey guidelines for Australia's threatened bats (DEWHA 2010b).

Additional survey completed replicates the survey effort completed by Nature Advisory, alongside adding additional coverage across the subject land. Sampling increased habitat variation will improve the ability to compare areas that may act as focal points for bat activity within the site. Data is also collected at height, allowing species composition and activity to be analysed above canopy height. The survey effort completed by Biosis will round out the existing survey effort undertaken by Nature Advisory, allowing for eight seasons of data collected across five years.

Survey personnel and relevant experience

Deployment of detectors was undertaken by Biosis zoologists with suitable experience in using and deploying ultrasonic bat detectors, outlined in Table 32 below. Call analysis was completed by Felicity Williams.

Table 37 Targeted microbat survey personnel and relevant experience

Staff member	Role	Relevant experience
Dr Caragh Heenan	Senior Zoologist – Major Projects (Zoology)	Over five years' experience undertaking bat surveys in NSW and 17 years' experience undertaking flora and fauna surveys across South Australia and Northern Territory.
Emma Heath	Zoologist	Over one year of experience undertaking bat surveys in NSW.
Joel Nicholson	Zoologist	Over five years' experience undertaking bat surveys in NSW.
Wyn Russell	Zoologist	Over six years' experience undertaking bat surveys in Victoria and NSW.
Felicity Williams	Senior Zoologist - Bat Ecology	Over eight years' experiencing implementing bat surveys and undertaking call data analysis.

Results

A total of nine bat species were positively identified within the subject land by Nature Advisory from data collected in spring and summer 2021. All nine bat species positively identified are noted as being considered common, secure and widespread species. No threatened species were positively identified. Corben's Long-eared Bat *Nyctophilus corbeni*, a threatened species listed as Vulnerable under the EPBC Act and BC Act, was also included as part of a species complex. This species cannot be confirmed through call analysis due to its call overlapping with other species preventing positive identification. Corben's Long-eared Bat is considered an ecosystem credit species under the BAM, so further targeted survey under the BAM is not required.

Twelve bat species were positively identified within the subject land by Biosis from data collected in spring 2024 and summer 2025 (Table 38). One threatened bat species, the Inland Forest Bat, was positively recorded as occurring within the subject land. Corben's Long-eared Bat has also been assessed as likely or possibly occurring within the subject land, with potential calls identified and/or suitable habitat occurring.

Southern Myotis is considered unlikely to occur within the subject land based on the results of the ultrasonic analysis combined with known distribution, habitat constraints, Bionet records and the habitat values present within the site.

Although calls of the Myotis/Nyctophilus species complex were recorded across the site, the broader distribution and habitat constraints of Southern Myotis were considered to determine the likelihood of calls in the species complex representing that species. This approach is consistent with section 5.2 of the BAM where the assessor is able to eliminate a species if "none of the habitat constraints for the species are present in a vegetation zone". Based on its foraging strategy, distribution and known habitat associations, it is considered highly unlikely that Southern Myotis extends into the project area. Suitable habitat for this species across the wind farm site is very limited. The site does not contain permanent rivers or streams, with the only available free water present associated with a number of ground tanks across the site that are isolated from areas of core riparian woodland along permanent watercourses.

Results of the BUS will be summarised within the BBAMP. If a threatened species not already assessed within this report is identified, an addendum BDAR would be compiled and submitted.

Twelve species were positively identified (Almost certain or Possible) of the 18 species that are known or predicted to occur within 10 kilometres of the subject land (AusBats 2025). Up to four additional species may also have been recorded however reliable identification to species level was not possible due to poor data quality and/or similarity of call characteristics between species.

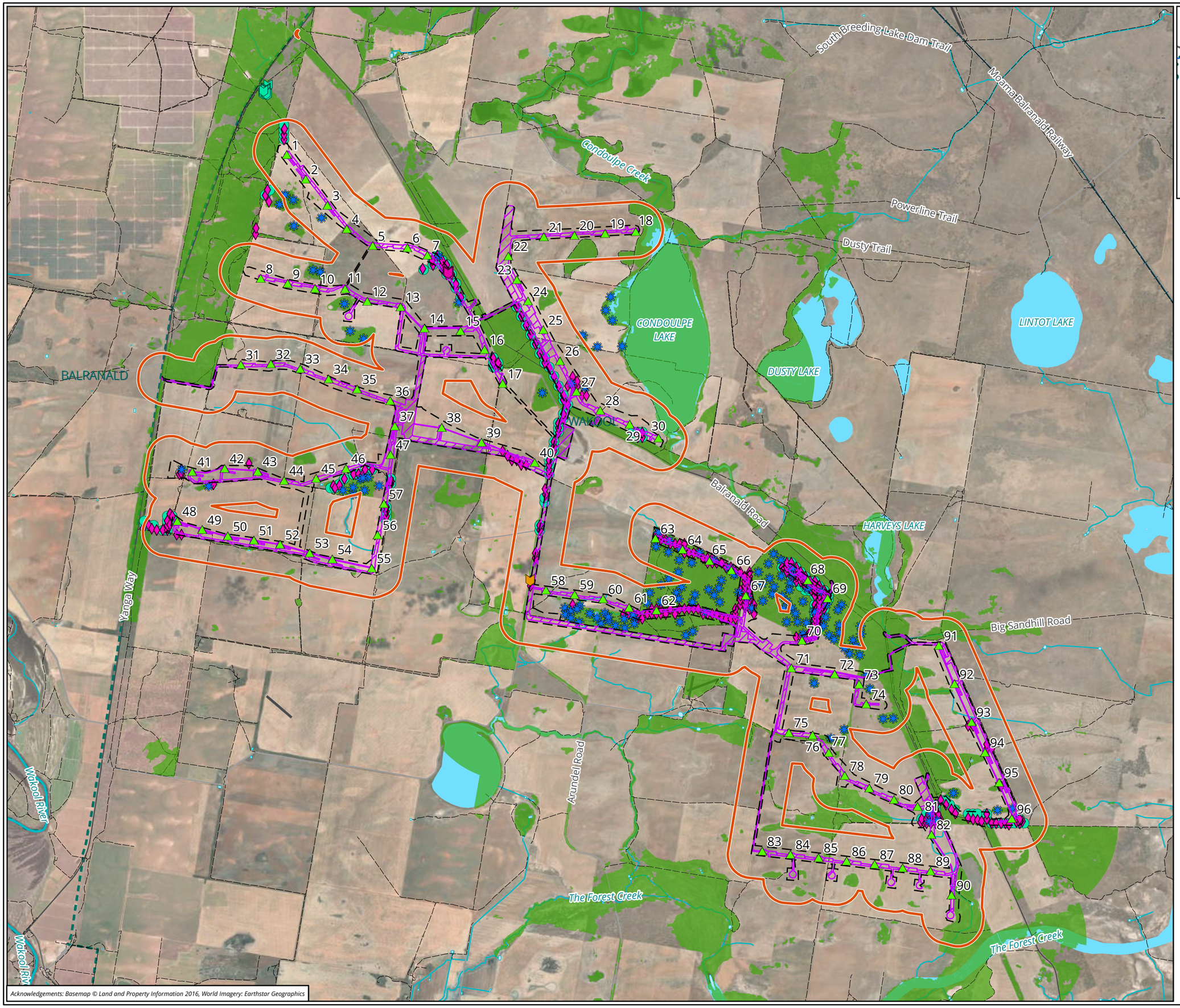
Table 38 provides a list of all species known or predicted to occur in the subject land, based on data collected by both Nature Advisory and Biosis, their conservation status, and identification following call analysis.

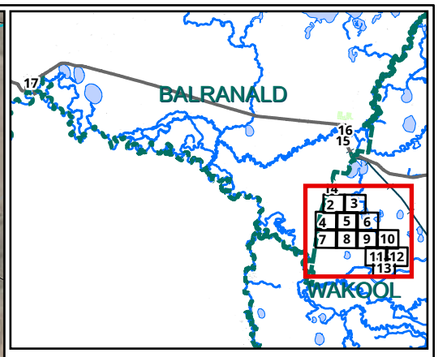
Table 38 Bat call analysis results Nature Advisory and Biosis combined

Species name	Common name	BC Act status	EPBC Act status	Identification	Recorded at height
Austronomus australis	White-striped Free-tailed Bat	-	-	Almost certain	Yes
Chalinolobus gouldii	Gould's Wattled Bat	-	-	Almost certain	Yes
Chalinolobus morio	Chocolate Wattled Bat	-	-	Almost certain	Possible
Ozimops petersi	Inland Free-tailed Bat	-	-	Almost certain	Yes
Ozimops planiceps	South-eastern Free-tailed Bat	-	-	Almost certain	Yes
Ozimops ridei	Ride's Free-tailed Bat	-	-	Almost certain	Yes
Scotorepens balstoni	Inland Broad-nosed Bat	-	-	Almost certain	Yes
Scotorepens greyii	Little Broad-nosed Bat	-	-	Almost certain	No
Vespadelus baverstocki	Inland Forest Bat	V	-	Almost certain	Possible
Vespadelus darlingtoni	Large Forest Bat	-	-	Almost certain	No
Vespadelus vulturnus	Little Forest Bat	-	-	Almost certain	Possible
Vespadelus regulus	Southern Forest Bat	-	-	Probable	Possible
Myotis macropus	Southern Myotis	V	-	Species Group	No
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Species Group	No
Nyctophilus geoffroyi	Lesser Long-eared Bat	-	-	Species Group	No
Nyctophilus gouldi	Gould's Long-eared Bat	-	-	Species Group	No
Chalinolobus picatus	Little Pied Bat	V	-	Not recorded	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Not recorded	No

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

Again it should be noted that despite being recorded as part of a species group, Southern Myotis is not considered to occur within the subject land. Further justification is provided in Appendix 10.





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

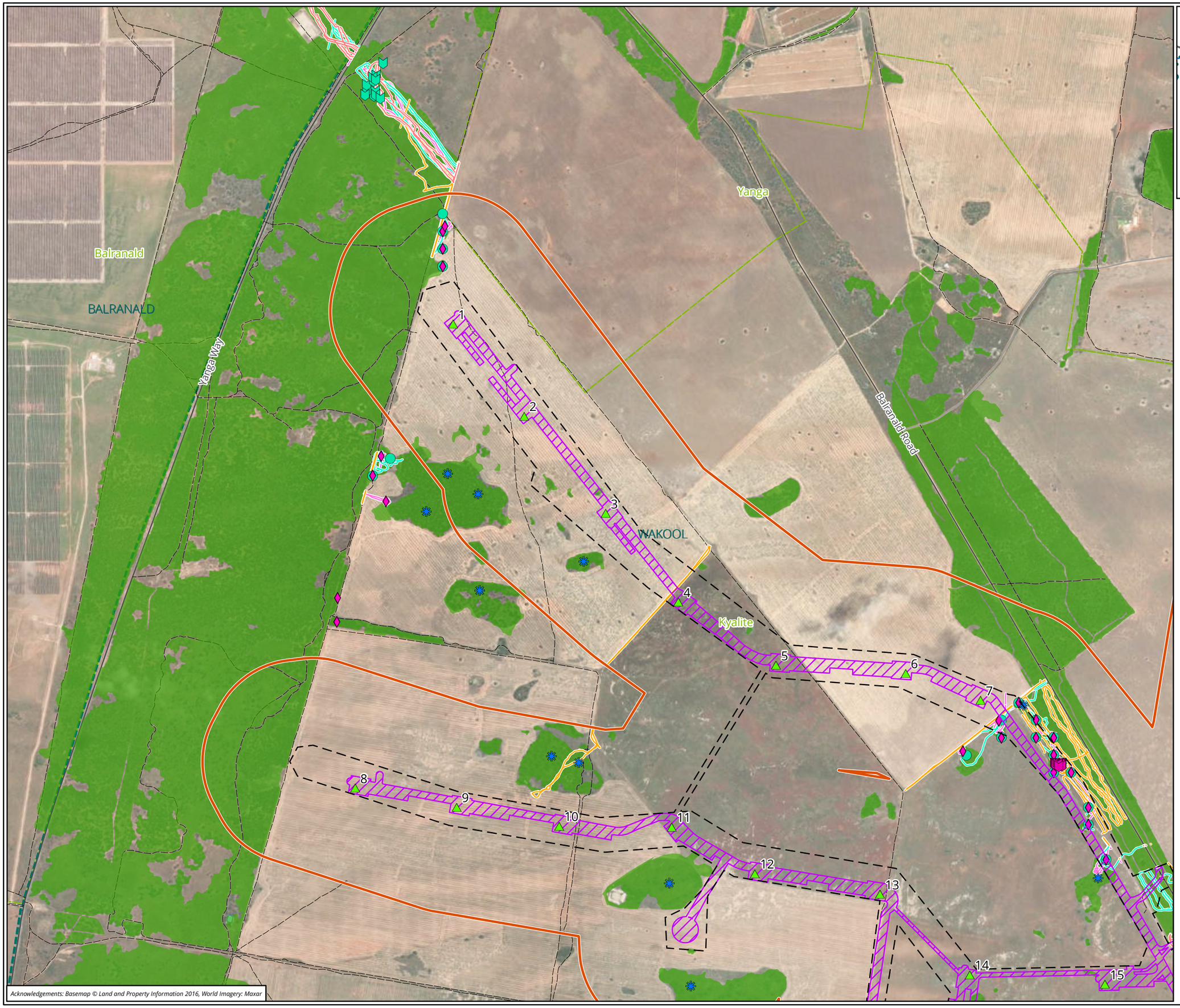
Scale: 1:75,000 @ A3

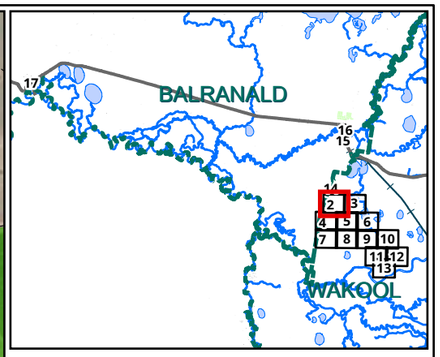
Coordinate System: GDA2020 MGA Zone 54

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

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

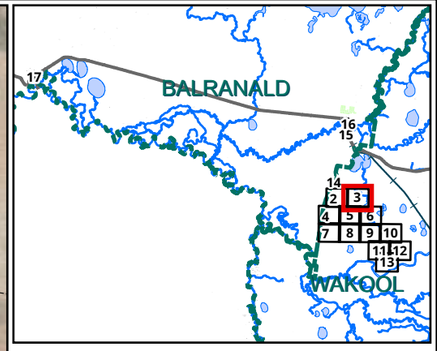
Meters

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

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

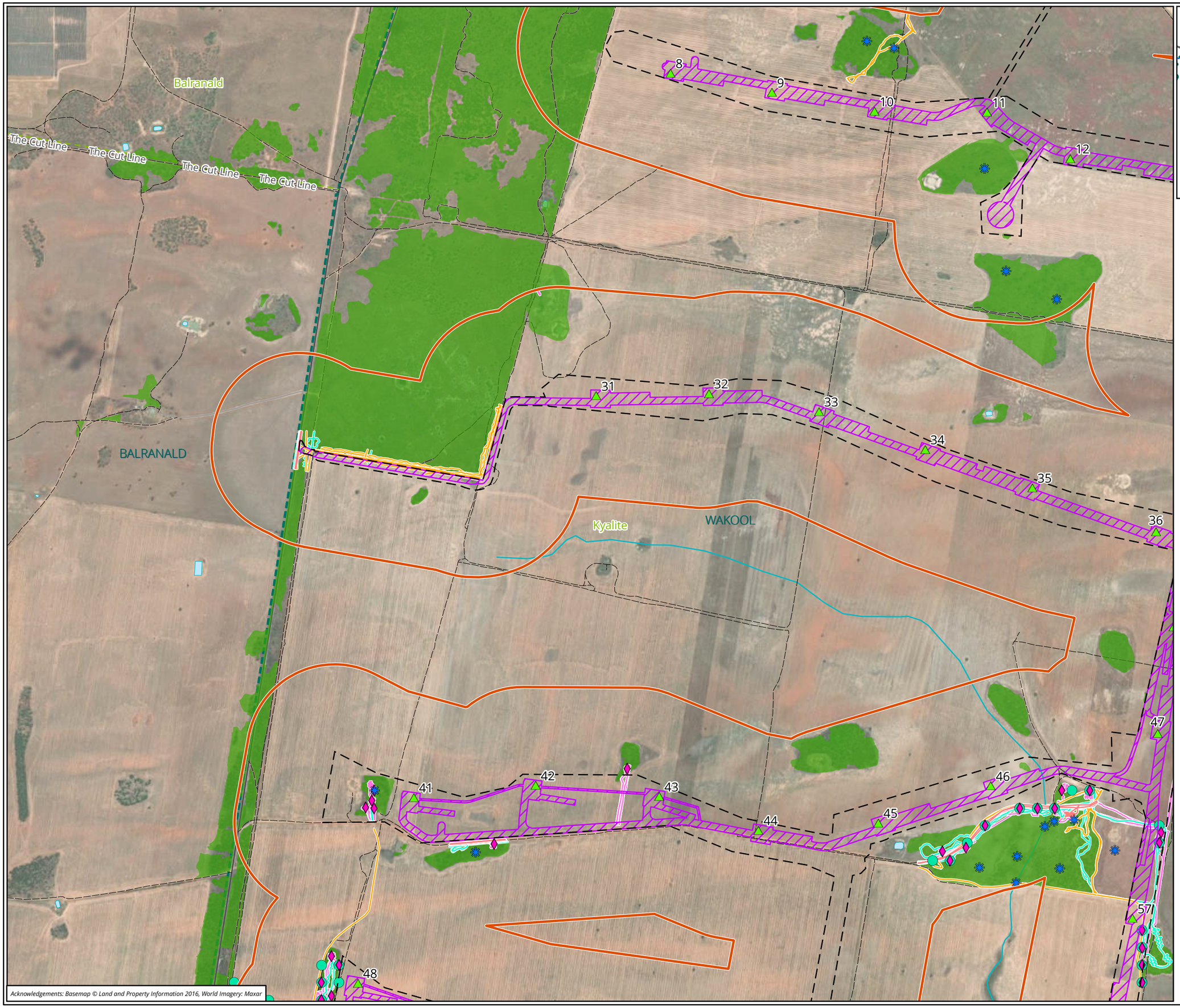
Coordinate System: GDA2020 MGA Zone 54

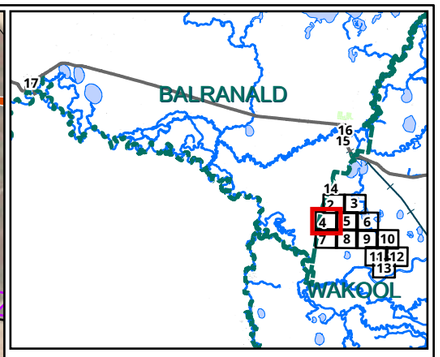
N

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
- 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

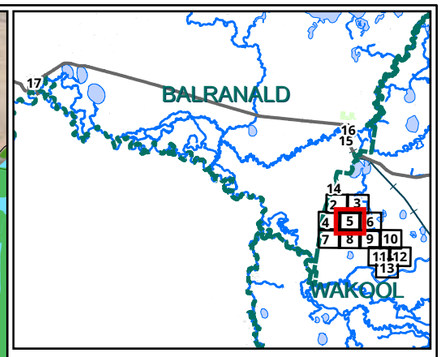
Coordinate System: GDA2020 MGA Zone 54

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
- 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

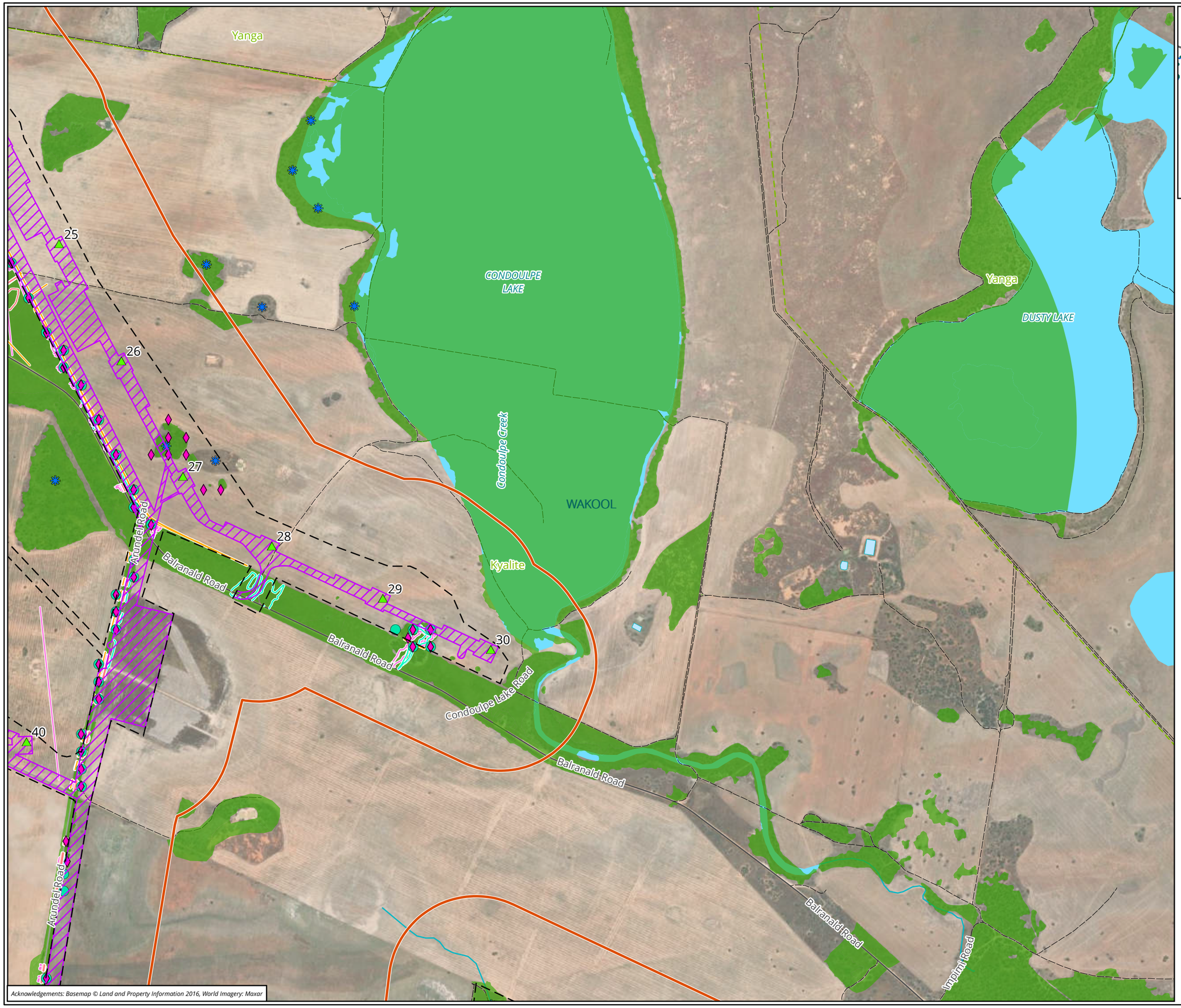
Coordinate System: GDA2020 MGA Zone 54

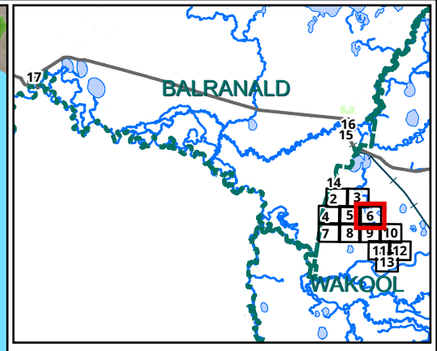
N

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
- 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

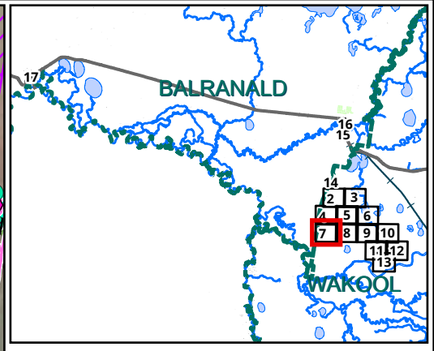
Scale: 1:20,000 @ A3

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.7 Targeted species mapping- Flora

0 200 400 600 800

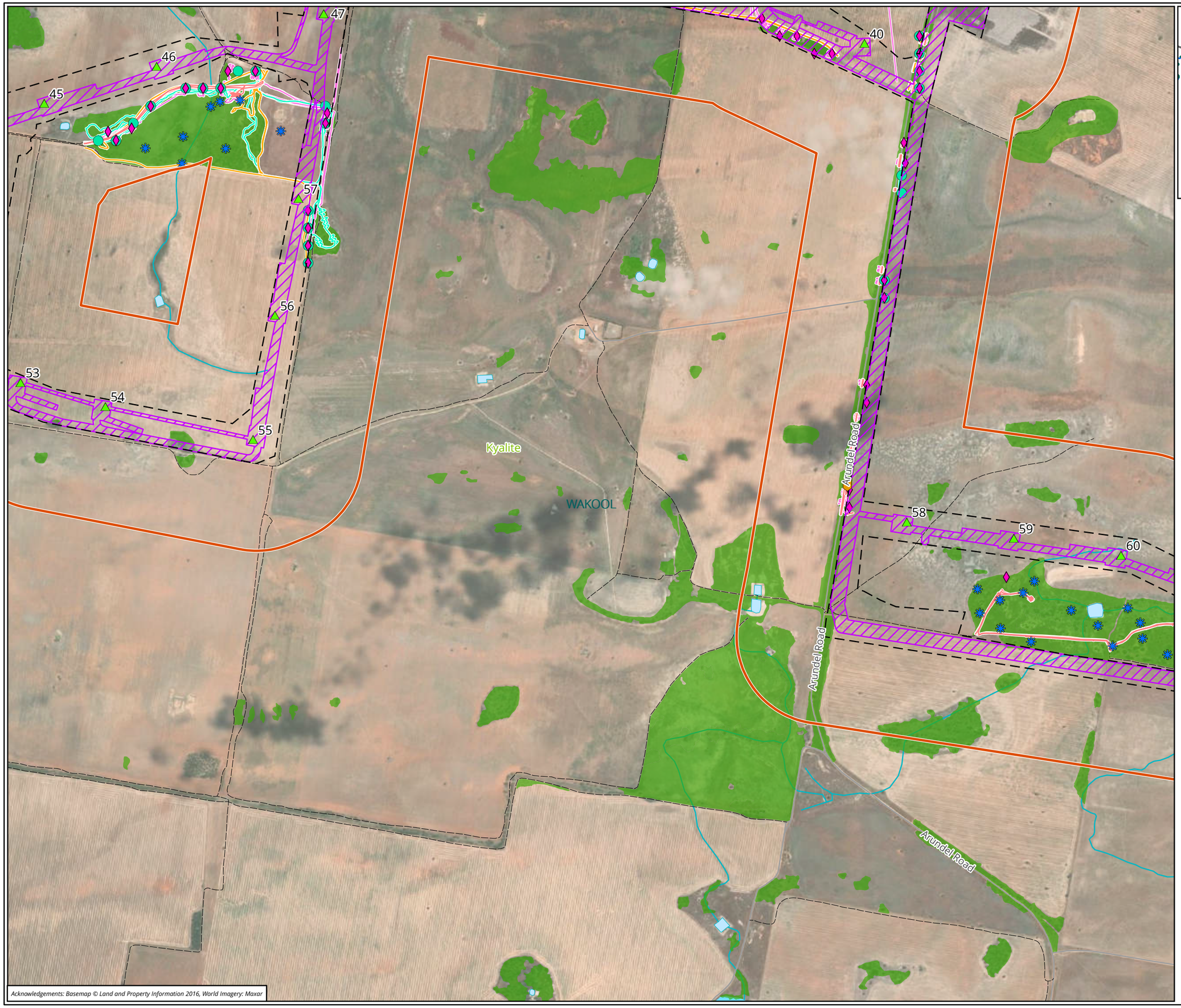
Meters

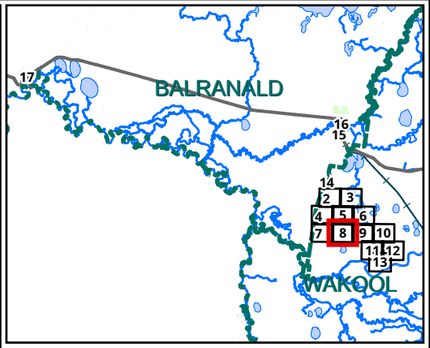
Scale: 1:20,000 @ A3

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.8 Targeted species mapping- Flora

0 200 400 600 800

Meters

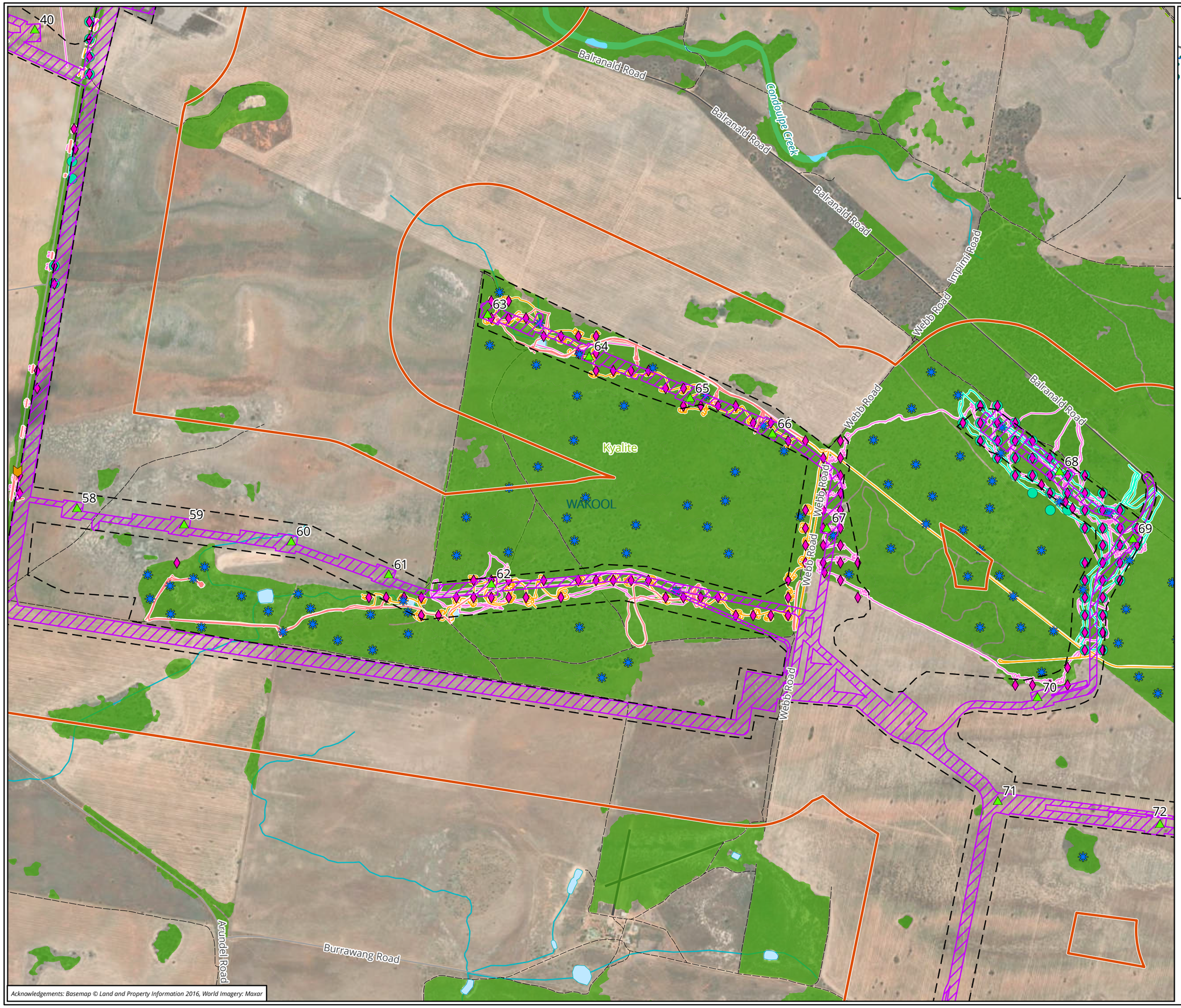
Scale: 1:20,000 @ A3

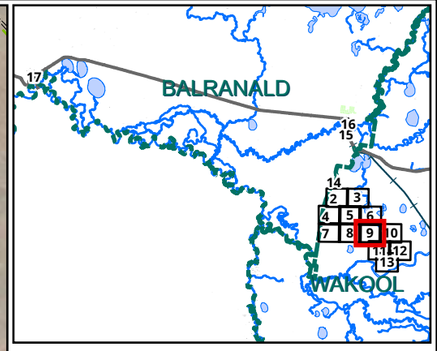
Coordinate System: GDA2020 MGA Zone 54

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.9 Targeted species mapping- Flora

0 200 400 600 800

Meters

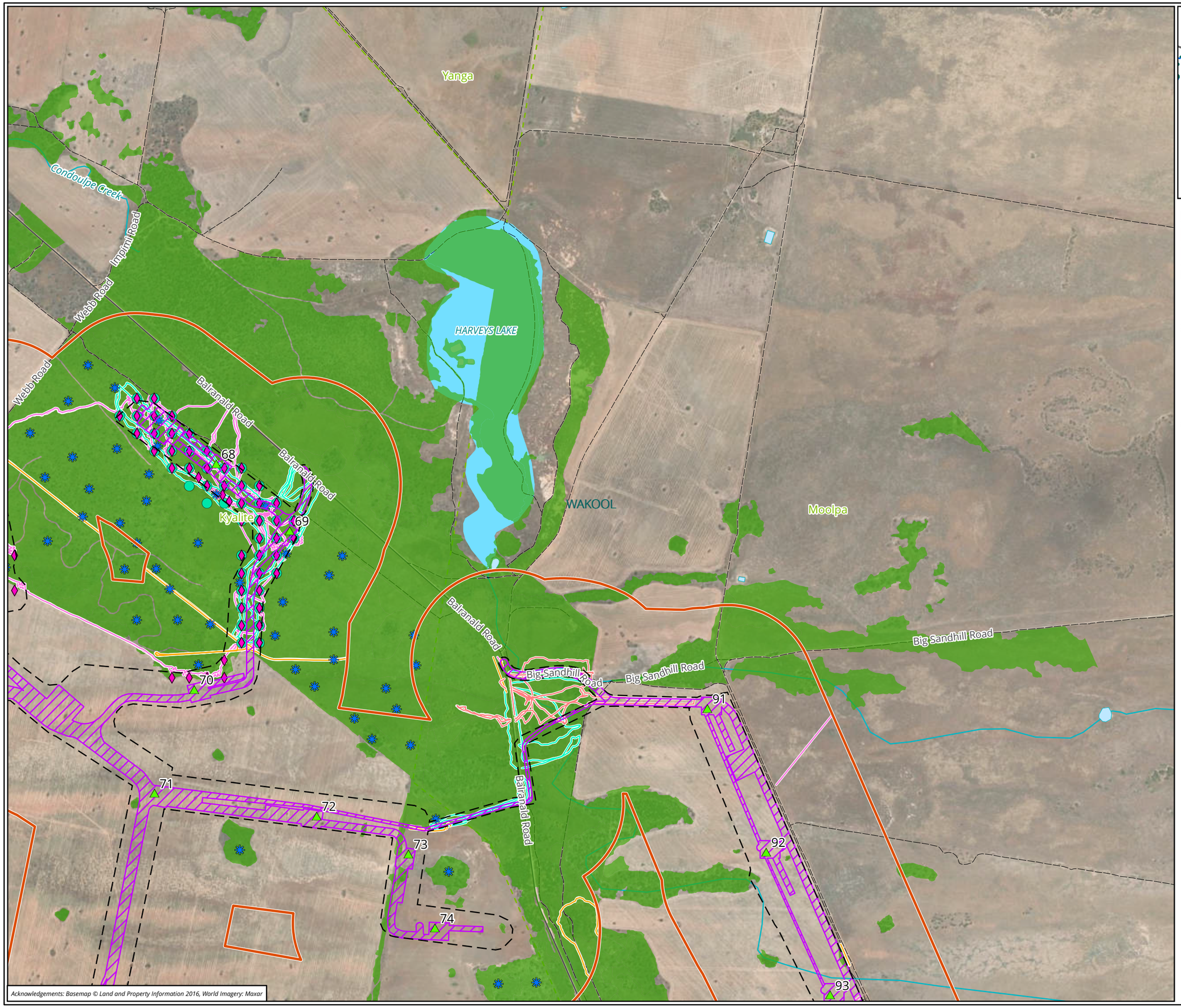
Scale: 1:20,000 @ A3

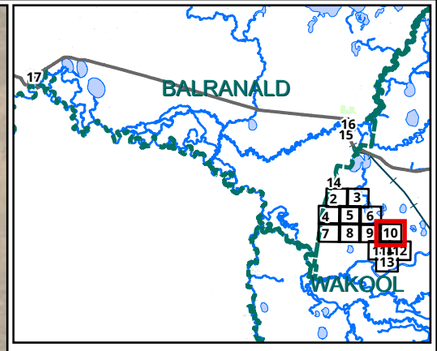
Coordinate System: GDA2020 MGA Zone 54

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

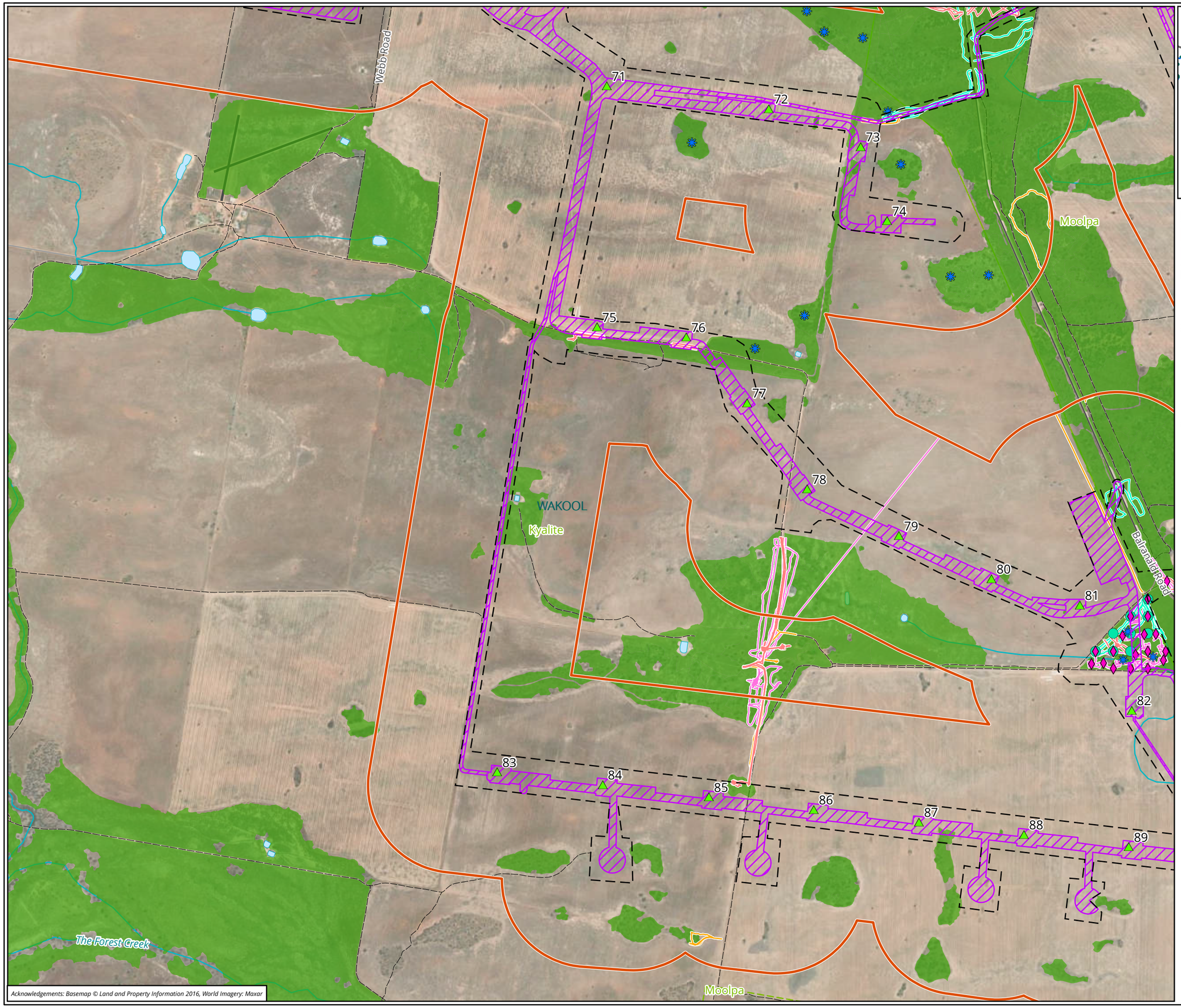
Scale: 1:20,000 @ A3

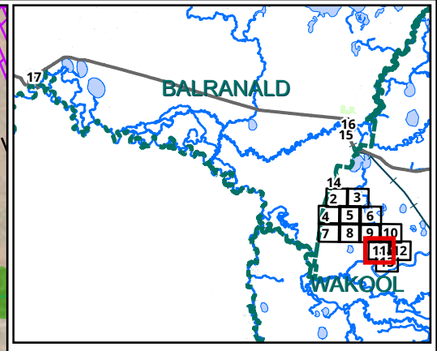
Coordinate System:
GDA2020 MGA Zone 54

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

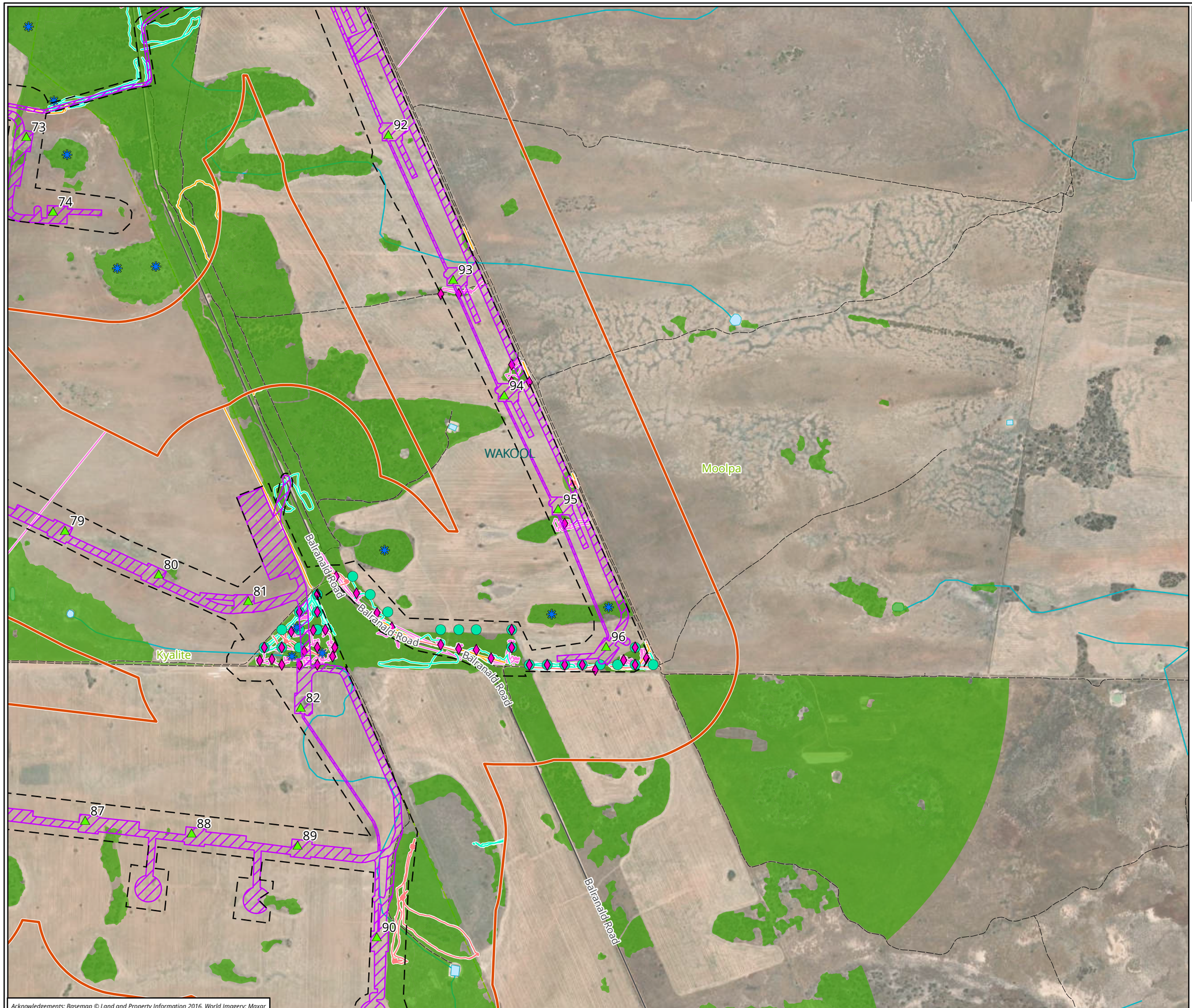
Coordinate System:
GDA2020 MGA Zone 54

N

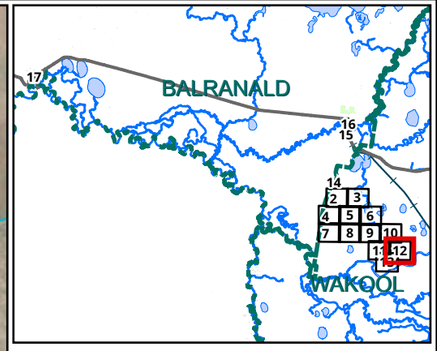
biosis

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

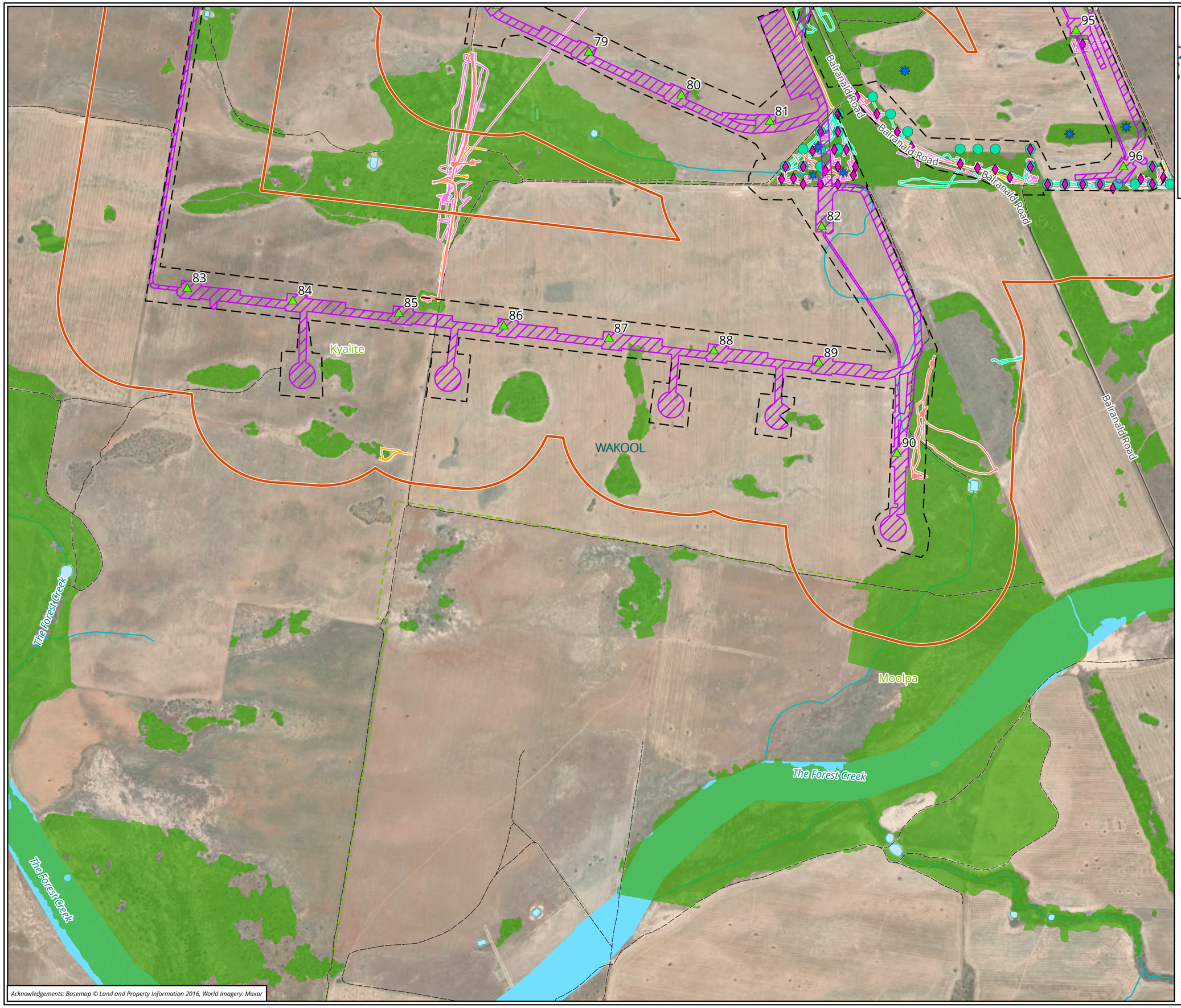
Figure 10a.12 Targeted species mapping- Flora

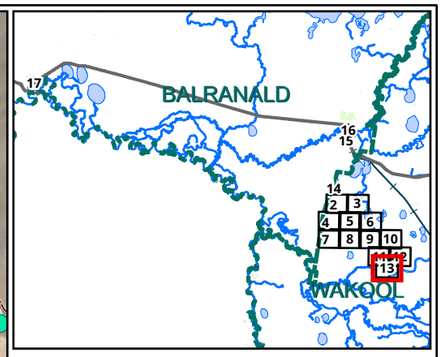
0 200 400 600 800

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

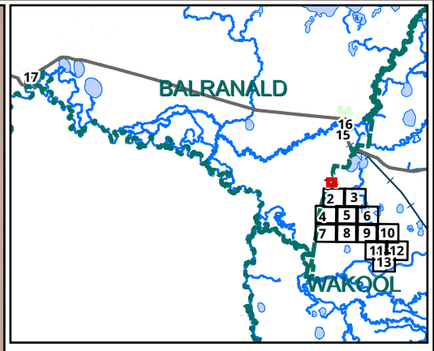
Meters

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

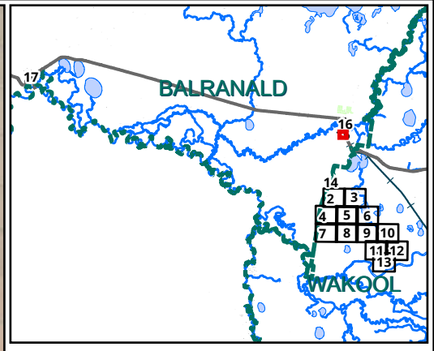
Scale: 1:5,000 @ A3

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

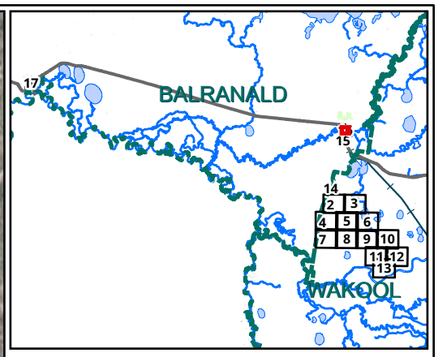
Coordinate System: GDA2020 MGA Zone 54

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

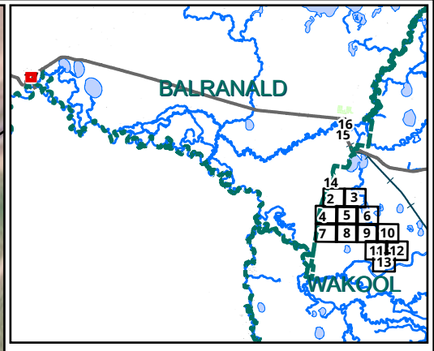
Scale: 1:5,000 @ A3

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

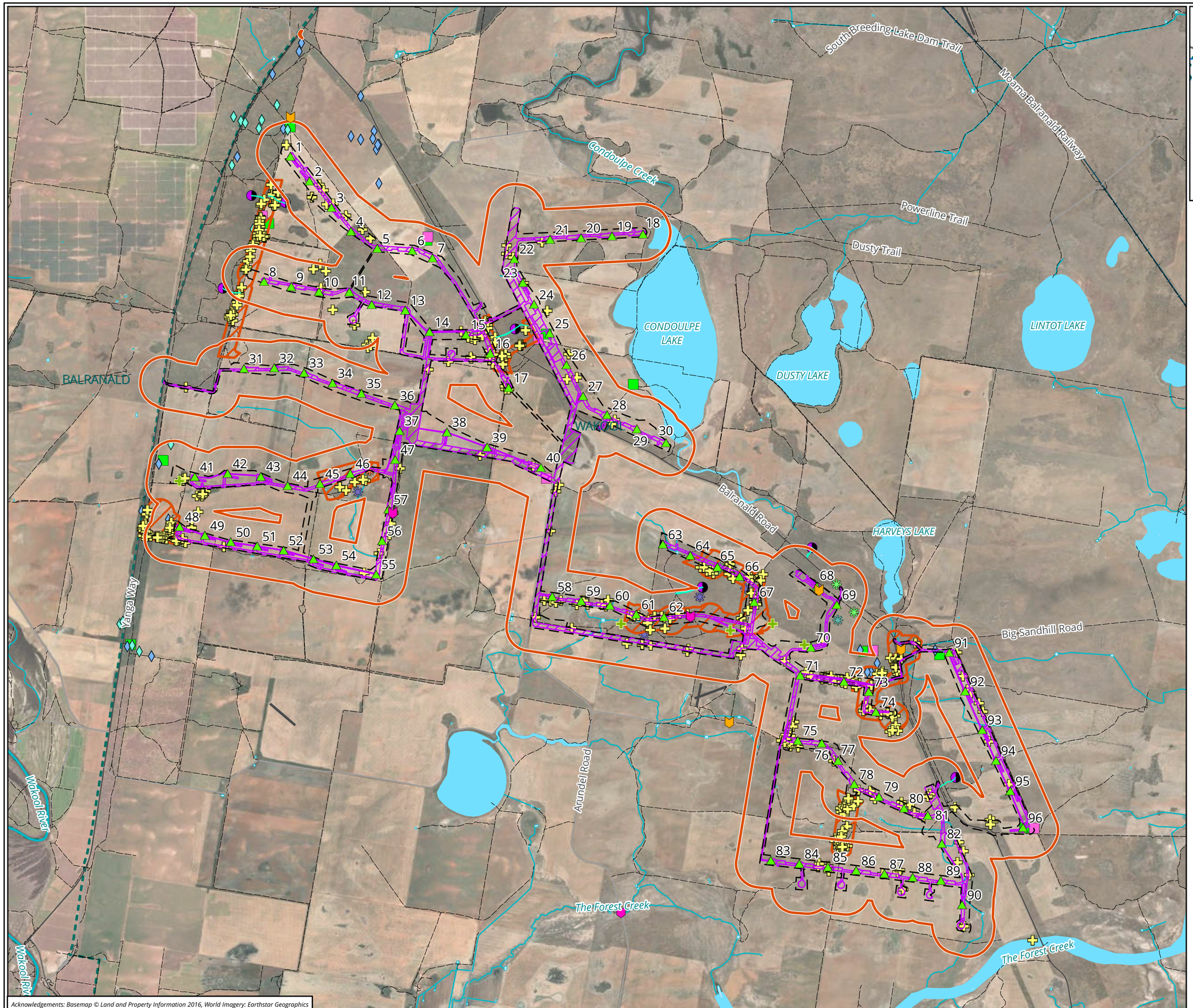
Coordinate System: GDA2020 MGA Zone 54

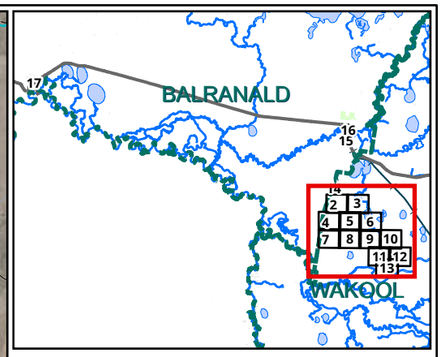
N

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

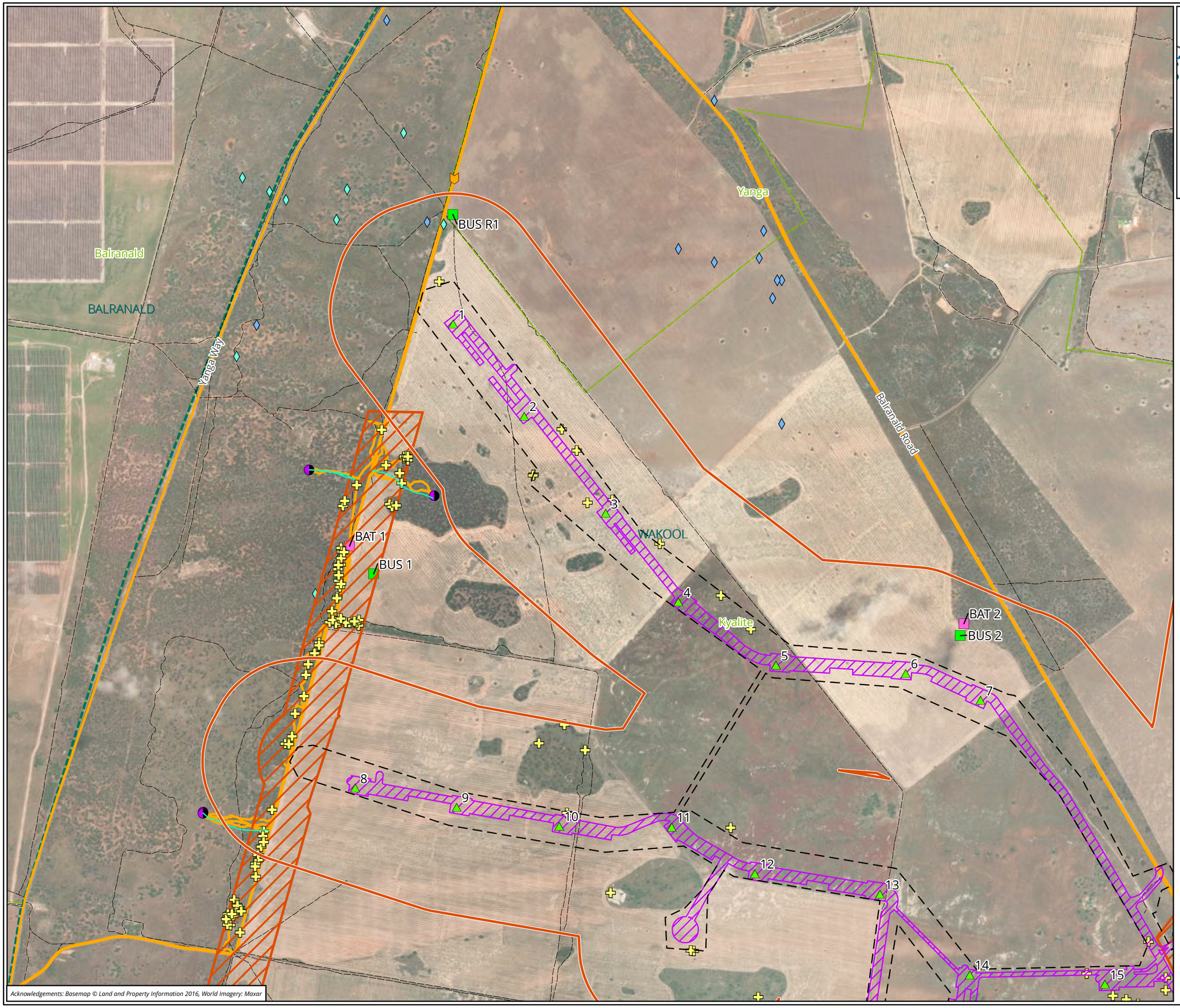
Scale: 1:75,000 @ A3

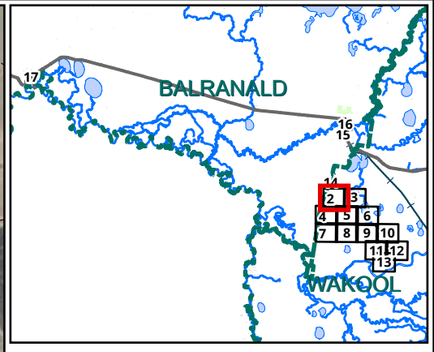
Coordinate System:
GDA2020 MGA Zone 54

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

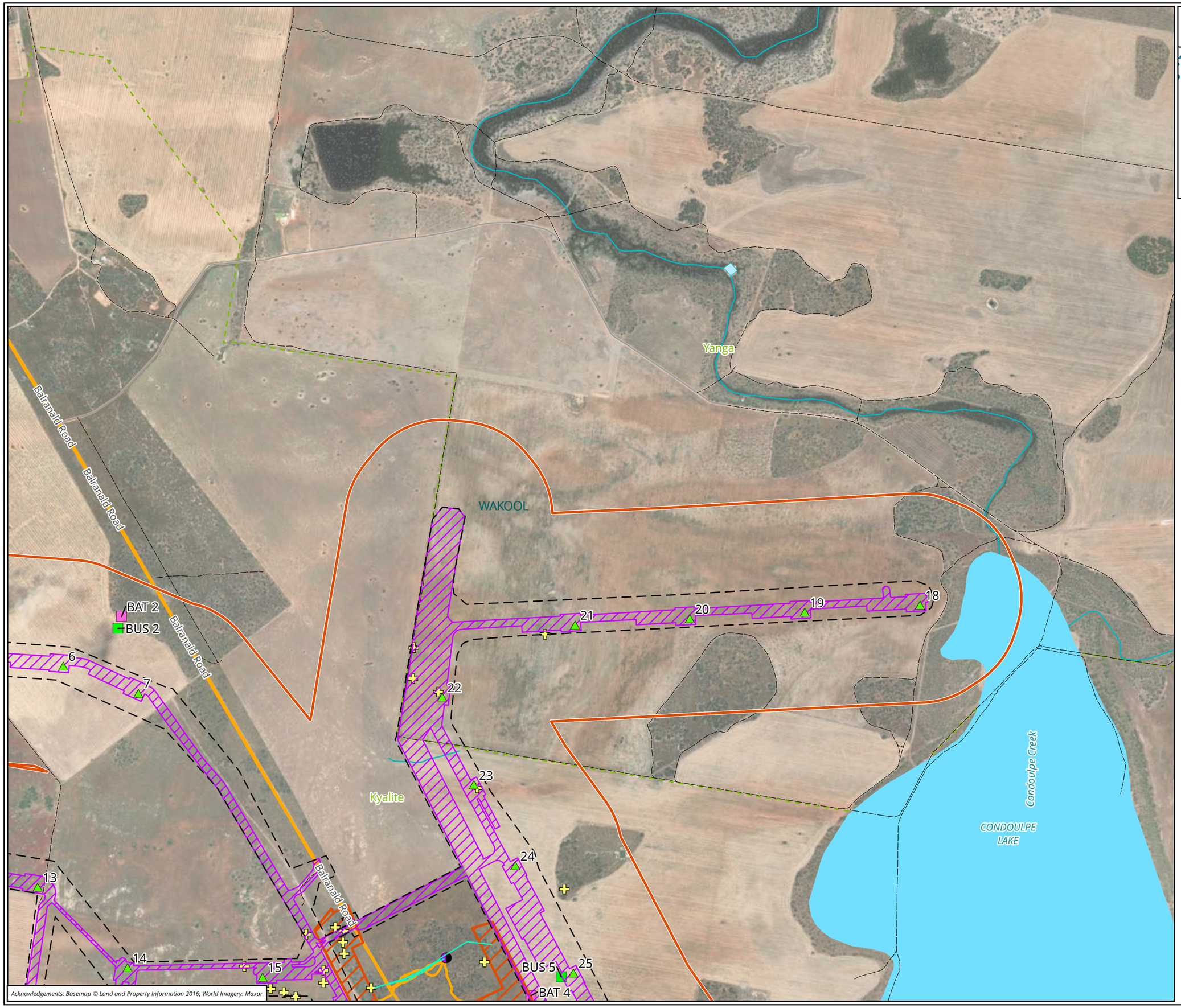
Scale: 1:20,000 @ A3

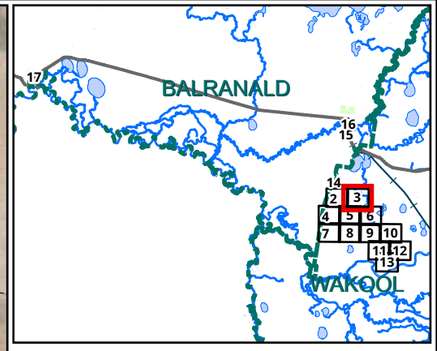
Coordinate System: GDA2020 MGA Zone 54

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

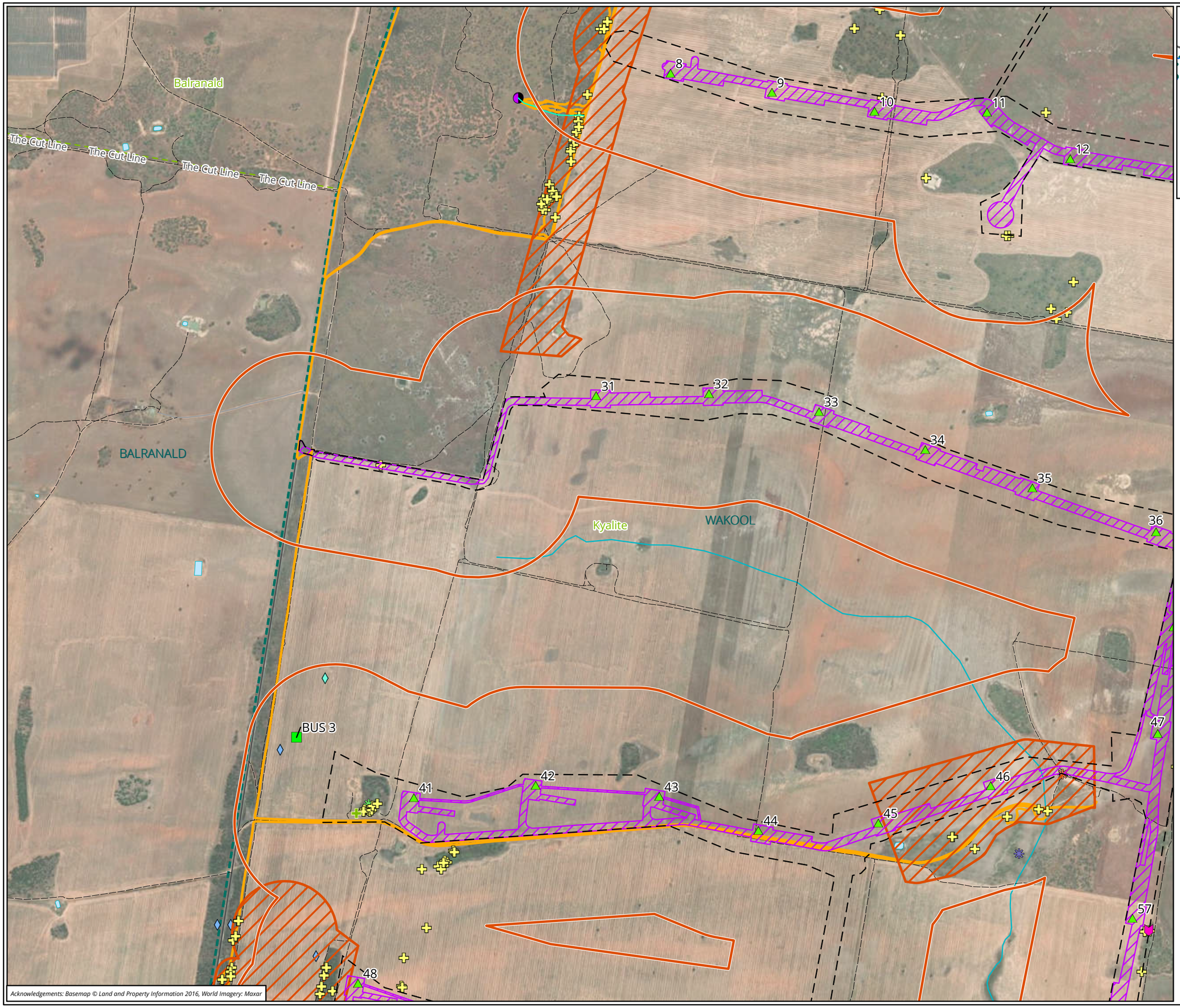
0 200 400 600 800

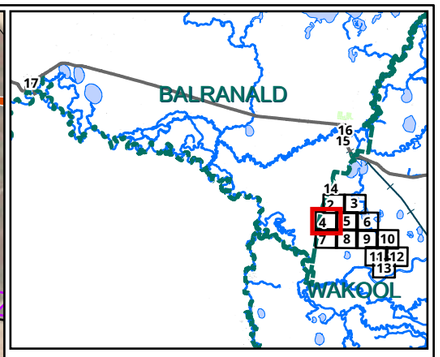
Meters
Scale: 1:20,000 @ A3
Coordinate System:
GDA2020 MGA Zone 54

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

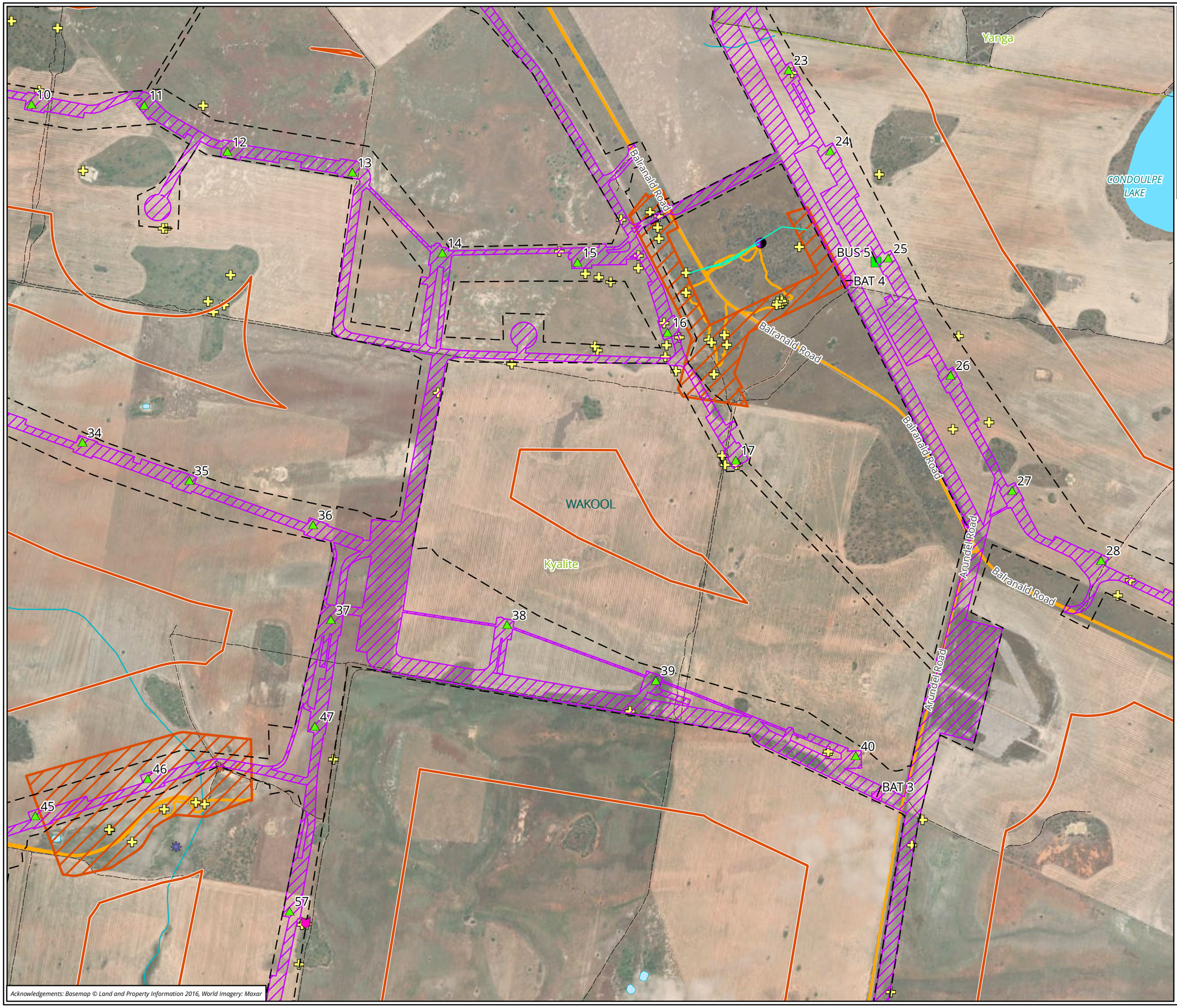
Scale: 1:20,000 @ A3

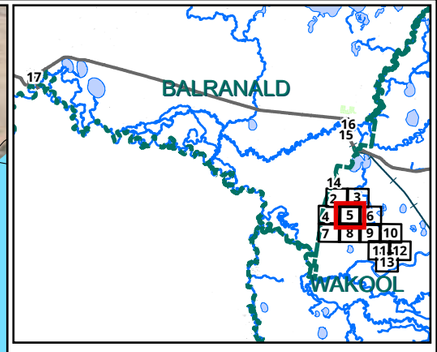
Coordinate System:
GDA2020 MGA Zone 54

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

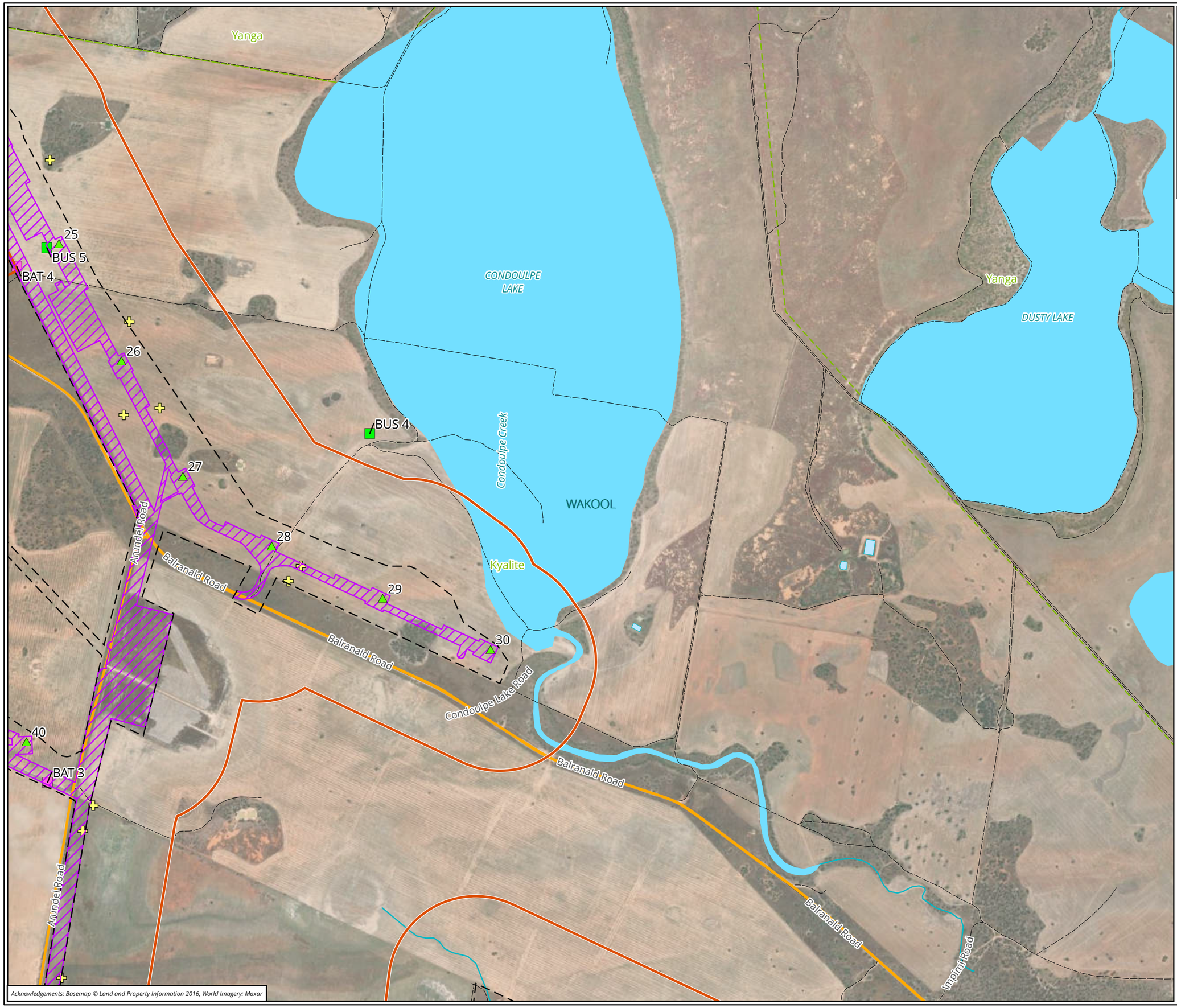
Meters

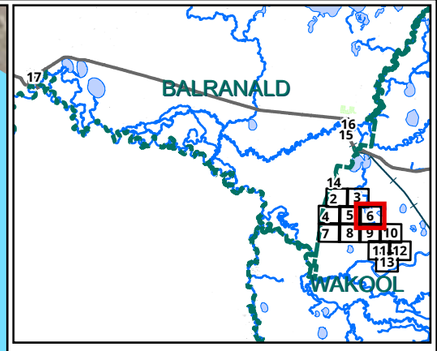
Scale: 1:20,000 @ A3

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

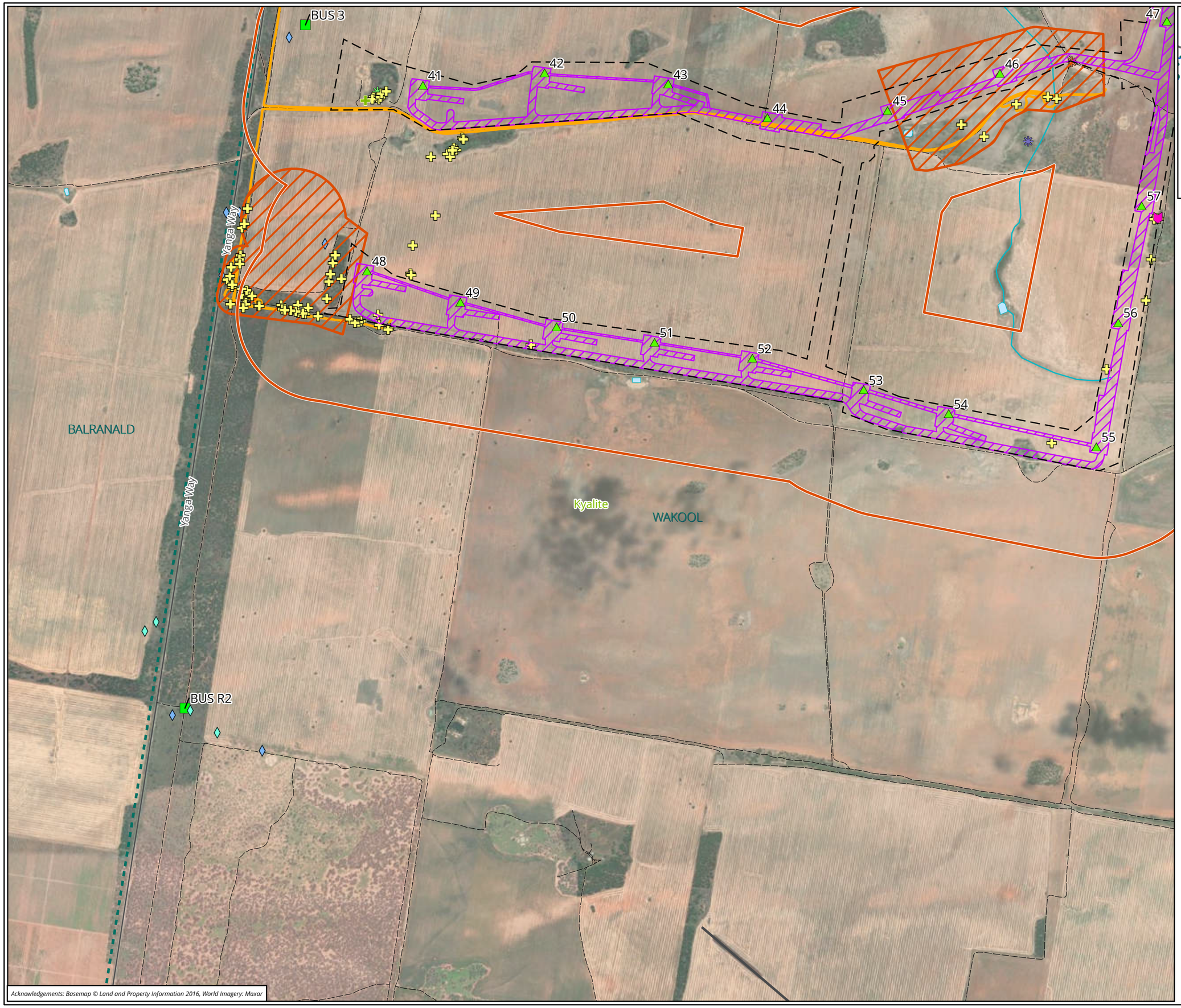
Scale: 1:20,000 @ A3

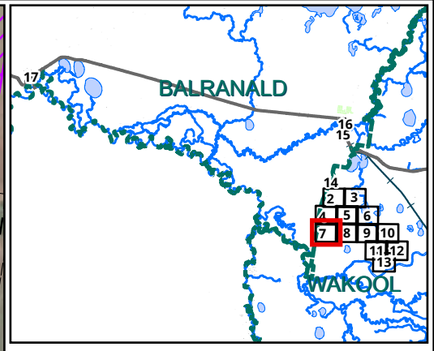
Coordinate System: GDA2020 MGA Zone 54

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

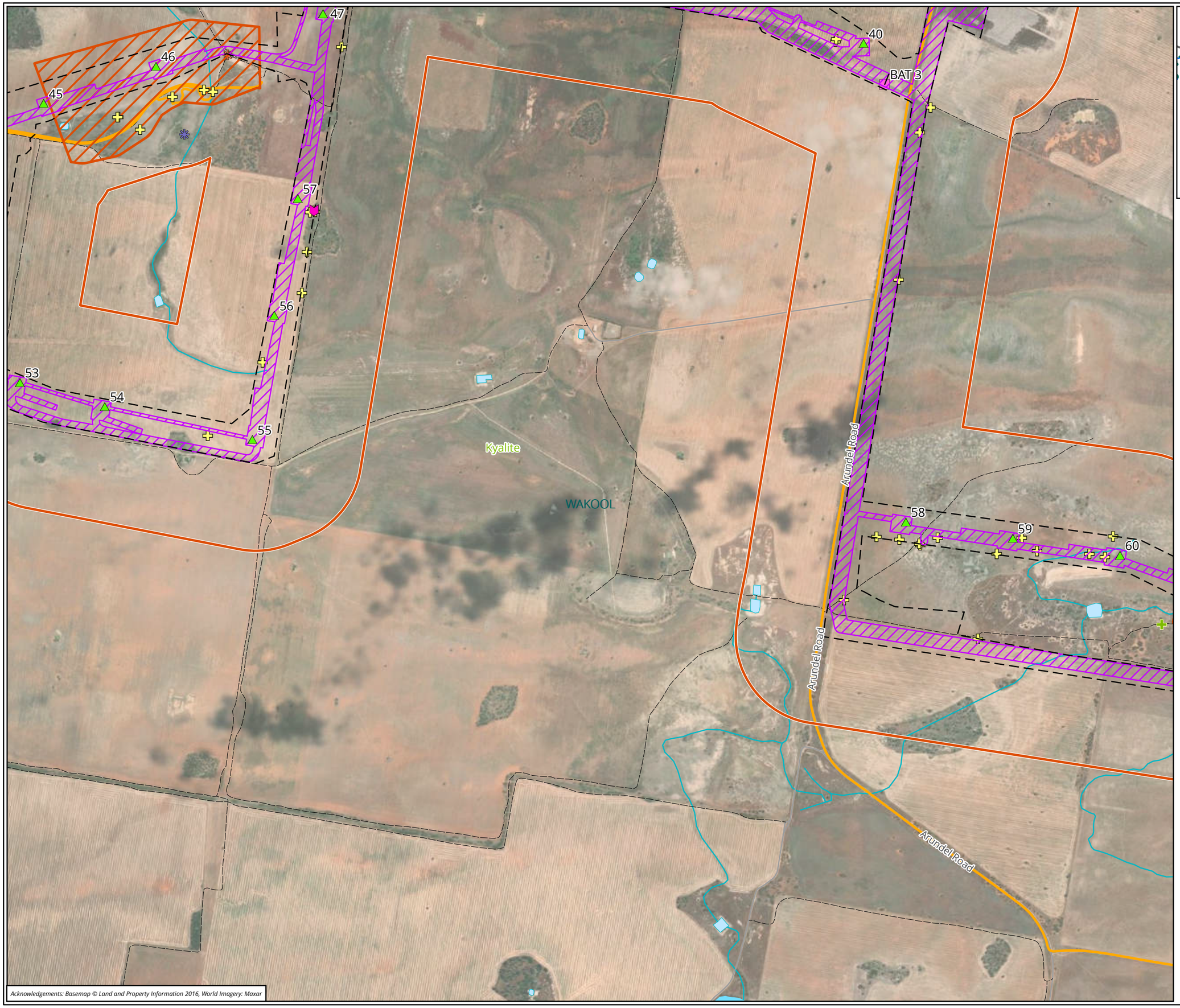
Scale: 1:20,000 @ A3

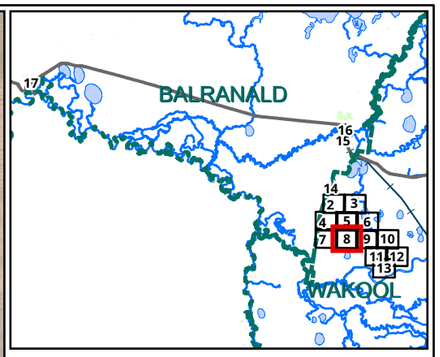
Coordinate System:
GDA2020 MGA Zone 54

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

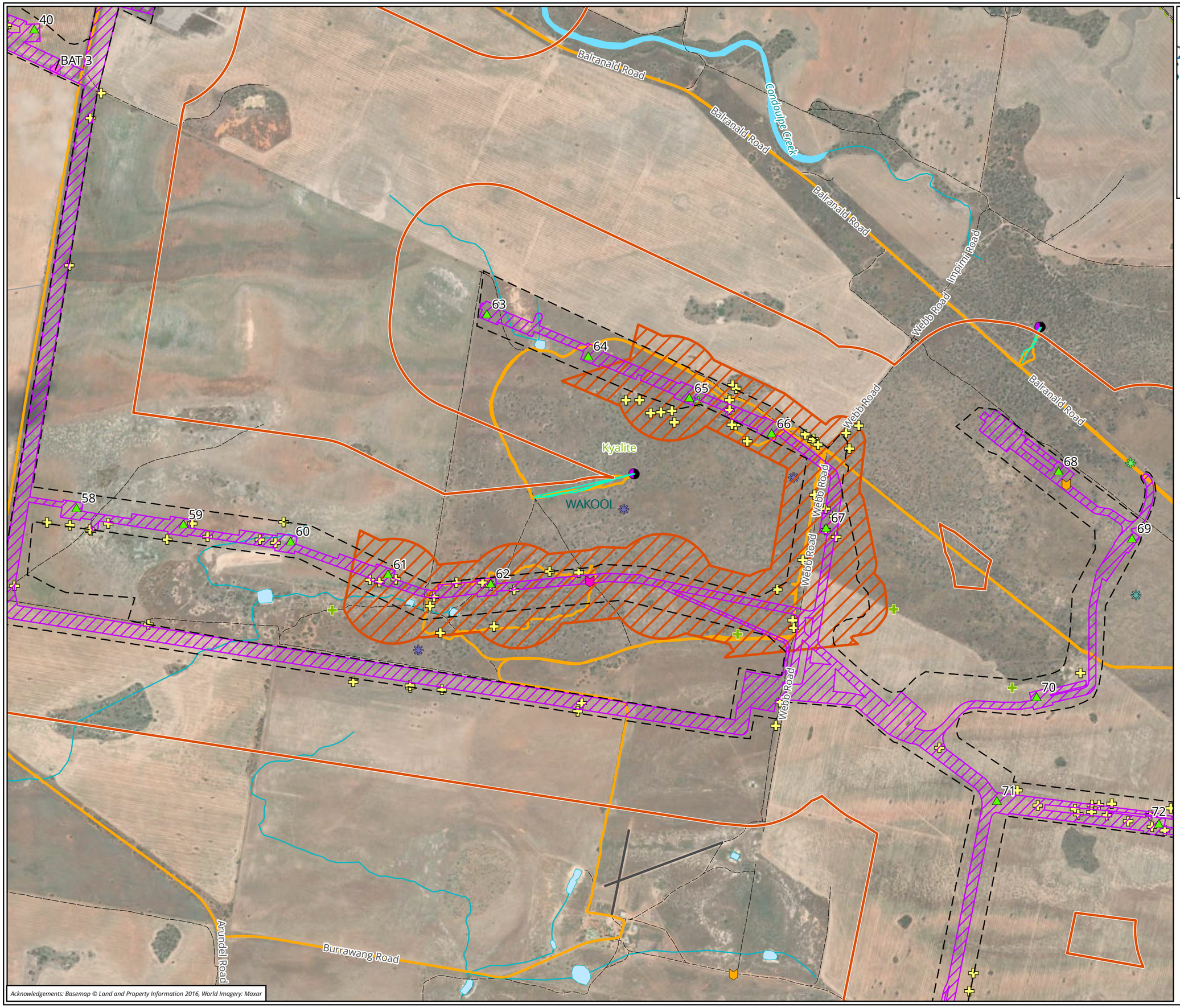
Coordinate System: GDA2020 MGA Zone 54

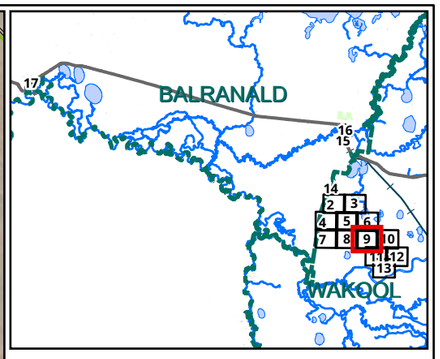
N

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

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
- 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

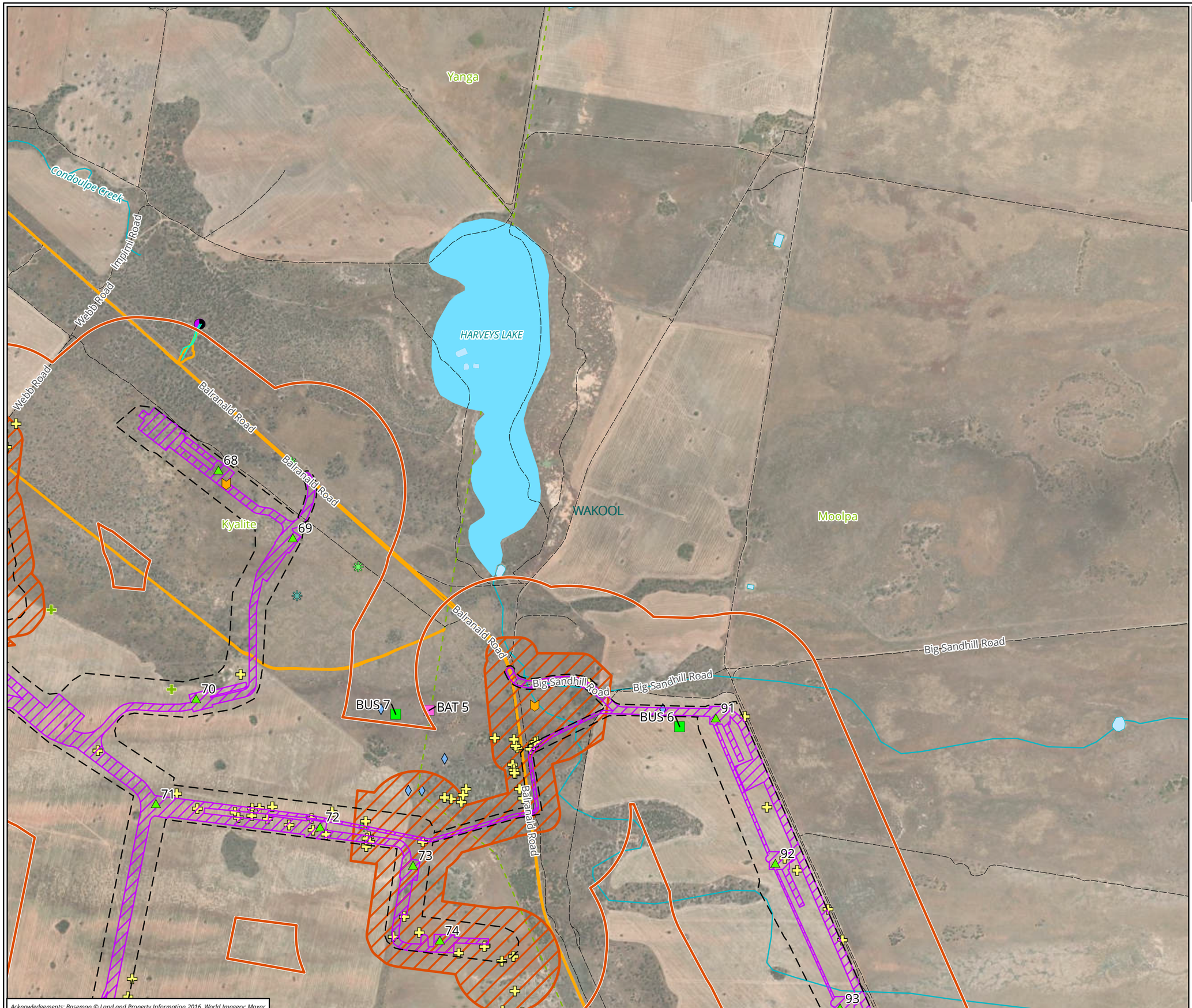
Scale: 1:20,000 @ A3

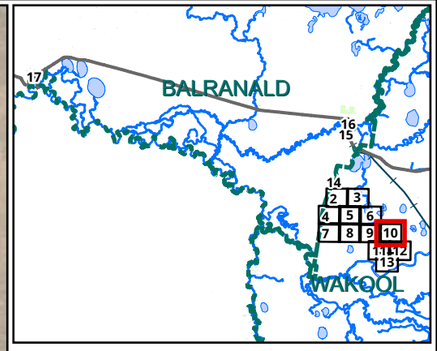
Coordinate System:
GDA2020 MGA Zone 54

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)

- 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

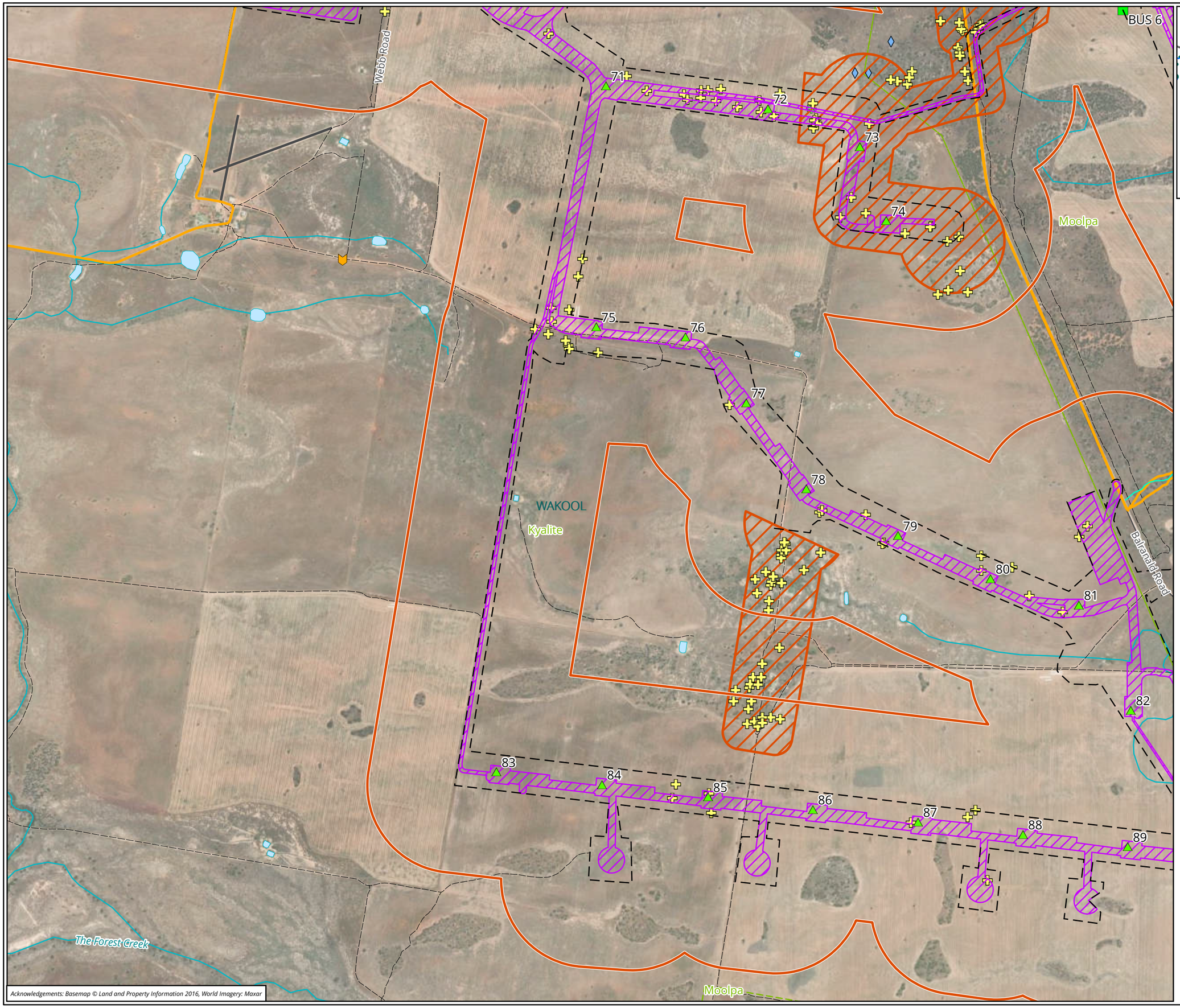
Scale: 1:20,000 @ A3

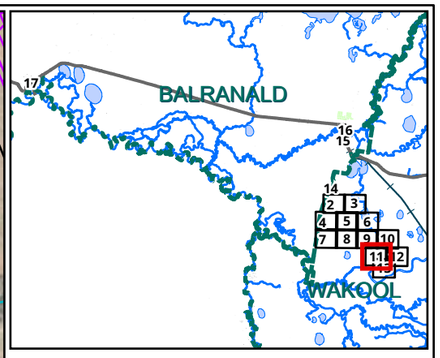
Coordinate System: GDA2020 MGA Zone 54

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
- 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

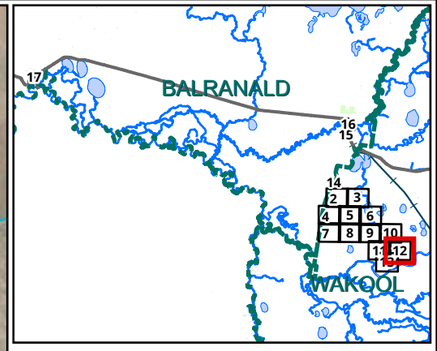
Scale: 1:20,000 @ A3

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

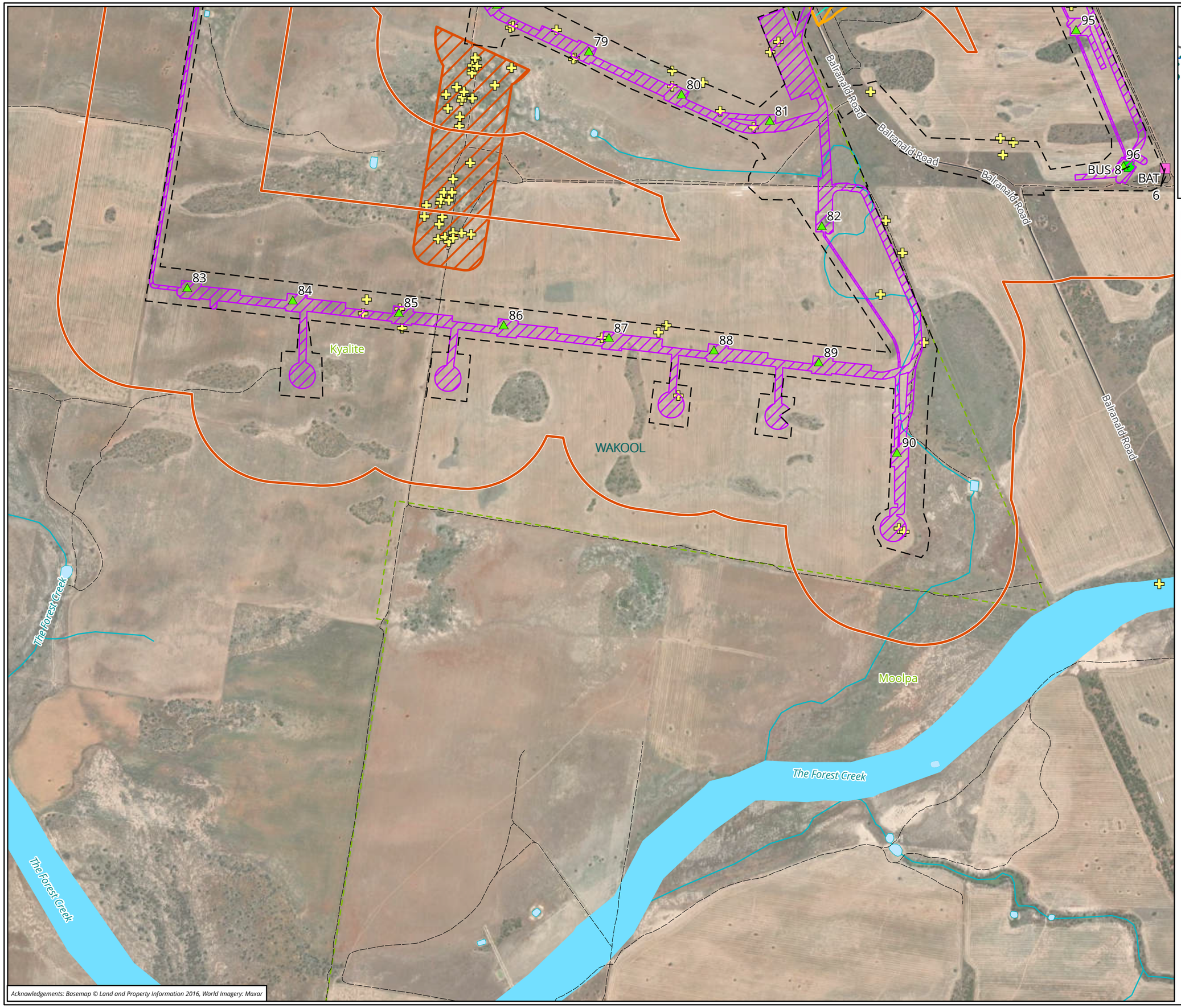
Coordinate System: GDA2020 MGA Zone 54

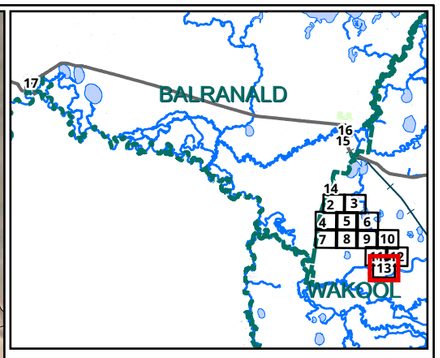
N

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

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
- 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

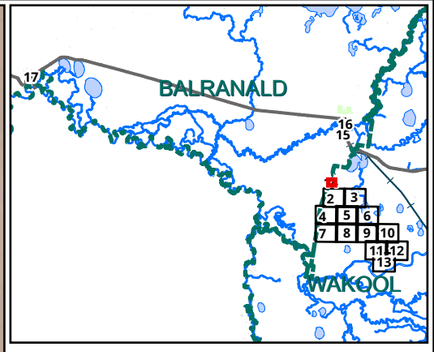
Coordinate System: GDA2020 MGA Zone 54

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

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



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

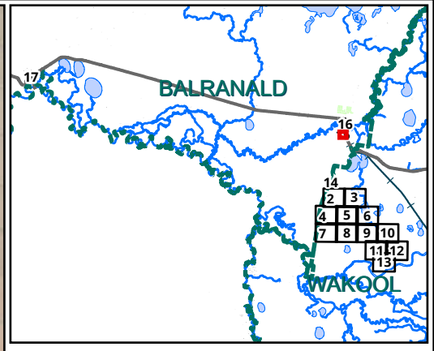
Coordinate System: GDA2020 MGA Zone 54

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

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



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

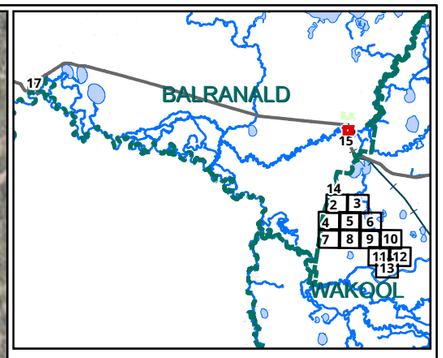
Scale: 1:5,000 @ A3

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

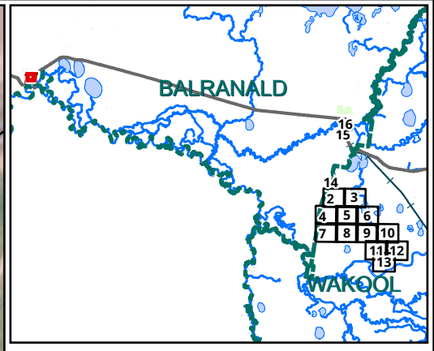
Coordinate System: GDA2020 MGA Zone 54

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

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



Legend

- Subject land
- Development footprint

Figure 10b.17 Targeted species mapping - Fauna

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

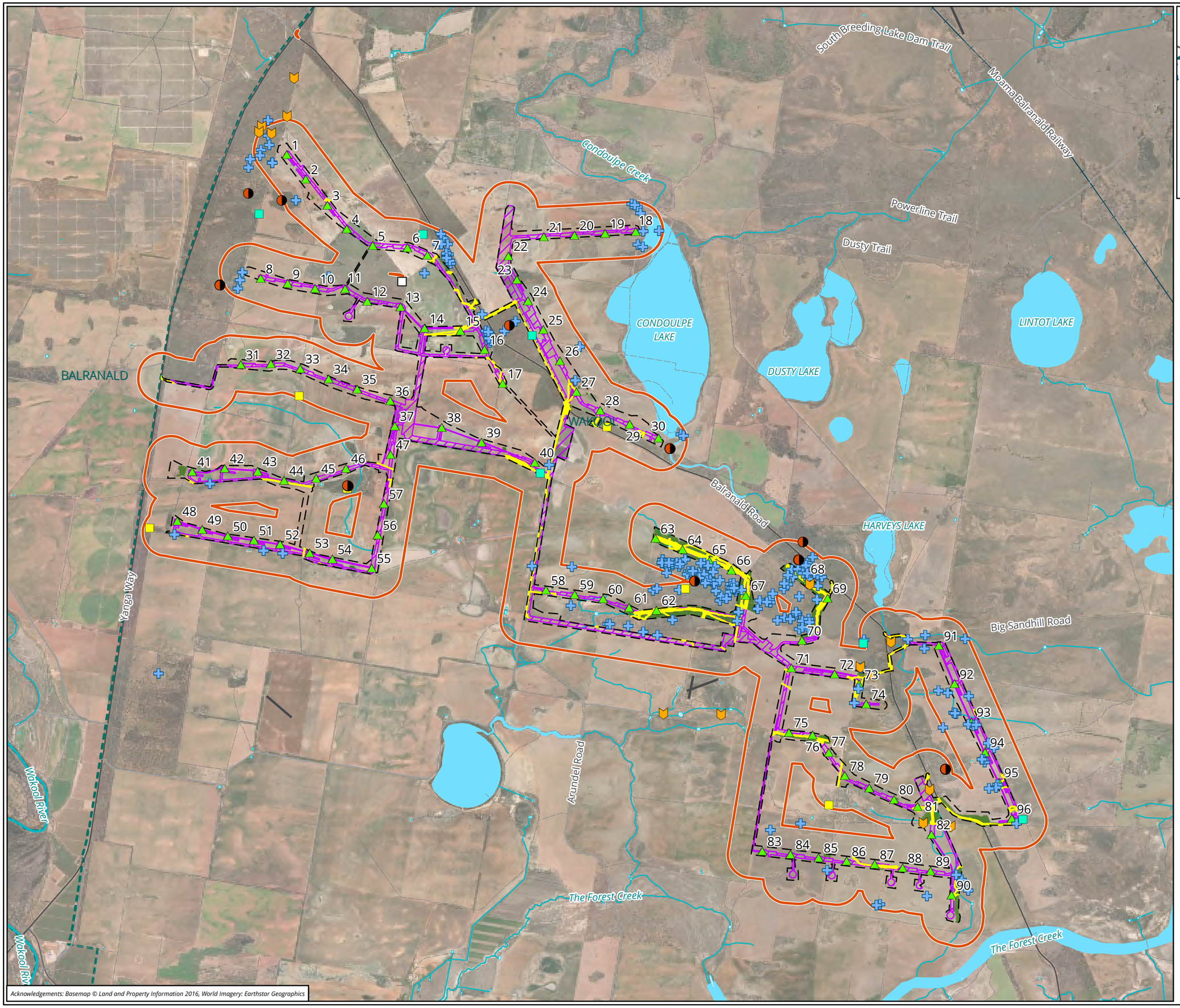
Coordinate System: GDA2020 MGA Zone 54

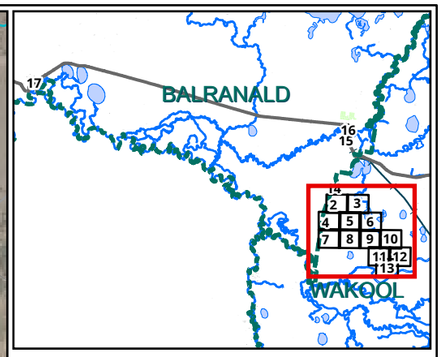
N

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

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





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Met mast
- Biosis additional location
- Nature Advisory original location

Figure 10c.1 RtS surveys

0 750 1,500 2,250 3,000

Meters

Scale: 1:75,000 @ A3

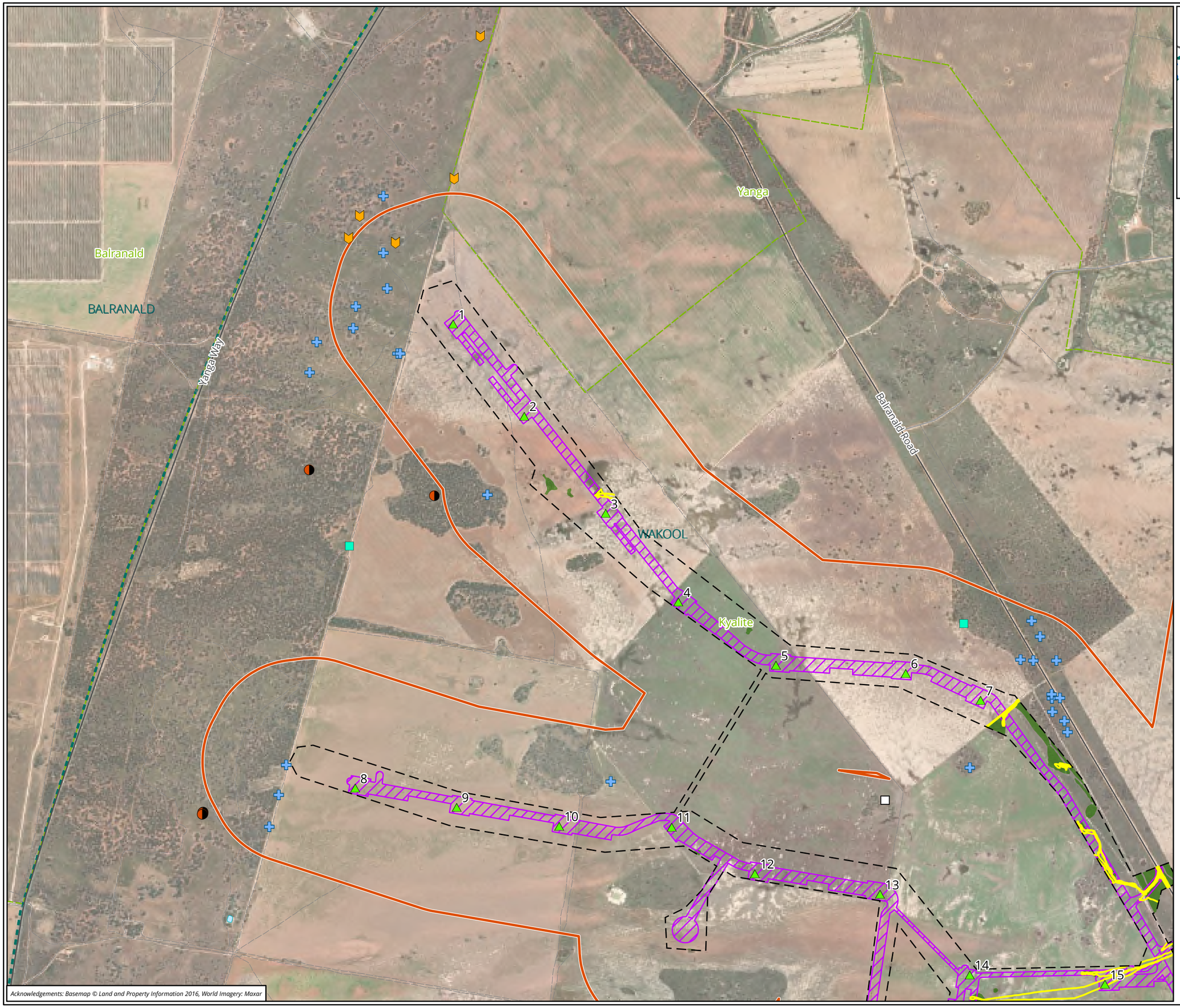
Coordinate System:
GDA2020 MGA Zone 54

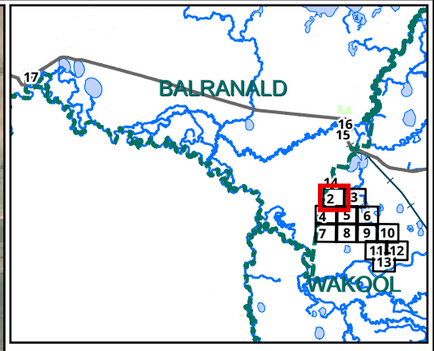
N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

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 - October 2024
- Call playback - Owl
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Met mast
- Nature Advisory original location

Figure 10c.2 RtS surveys

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

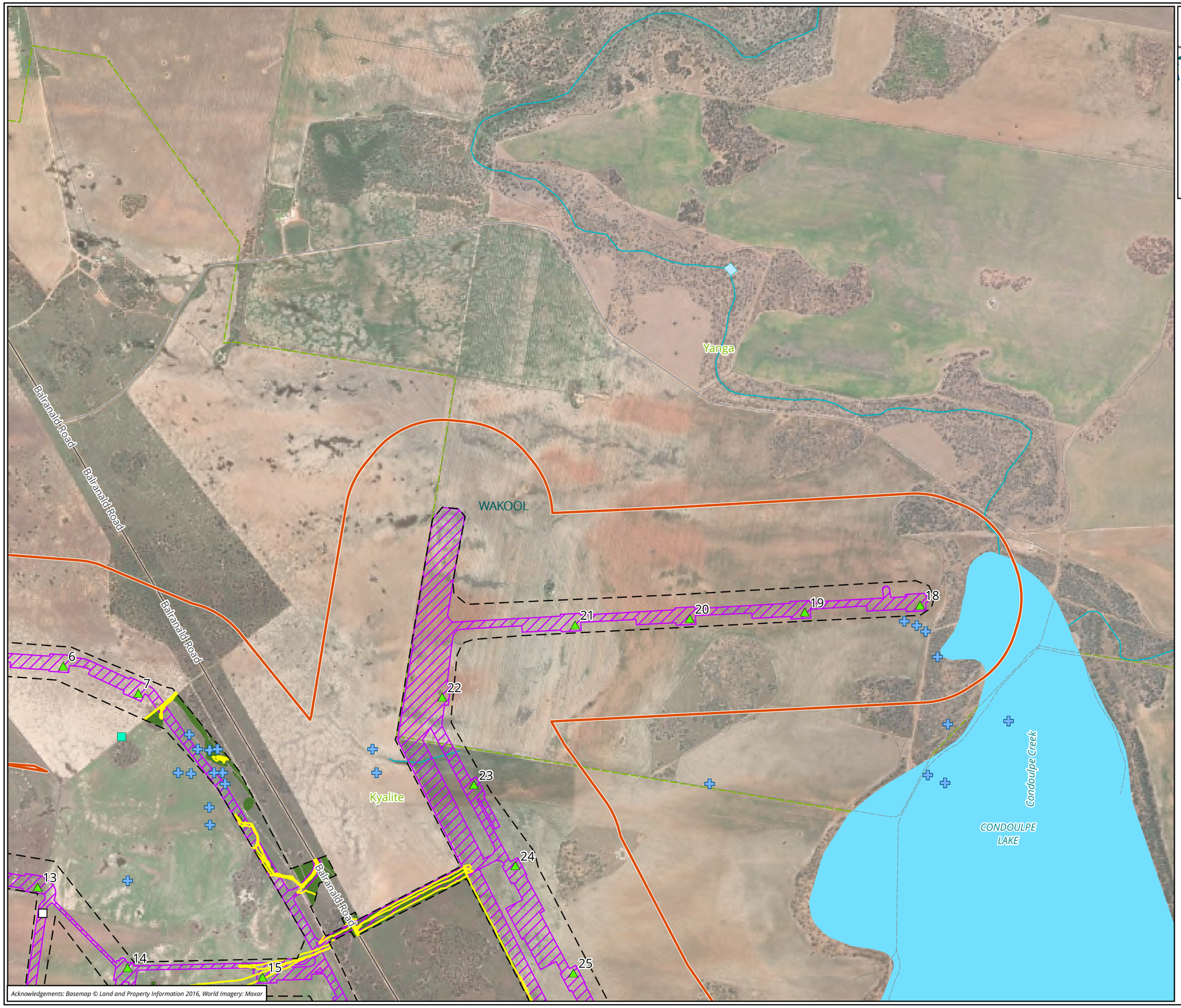
Coordinate System: GDA2020 MGA Zone 54

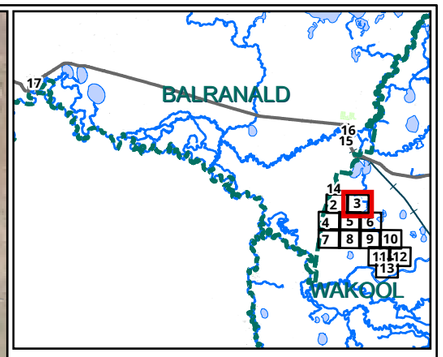
N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

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





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Microbat survey locations

- Met mast
- Nature Advisory original location

Figure 10c.3 RtS surveys

0 200 400 600 800

Meters

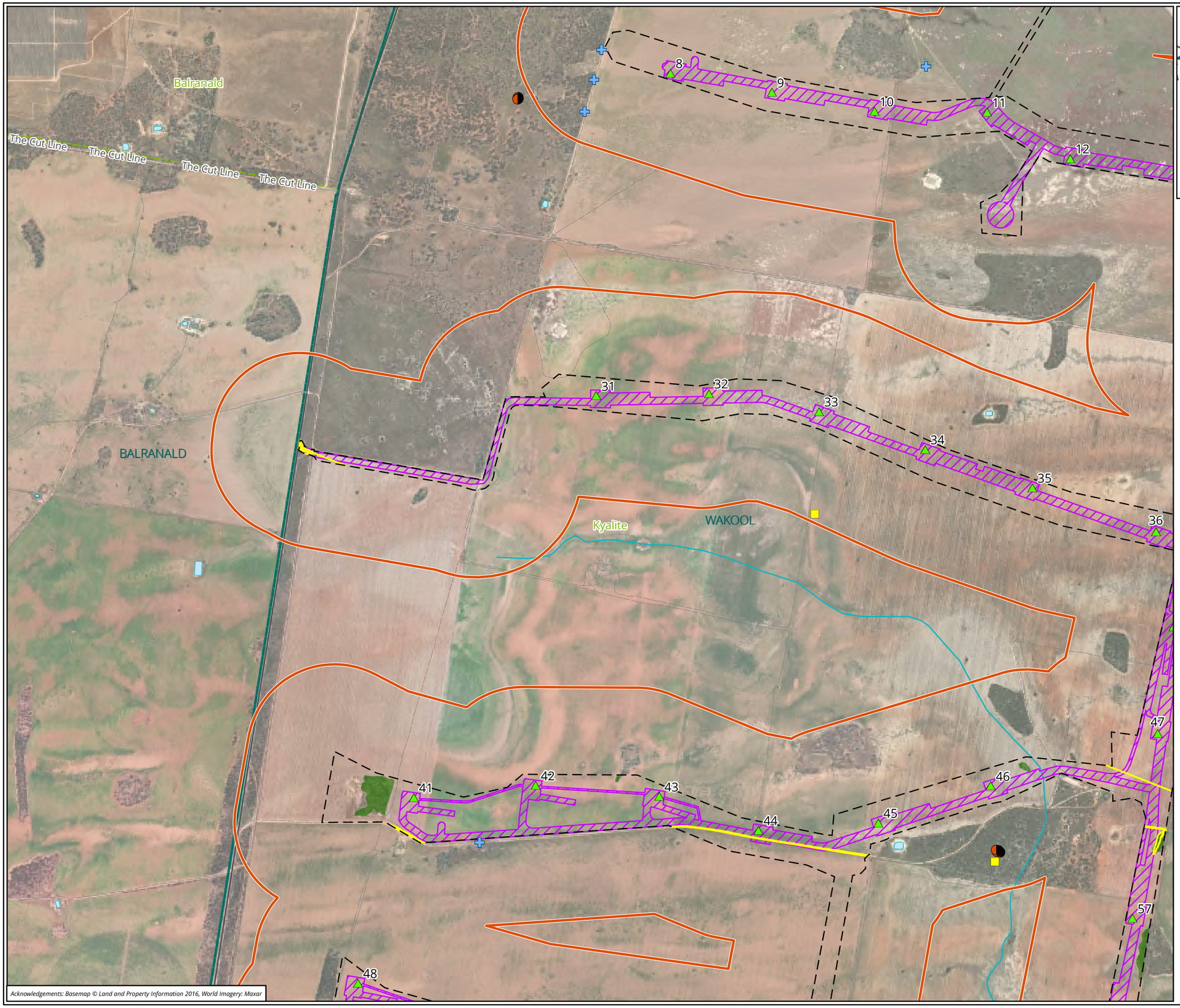
Scale: 1:20,000 @ A3

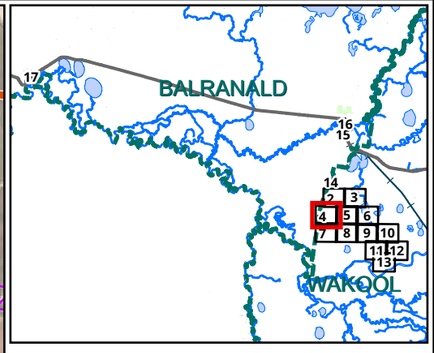
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Microbat survey locations

- Biosis additional location

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

Figure 10c.4 RtS surveys

0 200 400 600 800

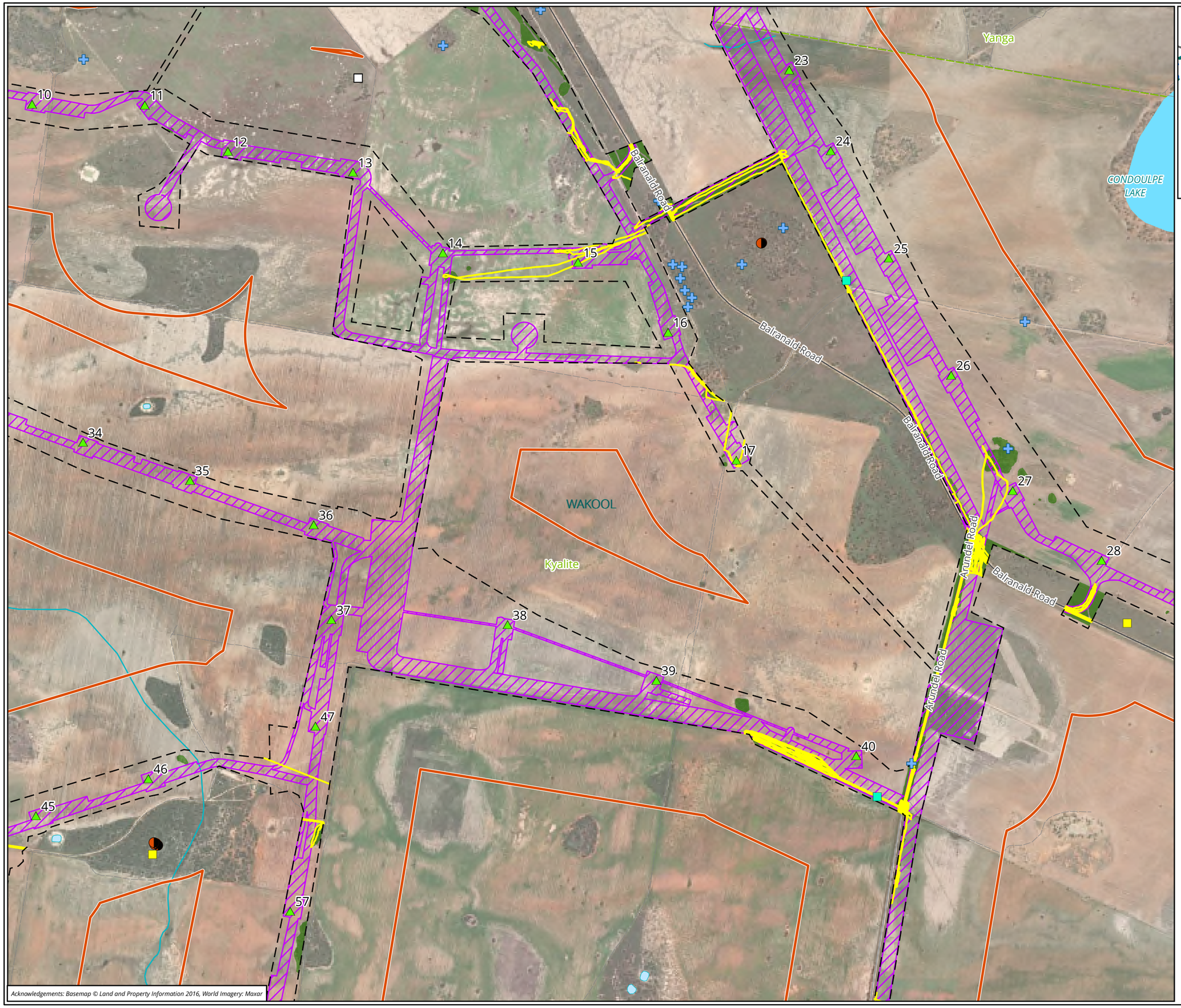
Meters

Scale: 1:20,000 @ A3

Coordinate System:
GDA2020 MGA Zone 54

N

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey



Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Microbat survey locations

- Met mast
- Biosis additional location
- Nature Advisory original location

Figure 10c.5 RtS surveys

0 200 400 600 800

Meters

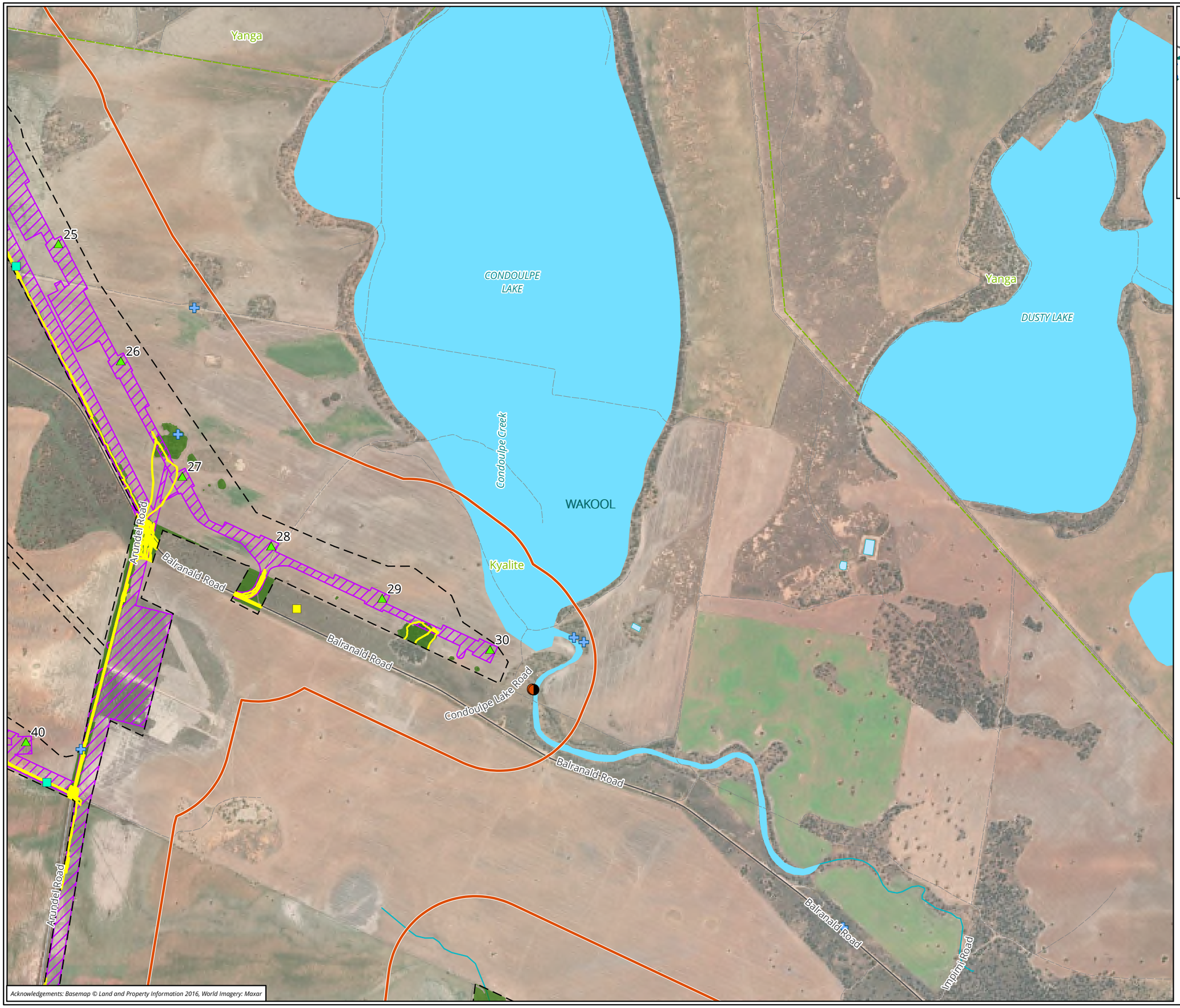
Scale: 1:20,000 @ A3

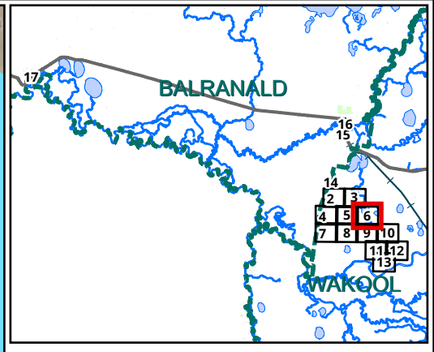
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Microbat survey locations

- Biosis additional location
- Nature Advisory original location

Figure 10c.6 RtS surveys

0 200 400 600 800

Meters

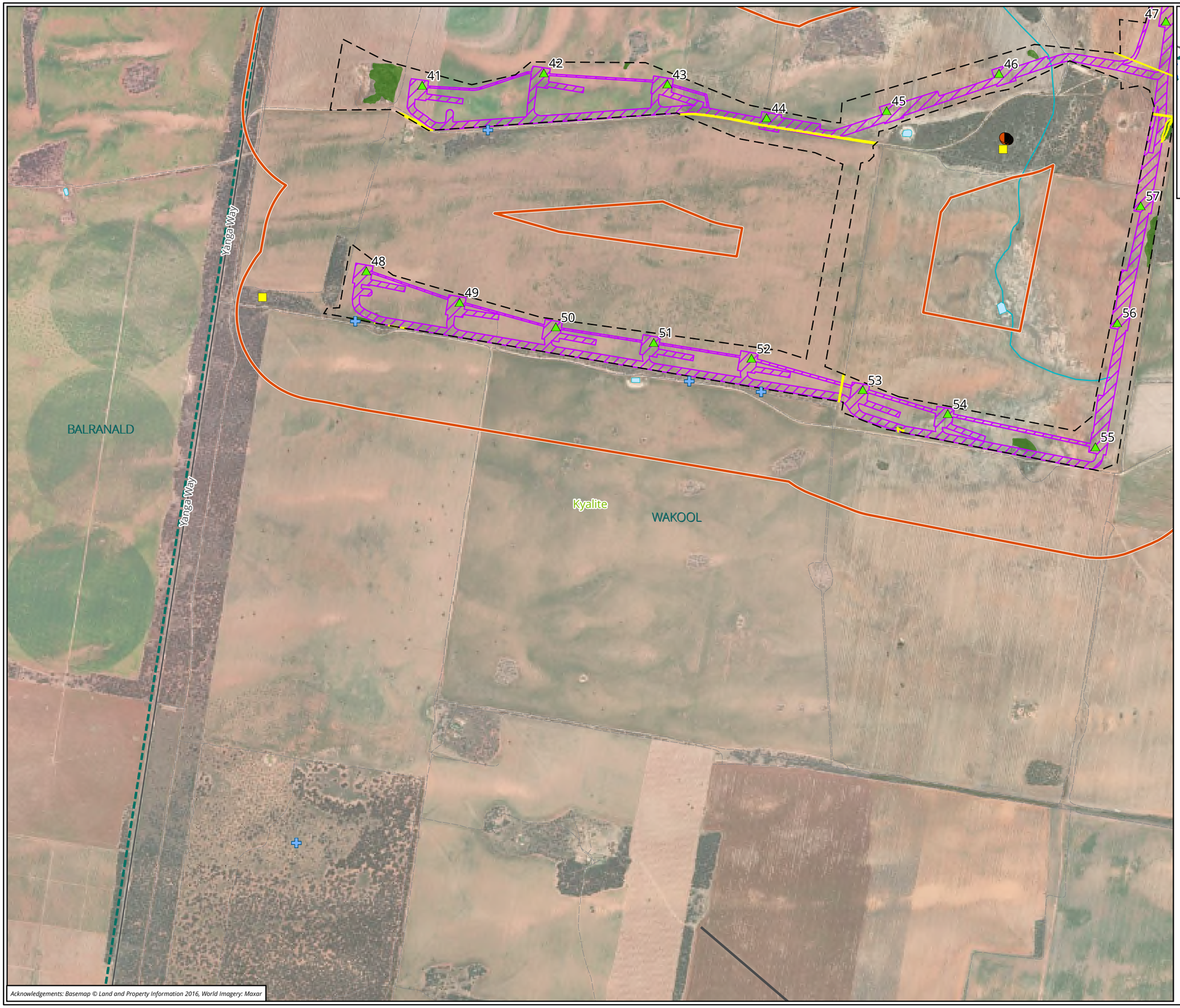
Scale: 1:20,000 @ A3

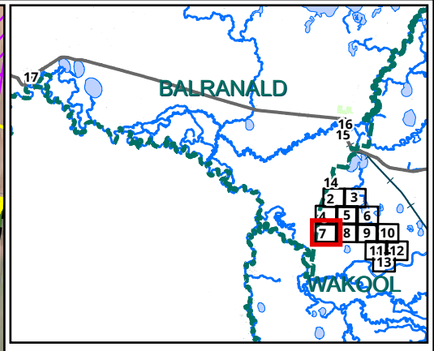
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Microbat survey locations

- Biosis additional location

Figure 10c.7 RtS surveys

0 200 400 600 800

Meters

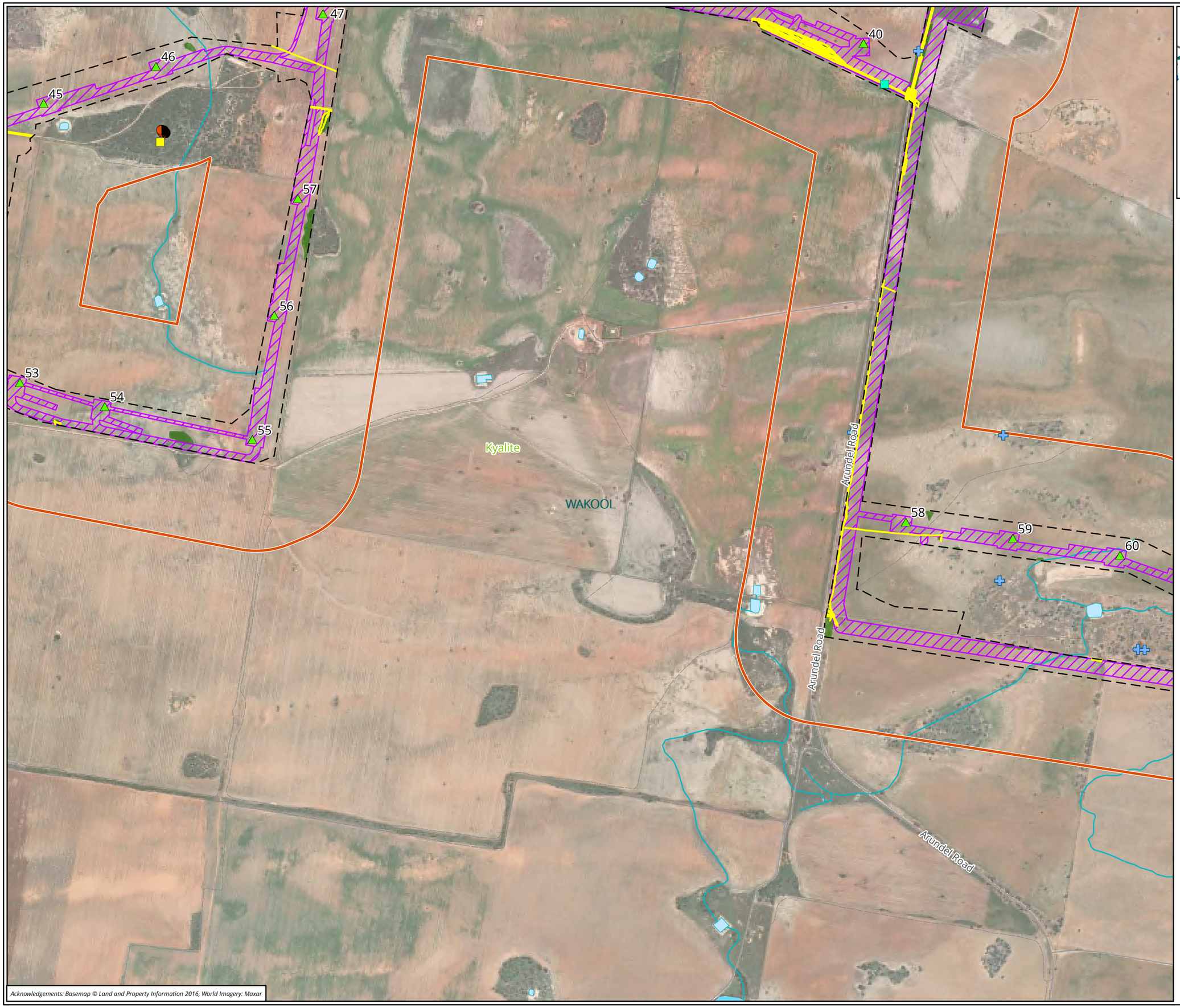
Scale: 1:20,000 @ A3

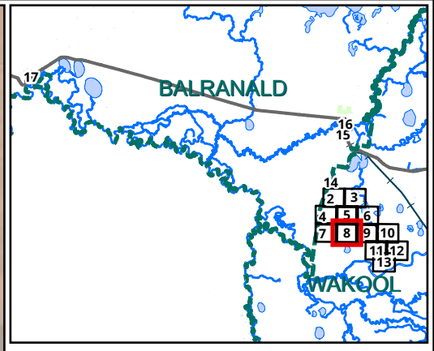
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Microbat survey locations

- Biosis additional location
- Nature Advisory original location

Figure 10c.8 RtS surveys

0 200 400 600 800

Meters

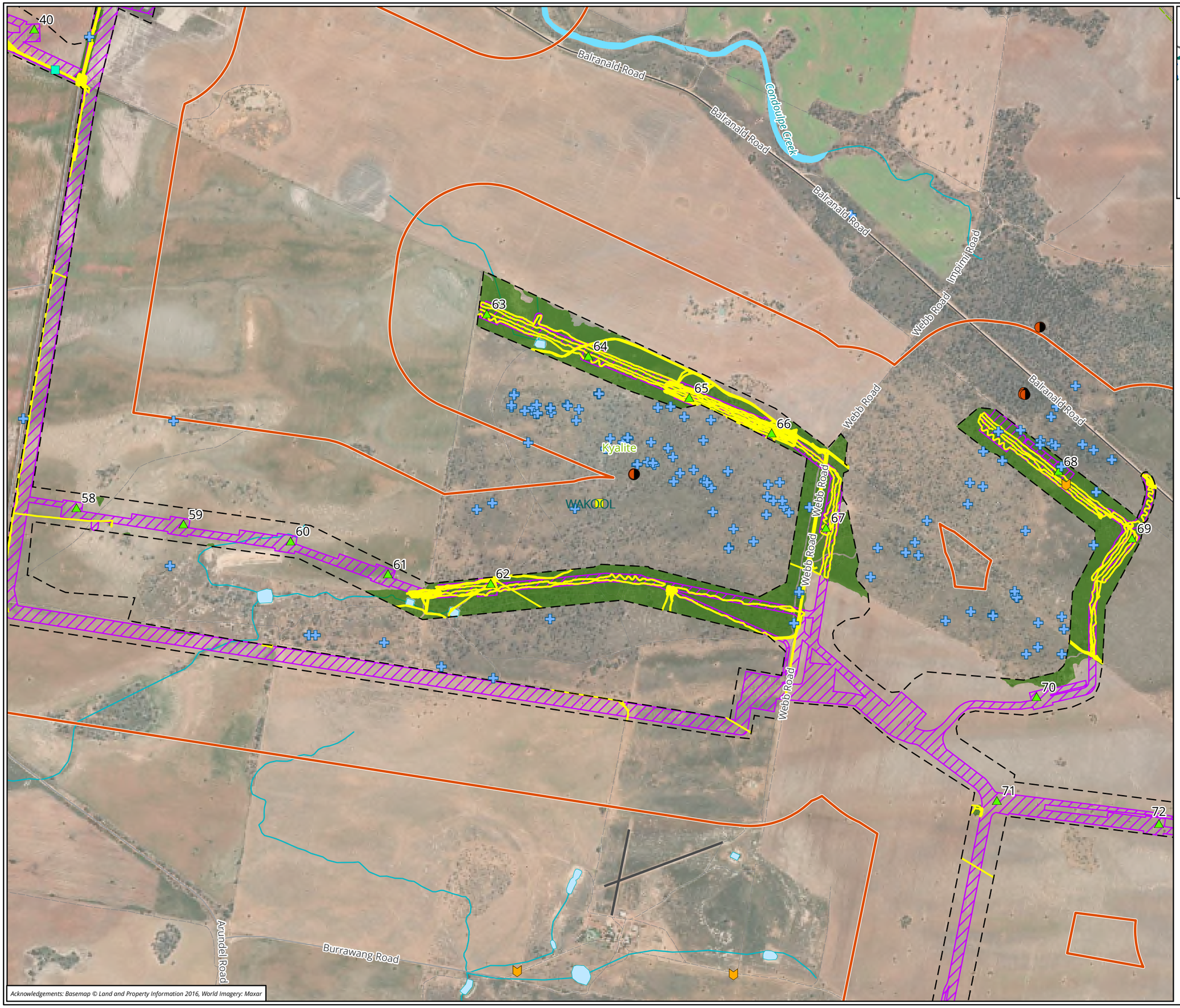
Scale: 1:20,000 @ A3

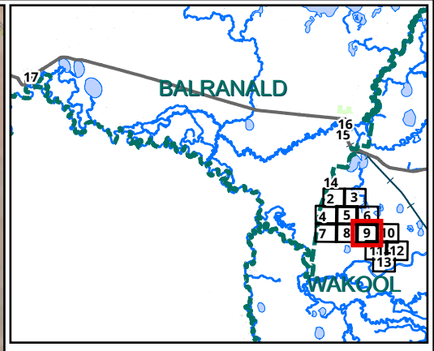
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Biosis additional location
- Nature Advisory original location

Figure 10c.9 RtS surveys

0 200 400 600 800

Meters

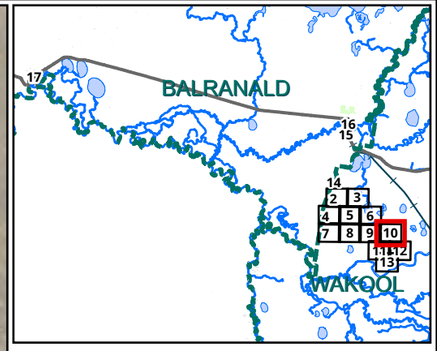
Scale: 1:20,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey



Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Nature Advisory original location

Figure 10c.10 RtS surveys

0 200 400 600 800

Meters

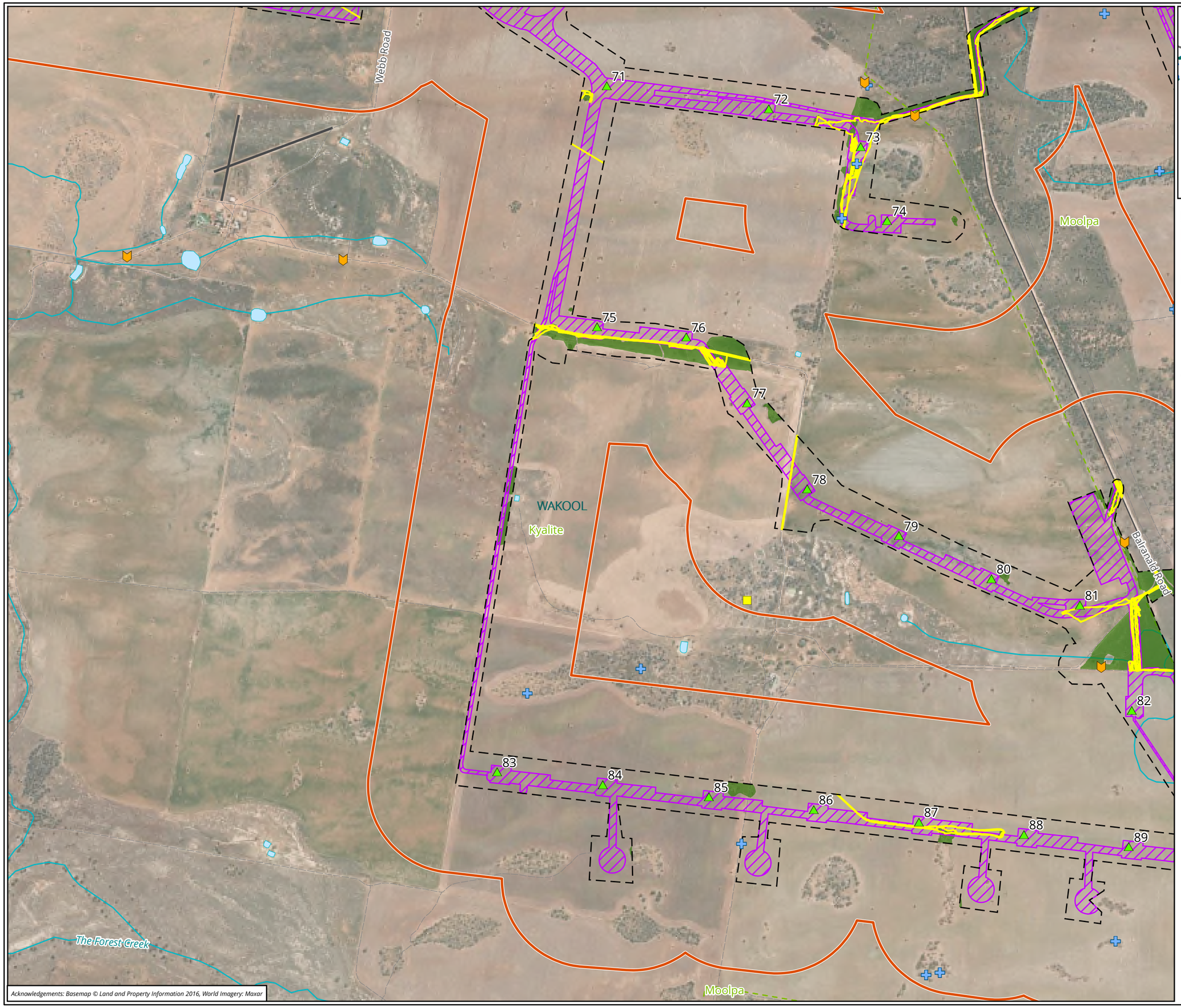
Scale: 1:20,000 @ A3

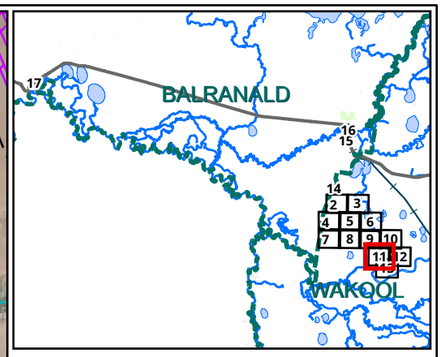
Coordinate System:
GDA2020 MGA Zone 54

N

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

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





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Biosis additional location

Figure 10c.11 RtS surveys

0 200 400 600 800

Meters

Scale: 1:20,000 @ A3

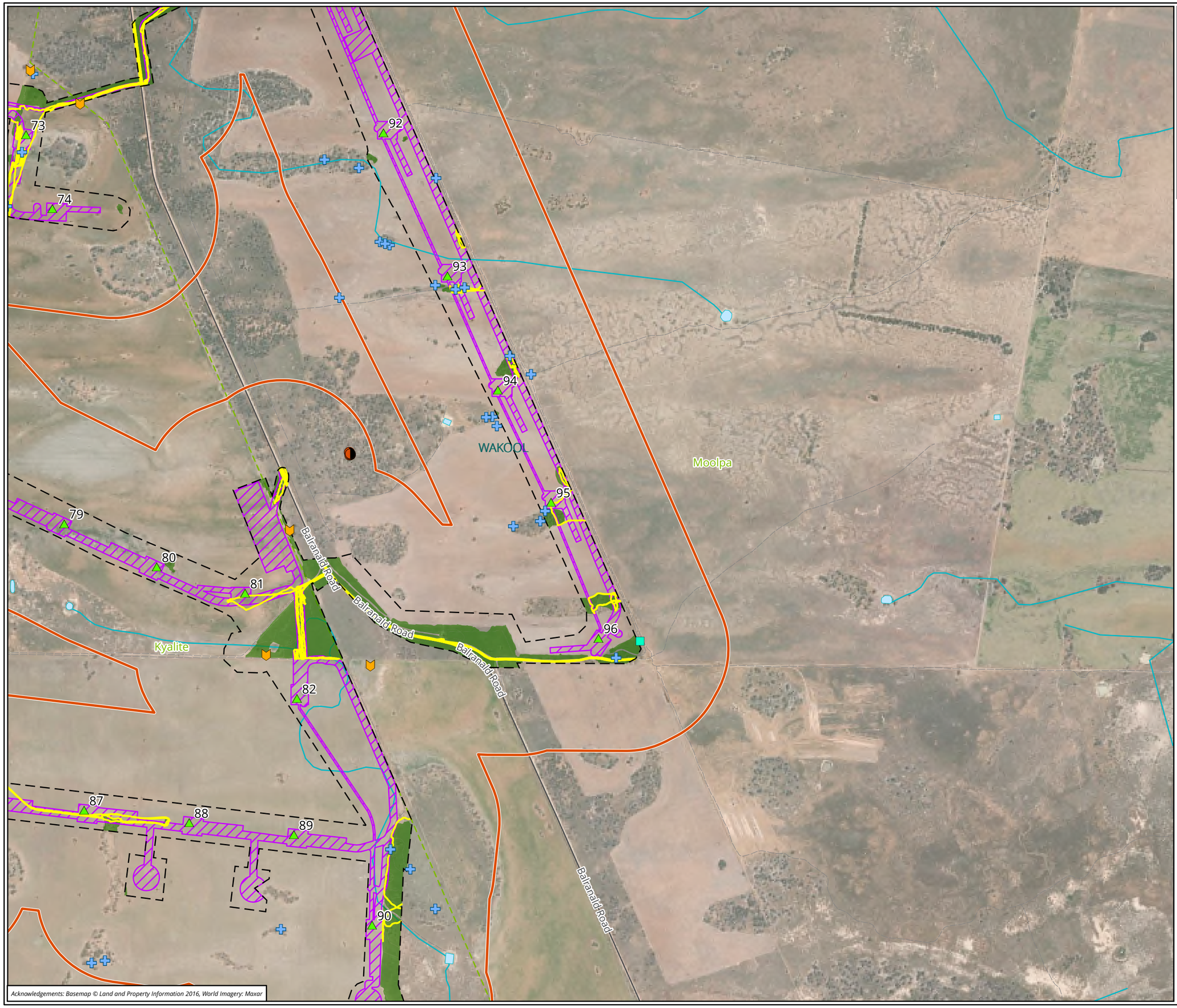
Coordinate System:
GDA2020 MGA Zone 54

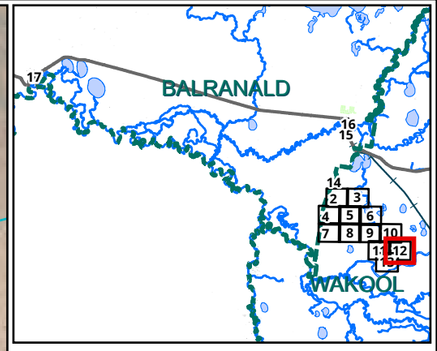
N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

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





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Call playback - Owl
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Nature Advisory original location

Figure 10c.12 RtS surveys

0 200 400 600 800

Meters

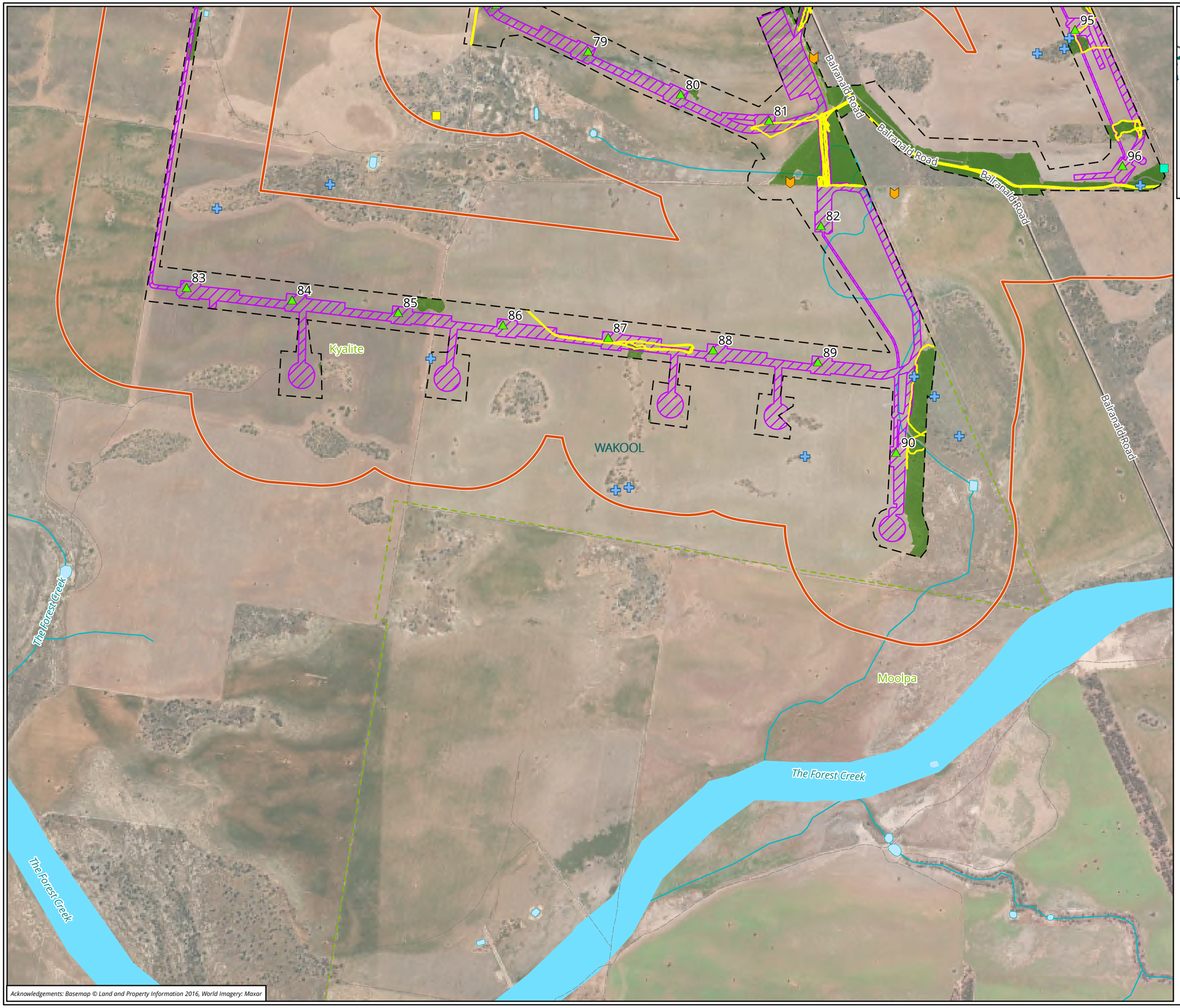
Scale: 1:20,000 @ A3

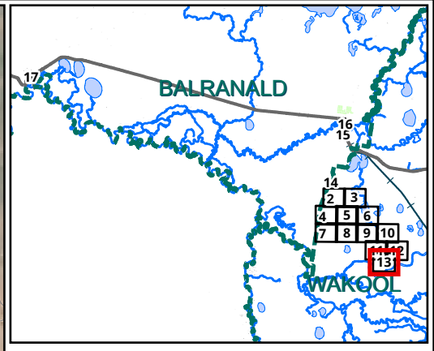
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey





Legend

- Subject land
- Development footprint
- Development corridor
- Wind turbine generators
- Native vegetation
- Survey tracks - October 2024
- Stick nest

Threatened fauna (Biosis)

- Pink Cockatoo (Major Mitchell's Cockatoo)

Microbat survey locations

- Biosis additional location
- Nature Advisory original location

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

Figure 10c.13 RtS surveys

0 200 400 600 800

Meters

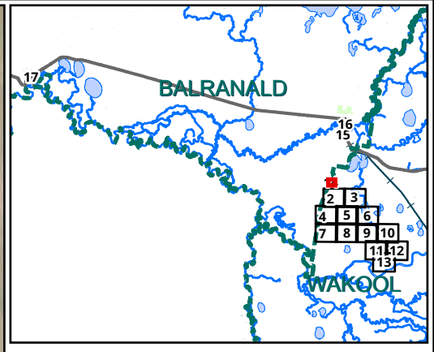
Scale: 1:20,000 @ A3

Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey



Legend

- Subject land
- Development footprint
- Development corridor

Figure 10c.14 RtS surveys

0 50 100 150 200

Meters

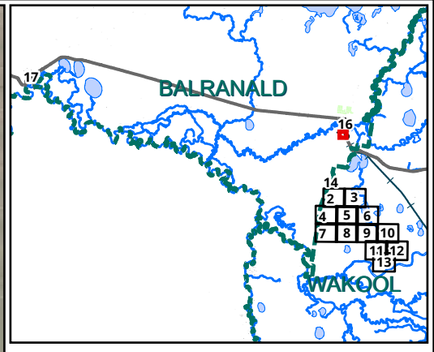
Scale: 1:5,000 @ A3

Coordinate System:
GDA2020 MGA Zone 54

N

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

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



Legend

- Subject land
- Development footprint
- Development corridor

Figure 10c.15 RtS surveys

0 50 100 150 200

Meters

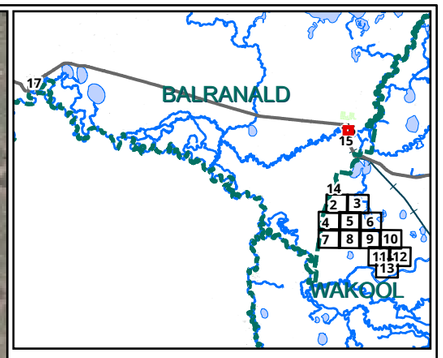
Scale: 1:5,000 @ A3

Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey



Legend

- Subject land
- Development footprint
- Development corridor

Figure 10c.16 RtS surveys

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

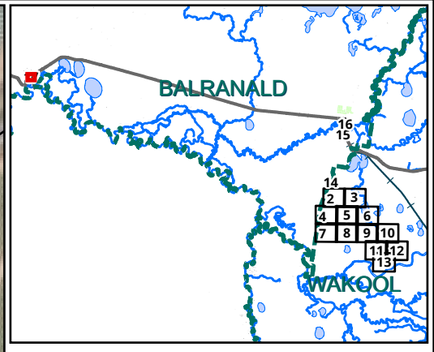
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

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



Legend

- Subject land
- Development footprint
- Development corridor

Figure 10c.17 RtS surveys

0 50 100 150 200

Meters

Scale: 1:5,000 @ A3

Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F10c_RtS_Survey

4.3.2. Expert reports

The presence of, and potential impacts to, Desert Mouse have been assessed via an Expert Report prepared by Dr John Read, recognised as an authority on the species by the Director South West CPHR on 17 November 2023.

The Expert Report was prepared to determine whether Desert Mouse is likely to occur within the subject land, in accordance with the requirements of Box 3 of the BAM (DPIE 2020). Dr Read, of Ecological Horizons, arranged for Alex Holmes of GHD to compile regional records (including through use of BioNet database and regional ecological connections) and conduct field inspections of the subject land for suitable habitat for Desert Mouse. Ecological Horizons have worked with Alex and trust and value his ecological skills, local knowledge and thoroughness, and have previously discussed with Alex optimum times and habitats for surveying the species. The Ecological Horizons and GHD reports are included in Appendix 11.

The report found that a resident populations of Desert Mouse is considered to be unlikely to occur within the subject land for three reasons:

- Scarcity of nearby records (including from the intensively surveyed Mallee Cliffs National Park) suggest that the Project lies just beyond the periphery of the consistently occupied range of the species, even though animal distributions are inherently dynamic.
- The habitat of the project area is 'heavily disturbed' (GHD 2025), without the extensive tracts of *Triodia* hummock land or sedges or good condition chenopod shrubland that typify the species' habitat.
- The site appraisal failed to locate likely habitat for the species within the study site (GHD 2025). (Ecological Horizons 2025)

The report concludes that the expert opinion provided of resident or important populations of Desert Mouse being unlikely at the Junction Rivers Wind Farm subject land is supported by the conclusions from the GHD (2025) site report and the lack of records from the comprehensive, long term local data from the nearby Mallee Cliffs National Park. (Ecological Horizons 2025)

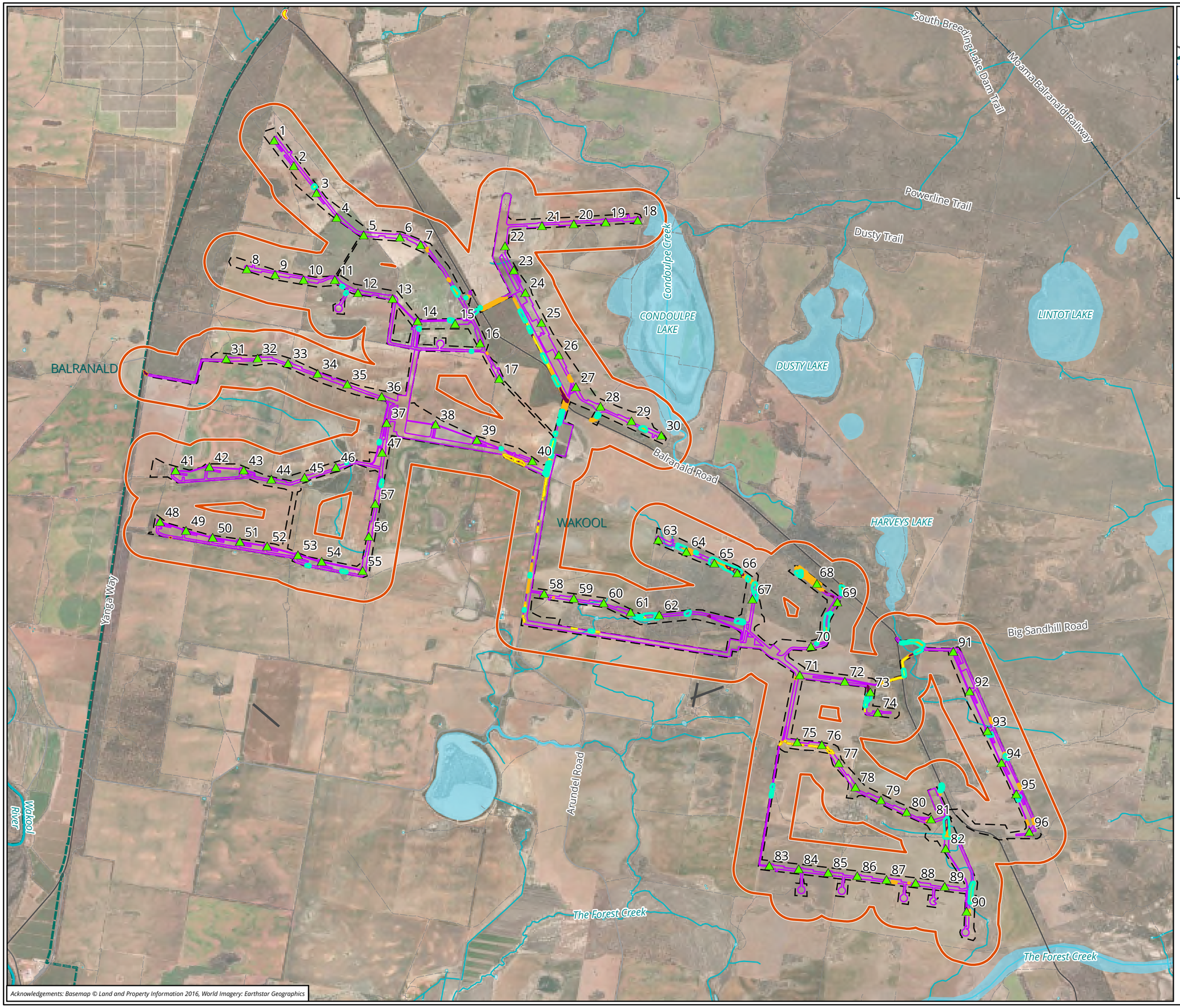
As such no further assessment of impact to Desert Mouse are required

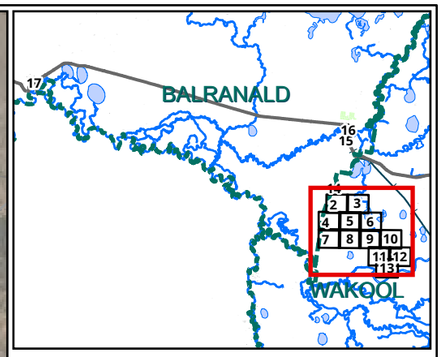
4.3.3. Threatened species summary and polygons

Table 39 below 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 39 Threatened species polygons within the development footprint

Threatened species	Impact (ha)	Unit of measure	Biodiv. Risk weighting	Polygon attributes
Flora				
Atriplex infrequens	• 14.34 ha	Area	2.0	• All PCTs associated with the specie sin BioNet in all condition zones
Fauna				
Pink Cockatoo	• 37.4 ha	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. – 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). • Surveyed areas confirmed not to support potential nest trees, or greater than 200m of a potential nest tree, have been excluded. • Unsurveyed areas greater than 200m from potential habitat (i.e., associated wooded PCTs that may support nest trees) have been excluded.
Crowned Gecko	• 8.74 ha	Area	2.0	• All PCTs associated with the species in BioNet in all condition zones
Painted Burrowing Frog	• 17.92 ha	Area	2.0	• All PCTs associated with the species in BioNet in all condition zones • Suitable habitat for this species is all areas of associated PCTs within 200 metres of aquatic habitats that would 'flood' or become inundated, including watercourses and farm dams • The above extent has been derived from the 1 % AEP flood event polygons developed by WRM (2024). The 1 % AEP event is considered the greatest flood extent likely to occur within the subject land during the life of the project, and equates to >50mm of rainfall in 24 hours, which is the minimum requirement for the species' surveys to be completed and thus create suitable habitat conditions for the species.





Legend

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

Threatened species polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.1 Threatened species polygons

0 825 1,650 2,475 3,300

Meters

Scale: 1:72,000 @ A3

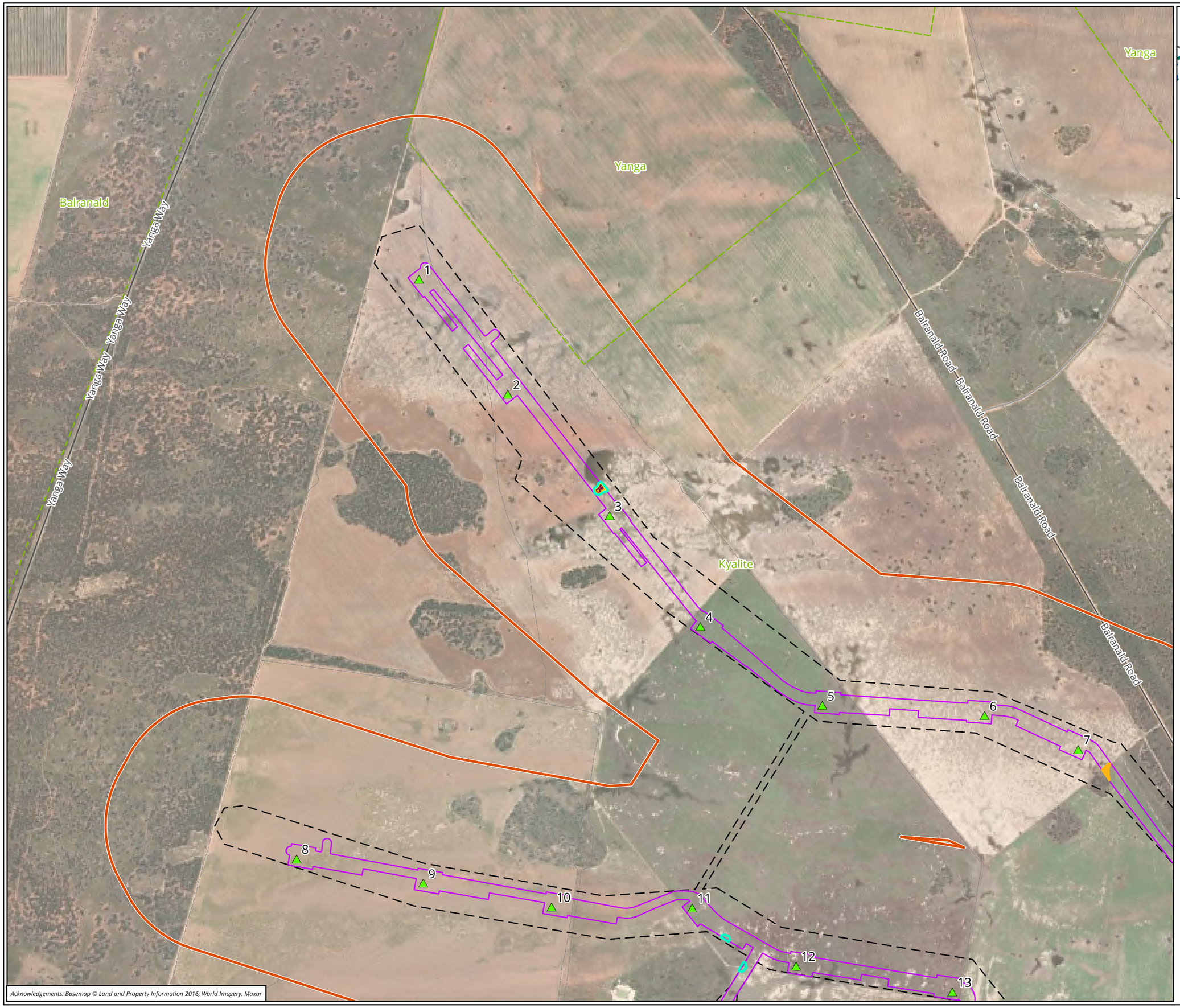
Coordinate System: GDA2020 MGA Zone 54

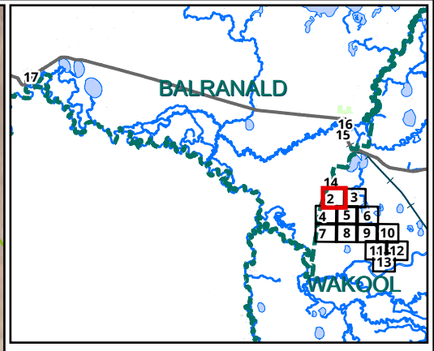
N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

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

Figure 11.2 Threatened species polygons

0 180 360 540 720

Meters

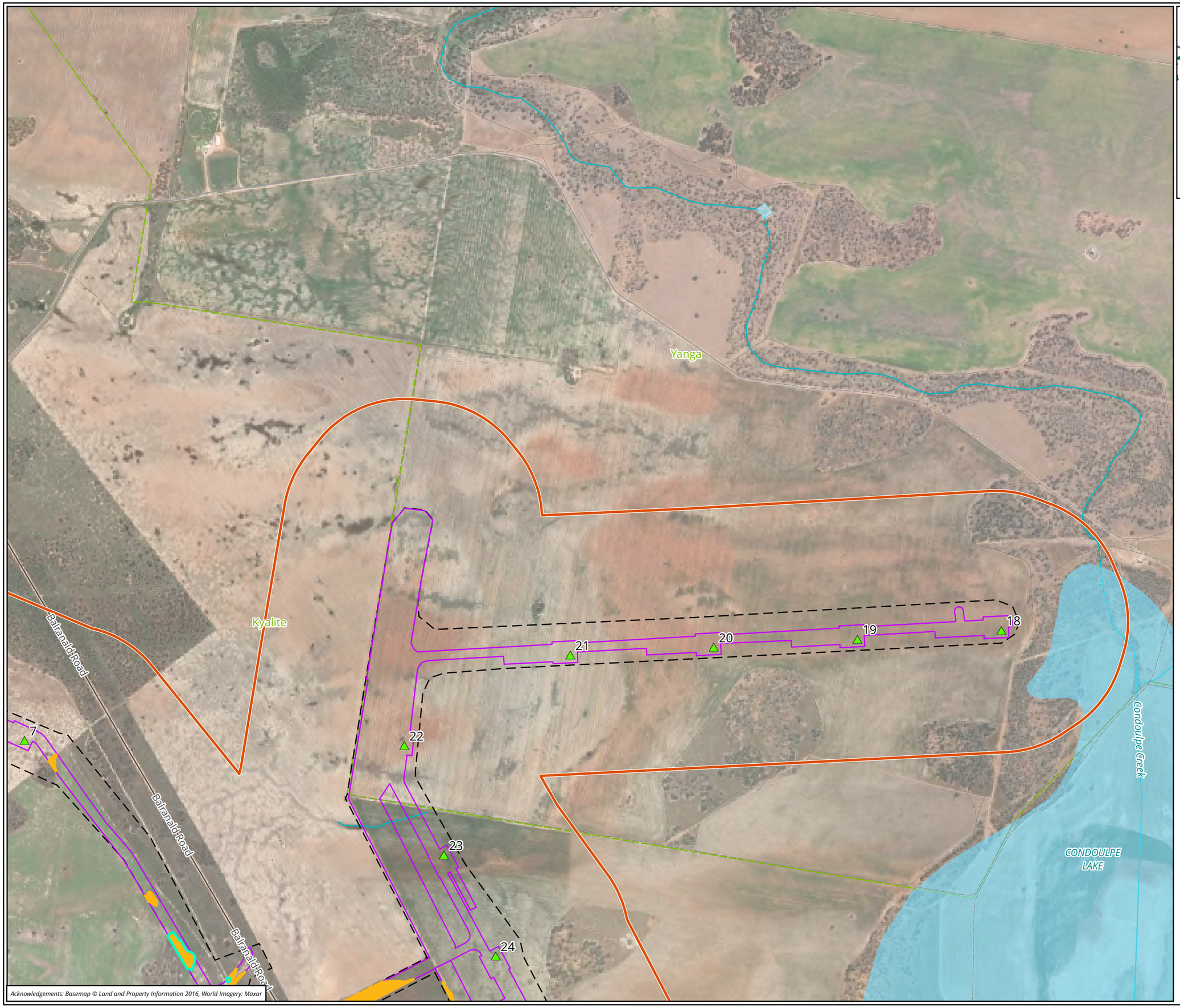
Scale: 1:16,000 @ A3

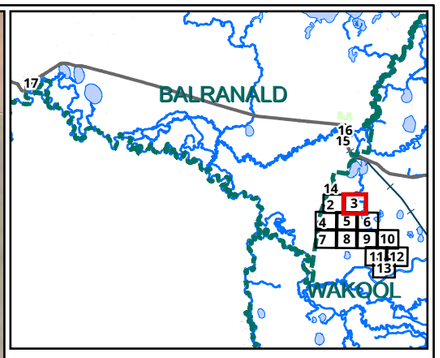
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP





Legend

- Subject land
- Development corridor
- Development footprint
- Wind turbine generators
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.3 Threatened species polygons

0 180 360 540 720

Meters

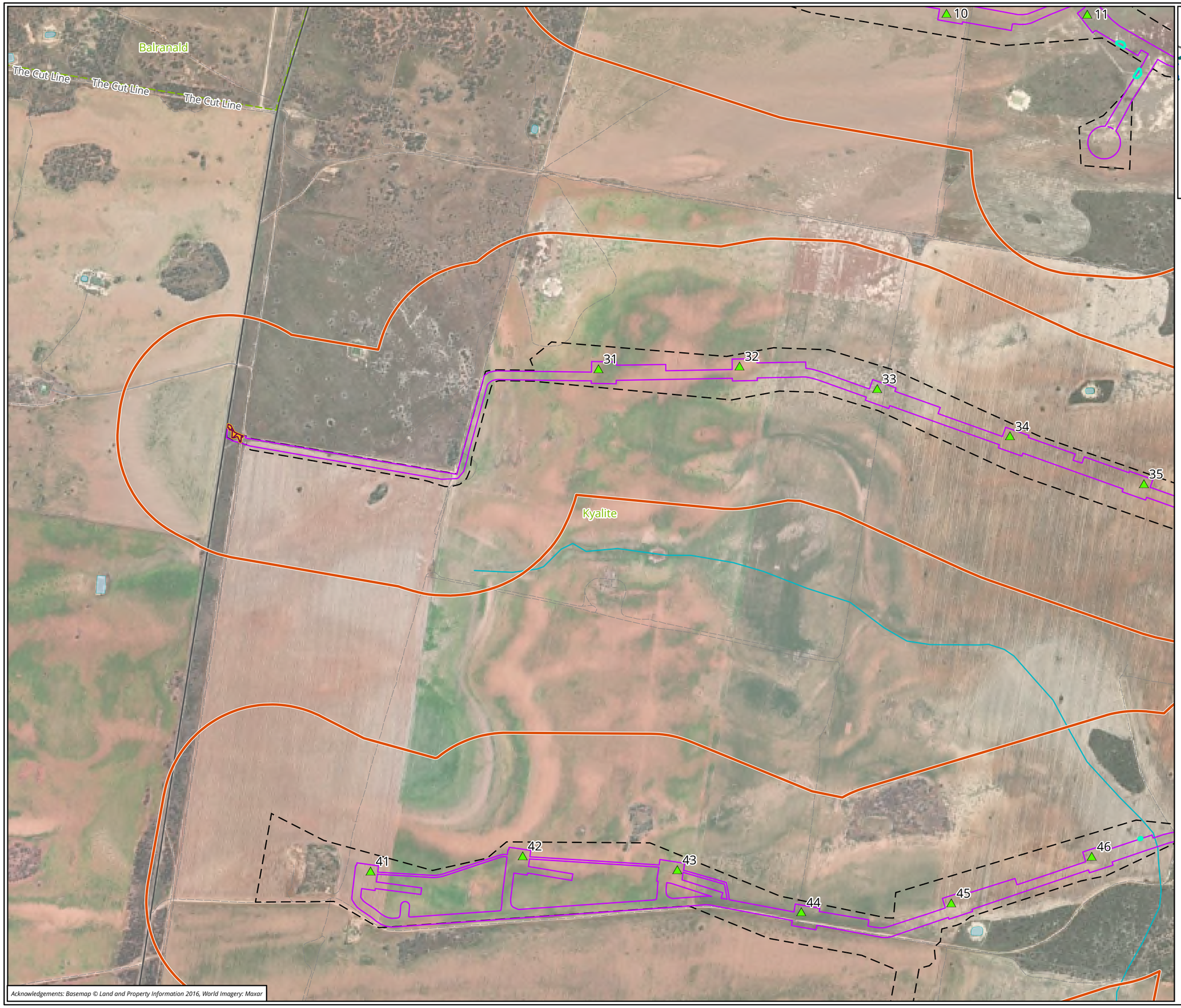
Scale: 1:16,000 @ A3

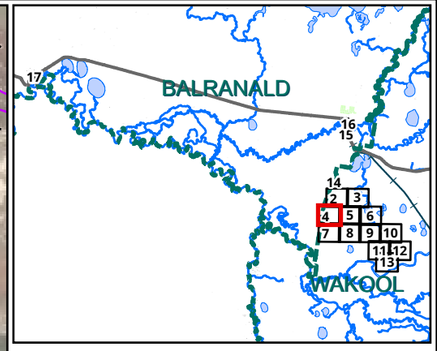
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.4 Threatened species polygons

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

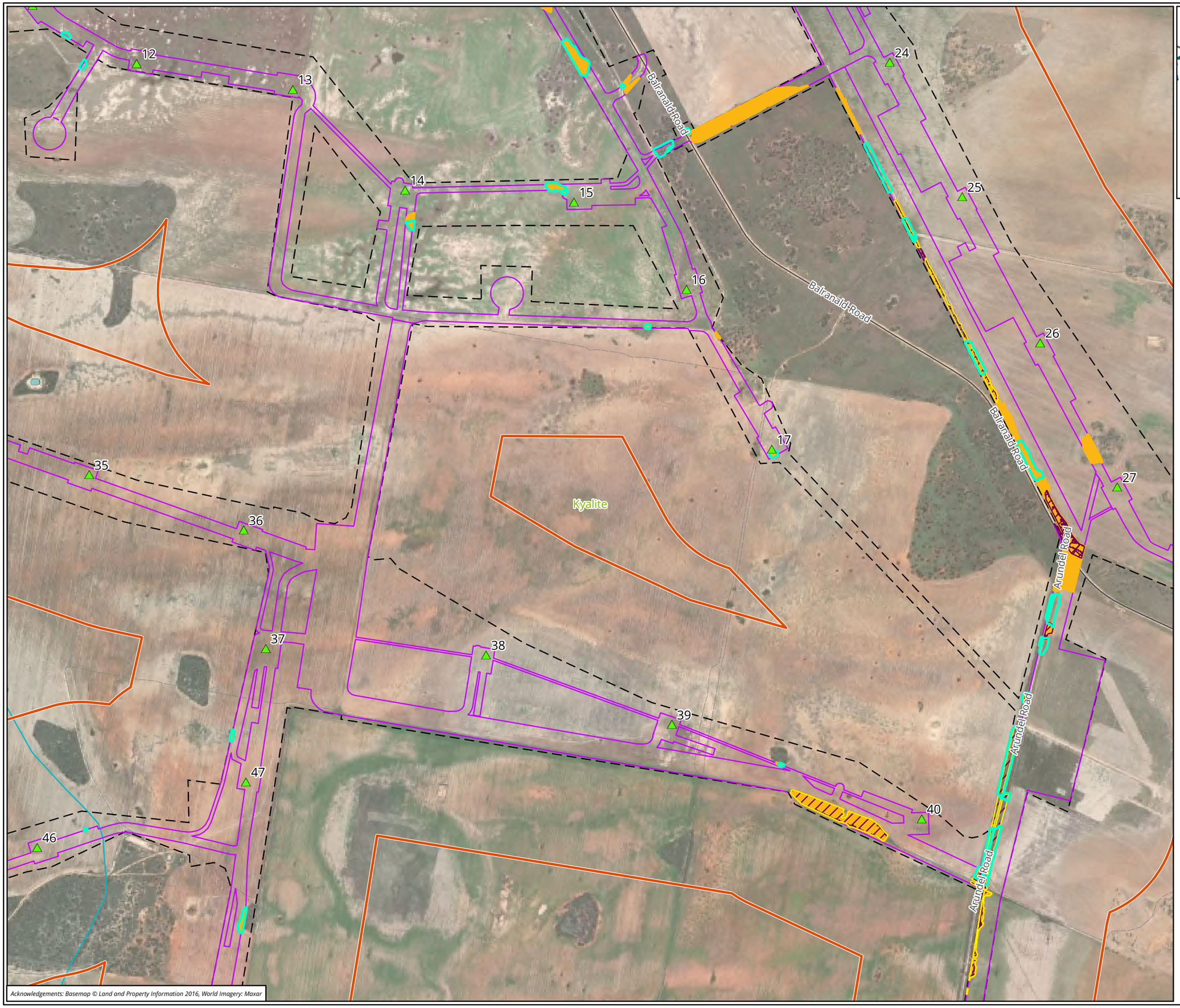
Coordinate System: GDA2020 MGA Zone 54

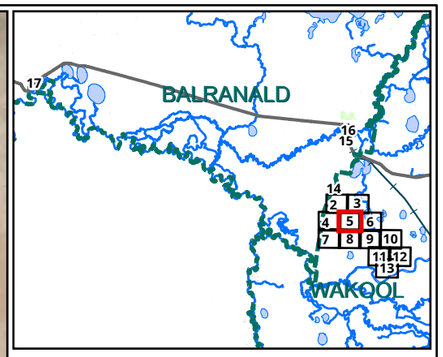
N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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





Legend

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

Threatened species polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.5 Threatened species polygons

0 180 360 540 720

Meters

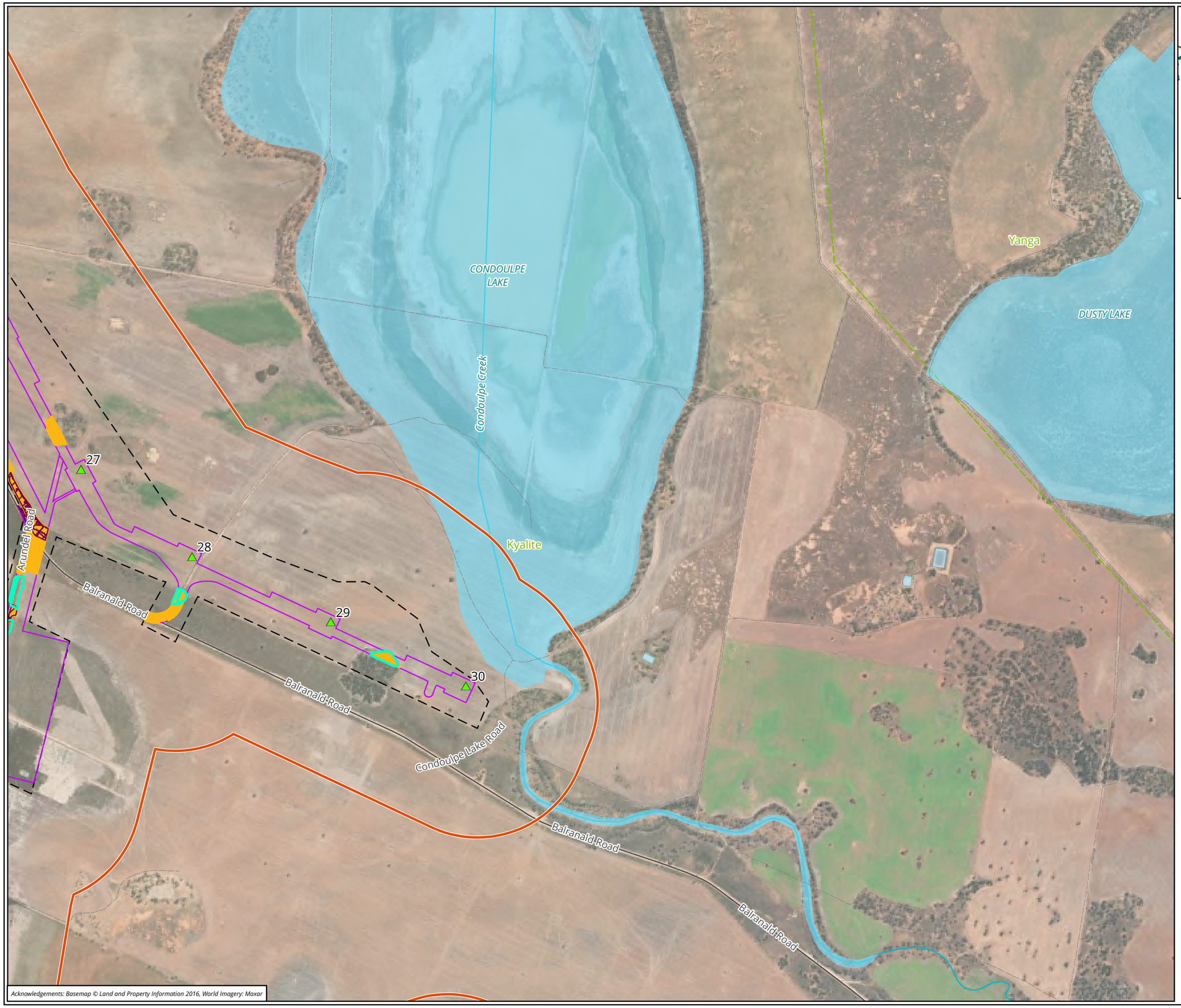
Scale: 1:16,000 @ A3

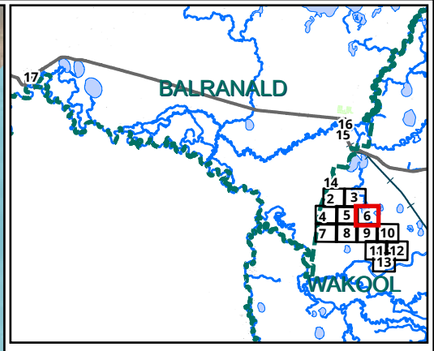
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.6 Threatened species polygons

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

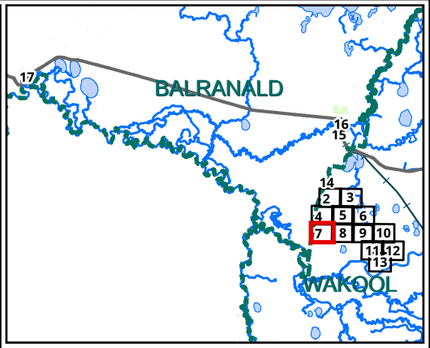
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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



Legend

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

Threatened species polygon

- Artiplex infrequens
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.7 Threatened species polygons

0 180 360 540 720

Meters

Scale: 1:16,000 @ A3

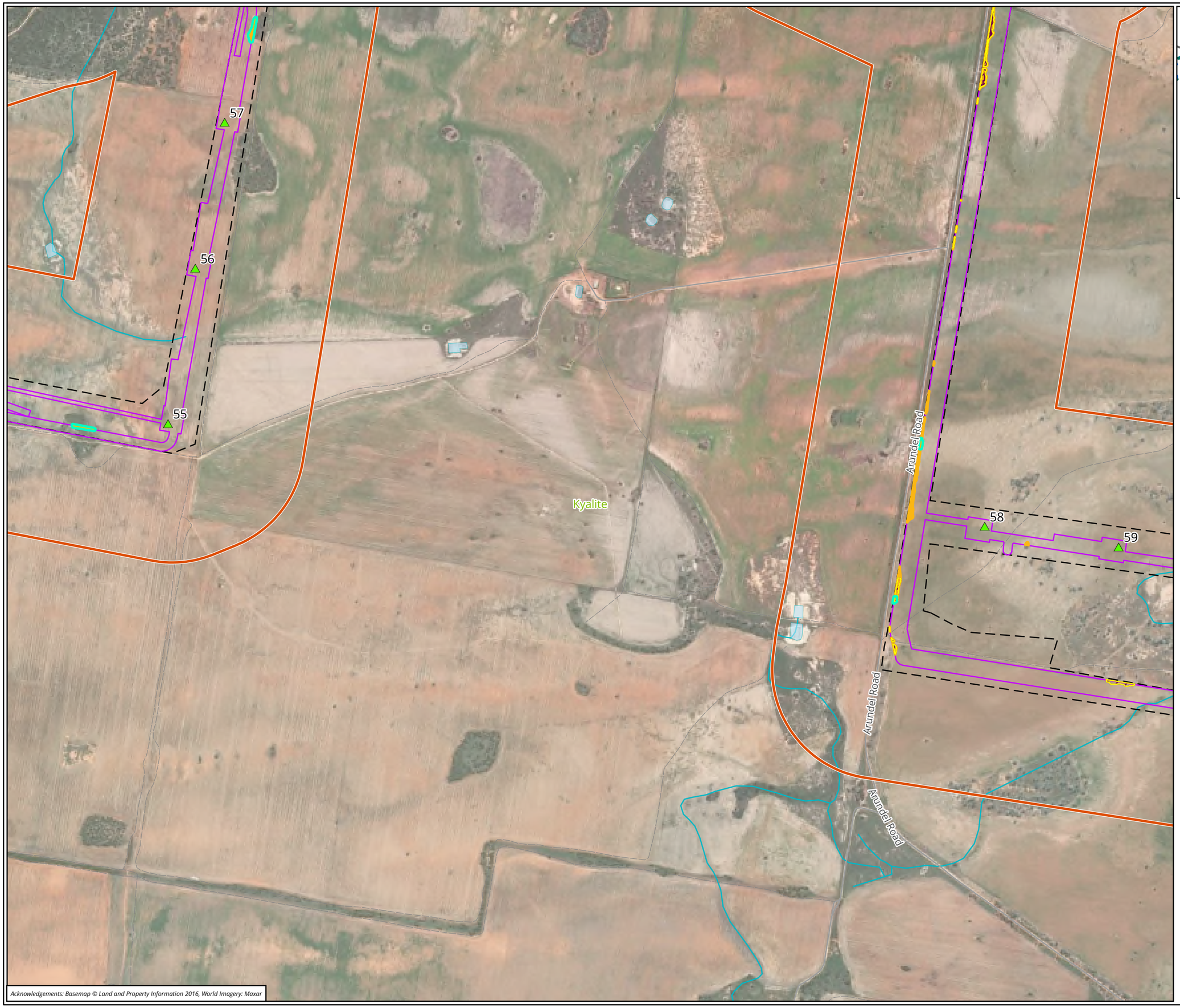
Coordinate System: GDA2020 MGA Zone 54

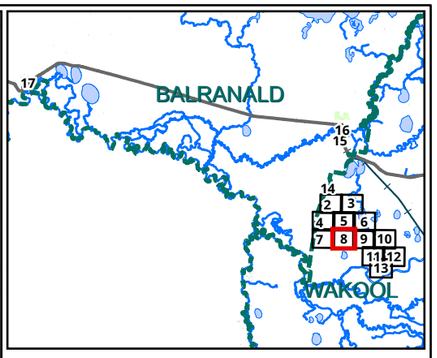
N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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





Legend

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

Threatened species polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.8 Threatened species polygons

0 180 360 540 720

Meters

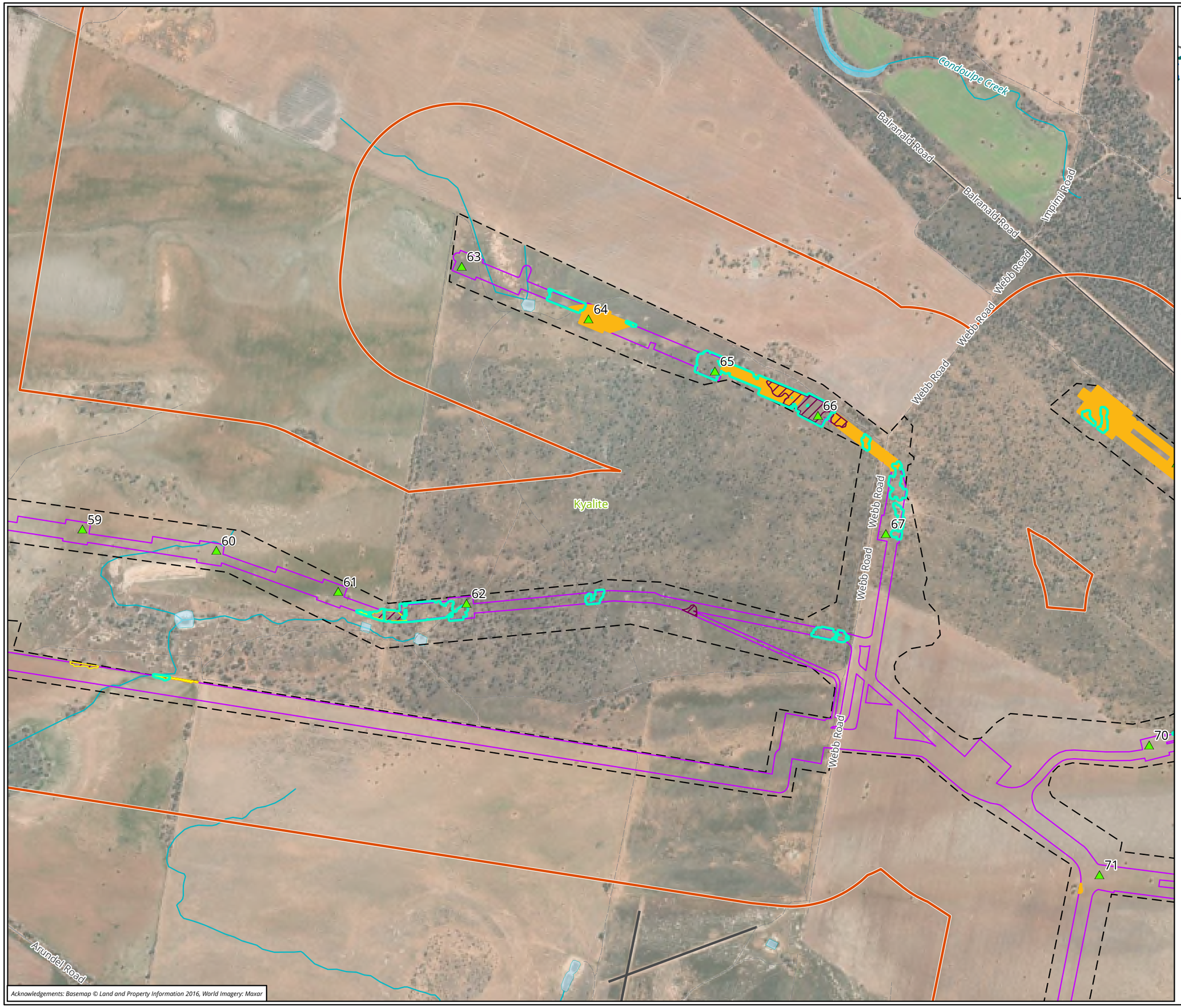
Scale: 1:16,000 @ A3

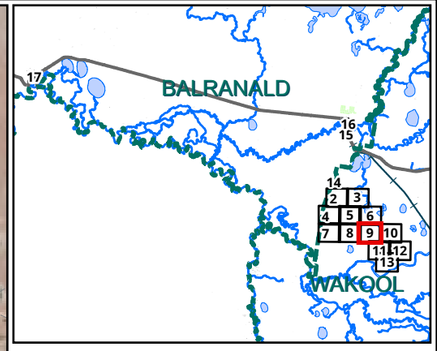
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.9 Threatened species polygons

0 180 360 540 720

Meters

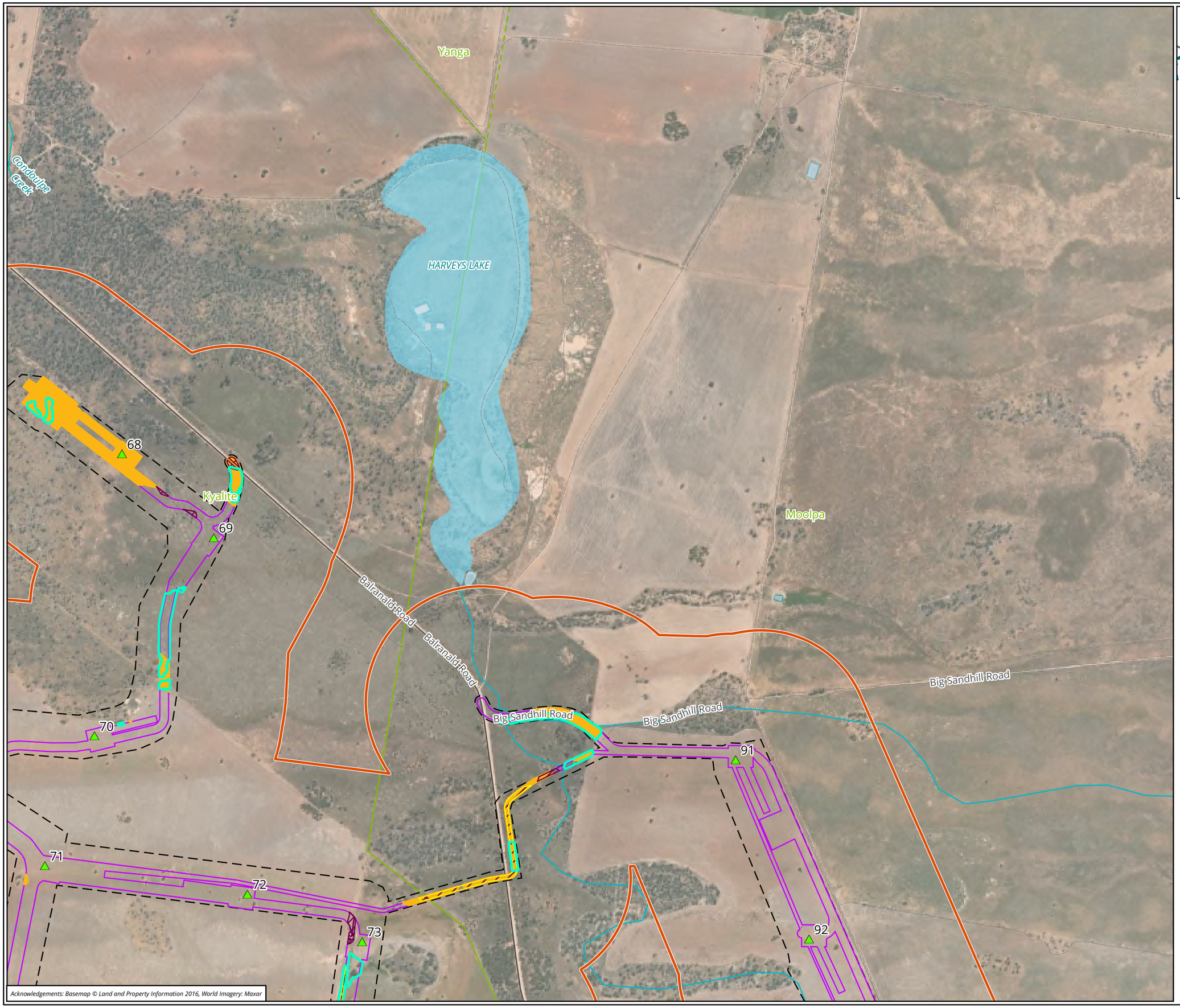
Scale: 1:16,000 @ A3

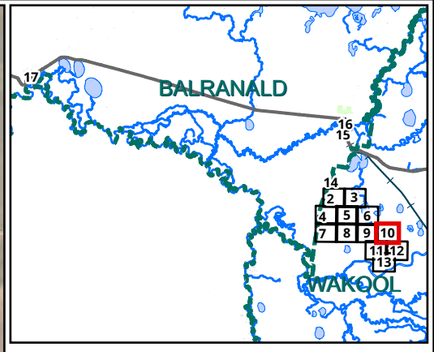
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.10 Threatened species polygons

0 180 360 540 720

Meters

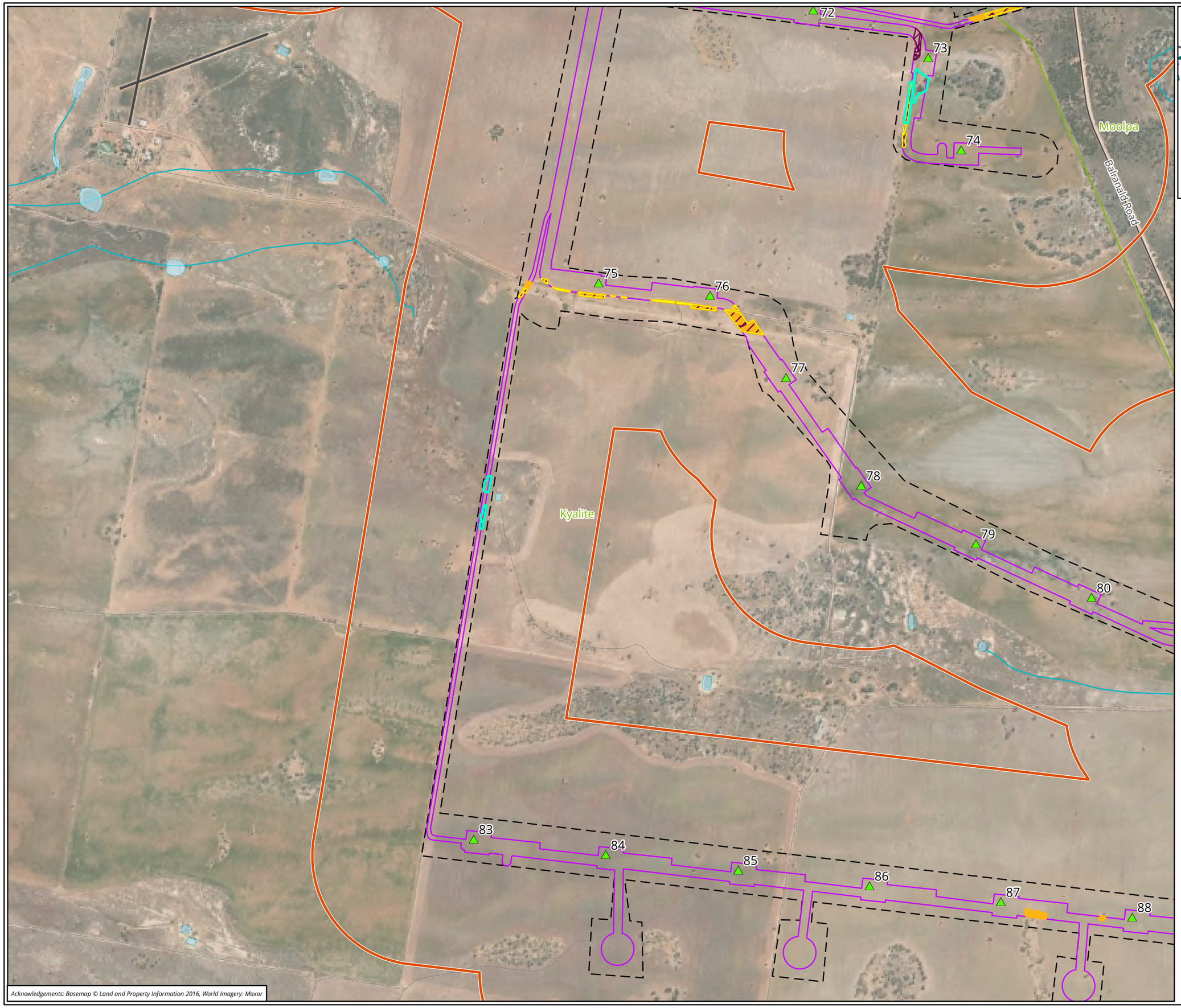
Scale: 1:16,000 @ A3

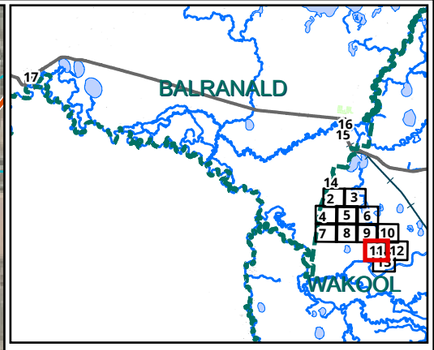
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (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

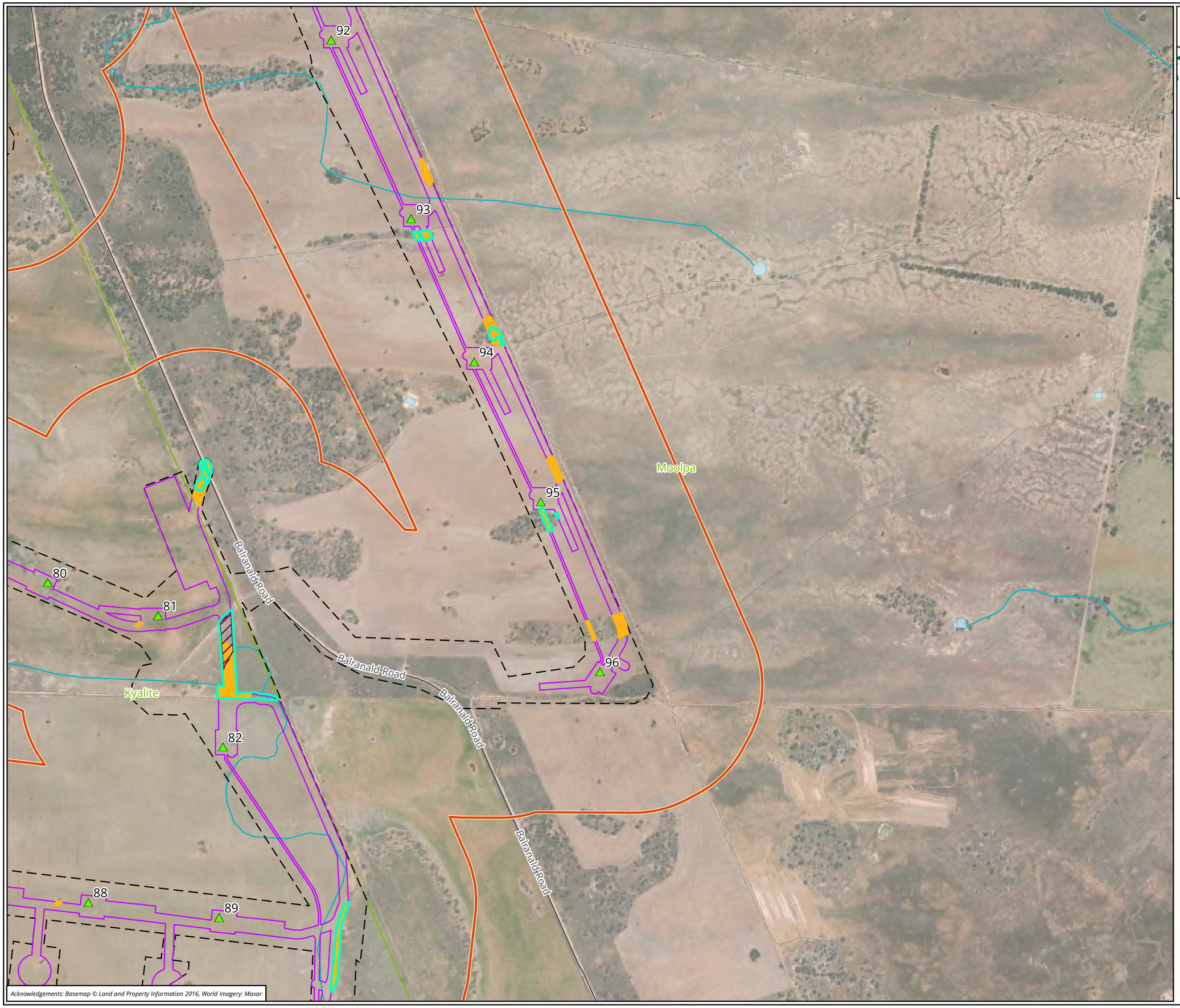
Scale: 1:16,000 @ A3

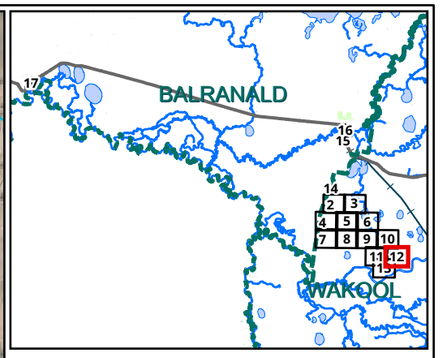
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.12 Threatened species polygons

0 180 360 540 720

Meters

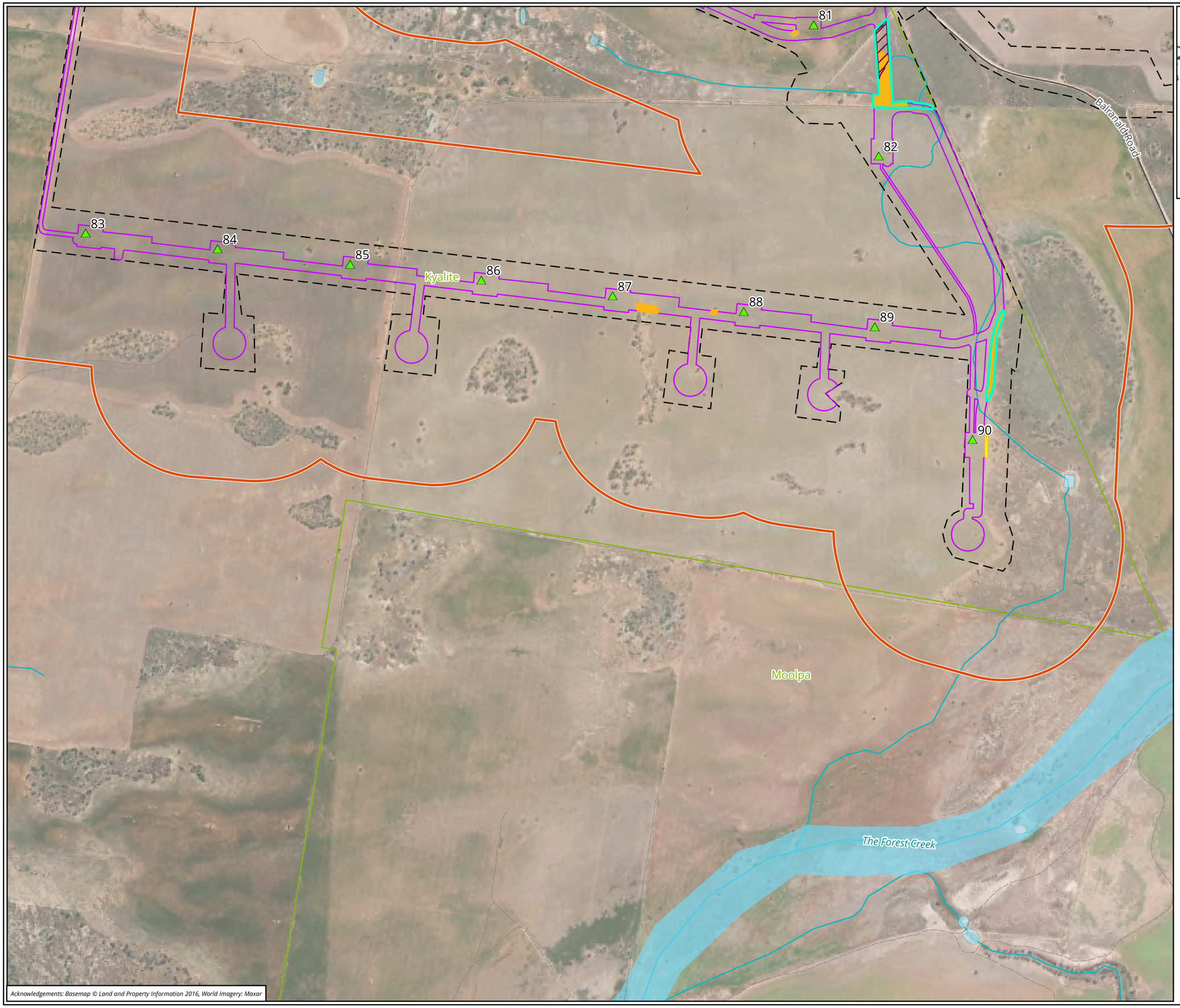
Scale: 1:16,000 @ A3

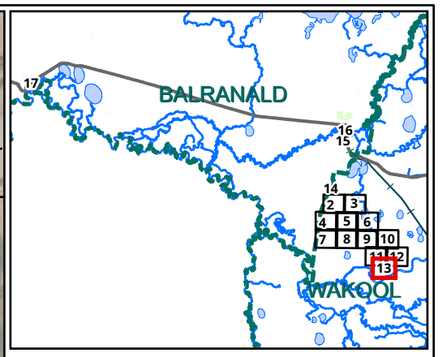
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
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 polygon

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 11.13 Threatened species polygons

0 180 360 540 720

Meters

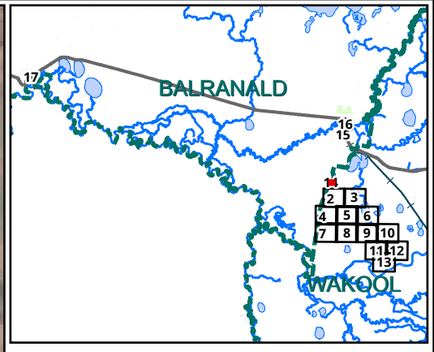
Scale: 1:16,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

N

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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



Legend

- Subject land
- Development footprint

Threatened species polygon

- Artiplex infrequens
- Crowned Gecko

Figure 11.14 Threatened species polygons

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

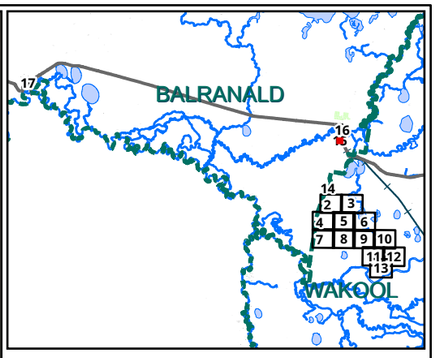
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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



Legend

- Subject land
- Development footprint

Threatened species polygon

- Artiplex infrequens
- Crowned Gecko

Figure 11.15 Threatened species polygons

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

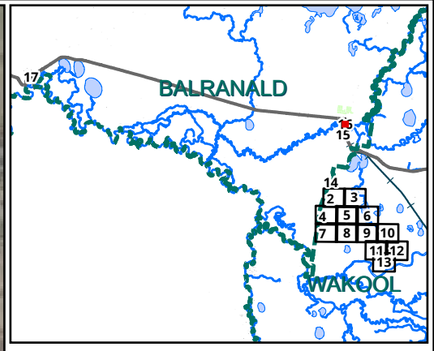
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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



Legend

- Subject land
- Development footprint

Figure 11.16 Threatened species polygons

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

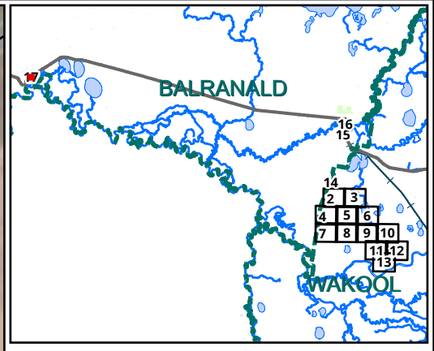
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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



Legend

- Subject land
- Development footprint

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

Figure 11.17 Threatened species polygons

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 22 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 1-10.aprx
Layout: 37502_F11_TSP

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 40 and Sections 5 and 6.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Table 40 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: • Dams. • Fences. • Farm tracks. • Formed public roads. • 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. 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. 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. Landscape scale habitat connectivity also exists for aerial species over the wind farm between water bodies present in the surrounding landscape. Waterbird species are likely to move between large watercourses and permanent (or near-permanent) water sources such as wetlands in the Nimmie Caira, Yanga National Park and the greater Lowbidgee area, to the north, and the Edward River, Wakool River and Murray River, to the south. Condoulpe Creek, along the north-eastern boundary of the subject land provides connectivity to the Yanga NP, Yanga SCA and Yanga RP.	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. Refer to Section 8.3.3.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Feature	Present	Description of feature characteristics and location	Threatened entities that use, are likely to use, or are part of the habitat feature.
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. 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 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.
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. Refer to section 8.3.6.	• Pink Cockatoo • 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 2023c).
  - 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).
- 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 (former) 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).

Further to the BUS completed by Nature Advisory, the results of raptor and cockatoo breeding surveys completed by Biosis, and detailed in Section 4.3.1 above, have been incorporated into the risk assessment framework detailed in Section 6 below.

Bat Utilisation Survey Year 1 (Nature Advisory 2022a) and Year 2

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

Nature Advisory completed two surveys in 2021 and three surveys in 2022 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.
- Autumn 2022: 27 April 2022 – 1 May 2022
  - 11 bat recorder-nights
- Winter 2022: 11 July – 15 July 2022
  - 24 bat recorder-nights
- Spring 2022: 3 October – 9 October
  - 17 bat recorder-nights

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. Survey locations in 2022 replicated existing locations surveyed within 2021.

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. Files were recorded in Zero Crossing (ZC) format.

Data was not recorded from one of the devices within Spring 2022. Data was not recorded from three of the devices within Autumn 2022. However, Nature Advisory 2021 and 2022 surveys comprised a total of at least 112 detector nights across the subject land.

All units were at ground level, there was no data collected at height during 2021 or 2022.

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 are being completed by Biosis and have been included herein, with pending data to be completed during the finalisation of the project's BBAMP.

Bat utilisation survey Year 3 (Biosis)

At-height data collection

Twelve months of paired surveys at height and ground-level will be completed by Biosis at the project met mast. Spring 2024 and summer 2025 have already been completed, with one unit installed at ground level and a second unit securely fixed to a pulley and mounted approximately 70 metres up the met mast (refer to Section 4.3.1). This has resulted in 15 paired detector nights in spring 2024 and 13 paired detector nights in summer 2025 so far collected.

Additional ground-level data collection

Additional surveys at ground-level sampling 12 points across the subject land will also be undertaken to supplement the existing surveys completed by Nature Advisory. The first of these began in summer 2025 (comprising 186 detector nights), with additional deployments planned for autumn and winter 2025.

The site was stratified into habitat types likely to be relevant to bats using desktop analysis to allocate survey points across the site in representative habitats. Stratification was associated with vegetation structure and diversity, with modified land assumed to provide little structural or floristic (and insect) diversity and woodland habitats likely to contain the highest structural and floristic diversity and therefore be more highly utilised by bats. The habitat was broadly stratified into three habitat types:

- Open (cropped)
- Open (DNG)
- Semi-cluttered (open woodland)

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.
- Pink 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).

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).

Bat utilisation survey Year 1 (Nature Advisory 2022a) and Year 2

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. No new species were identified during the autumn, winter or spring 2022 surveys. Species identified by Nature Advisory include:

- 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*.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

- 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 2021 survey periods were analysed by Rob Gration of EcoAerial Environmental Services using Kaleidoscope Pro analysis software by Wildlife Acoustics USA.

Data collected by Nature Advisory in 2022 was analysed by Biosis using Anabat Insight (version 2.0.8, licensed), Titley Scientific.

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 6.1.1. 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, and as such Biosis is completing a second summer, autumn and winter survey in 2025.

Bat utilisation surveys Year 3 (Biosis)

Surveys by Biosis confirmed an additional three species (to those identified by Nature Advisory):

- Ride's Free-tailed Bat *Ozimops ridei*
- Little Broad-nosed Bat *Scotorepens greyii*
- Inland Forest Bat *Vespadelus baverstocki*

Inland Forest bat is a listed Vulnerable species under the BC Act. Corben's Long-eared Bat (Vulnerable BC Act and EPBC Act) is also considered as likely or possibly occurring within the project site, with potential calls identified and/or suitable habitat occurring. Neither of these species are considered likely to be at increased strike-risk due to their foraging habits being focused in and around vegetation.

The remaining bat species positively identified are noted as being considered common, secure and widespread species (Nature Advisory 2022a).

A total of 14,073 files were recorded during the deployment in spring 2024. Of these, 4075 (29%) were valid bat calls with the remainder discarded by the allbats filter or containing less than five pulses.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

A total of 101,505 files were recorded across the summer 2025 deployment. Of these, 74979 files were valid bat calls, with the remainder discarded by the allbats filter as noise/false triggers and not used in further analysis. Files containing less than five pulses were also removed using a custom decision tree. These were not used for species identification or metrics of bat activity. This resulted in 74,979 files deemed to be valid bat calls.

A total of 15 paired detector nights were analysed in spring and 173 detector nights in summer from ground level units plus 13 paired detector nights from the met mast units. Comparisons of bat activity across the site were only made for nights where adequate replication was achieved across the survey (at least 90% of units working on a given night). This resulted in omission of data from the nights of 20/1/2025 and 2/2/2025 from activity comparisons at ground level. A total of 154 detector nights were included for activity comparisons for ground level data.

For the paired detectors at the met mast, both units stopped correct functioning 30 October 2024, resulting in a total of 15 nights of paired recording. In summer, both units worked successfully for the summer deployment period resulting in 13 nights of paired recording. This resulted in a combined total of 28 nights of paired recording at ground level and height.

Twelve species were positively identified (Almost certain or Possible) of the 18 species that are known or predicted to occur within 10 kilometres of the subject land (AusBats 2025). Up to four additional species may also have been recorded however reliable identification to species level was not possible due to poor data quality and/or similarity of call characteristics between species.

Table 38 provides a list of all species known or predicted to occur in the subject land, their conservation status, and identification following call analysis.

Table 41 Bat call analysis results

Species name	Common name	BC Act status	EPBC Act status	Identification	Recorded at height
Austronomus australis	White-striped Free-tailed Bat	-	-	Almost certain	Yes
Chalinolobus gouldii	Gould's Wattled Bat	-	-	Almost certain	Yes
Chalinolobus morio	Chocolate Wattled Bat	-	-	Almost certain	Possible
Ozimops petersi	Inland Free-tailed Bat	-	-	Almost certain	Yes
Ozimops planiceps	South-eastern Free-tailed Bat	-	-	Almost certain	Yes
Ozimops ridei	Ride's Free-tailed Bat	-	-	Almost certain	Yes
Scotorepens balstoni	Inland Broad-nosed Bat	-	-	Almost certain	Yes
Scotorepens greyii	Little Broad-nosed Bat	-	-	Almost certain	No
Vespadelus baverstocki	Inland Forest Bat	V	-	Almost certain	Possible
Vespadelus darlingtoni	Large Forest Bat	-	-	Almost certain	No
Vespadelus vulturnus	Little Forest Bat	-	-	Almost certain	Possible
Vespadelus regulus	Southern Forest Bat	-	-	Probable	Possible
Myotis macropus	Southern Myotis	V	-	Species Group	No
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Species Group	No
Nyctophilus geoffroyi	Lesser Long-eared Bat	-	-	Species Group	No

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Species name	Common name	BC Act status	EPBC Act status	Identification	Recorded at height
Nyctophilus gouldi	Gould's Long-eared Bat	-	-	Species Group	No
Chalinolobus picatus	Little Pied Bat	V	-	Not recorded	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Not recorded	No

Again it should be noted that despite being recorded as part of a species group, Southern Myotis is not considered to occur within the subject land. Further justification is provided in Appendix 10.

Bat activity at height

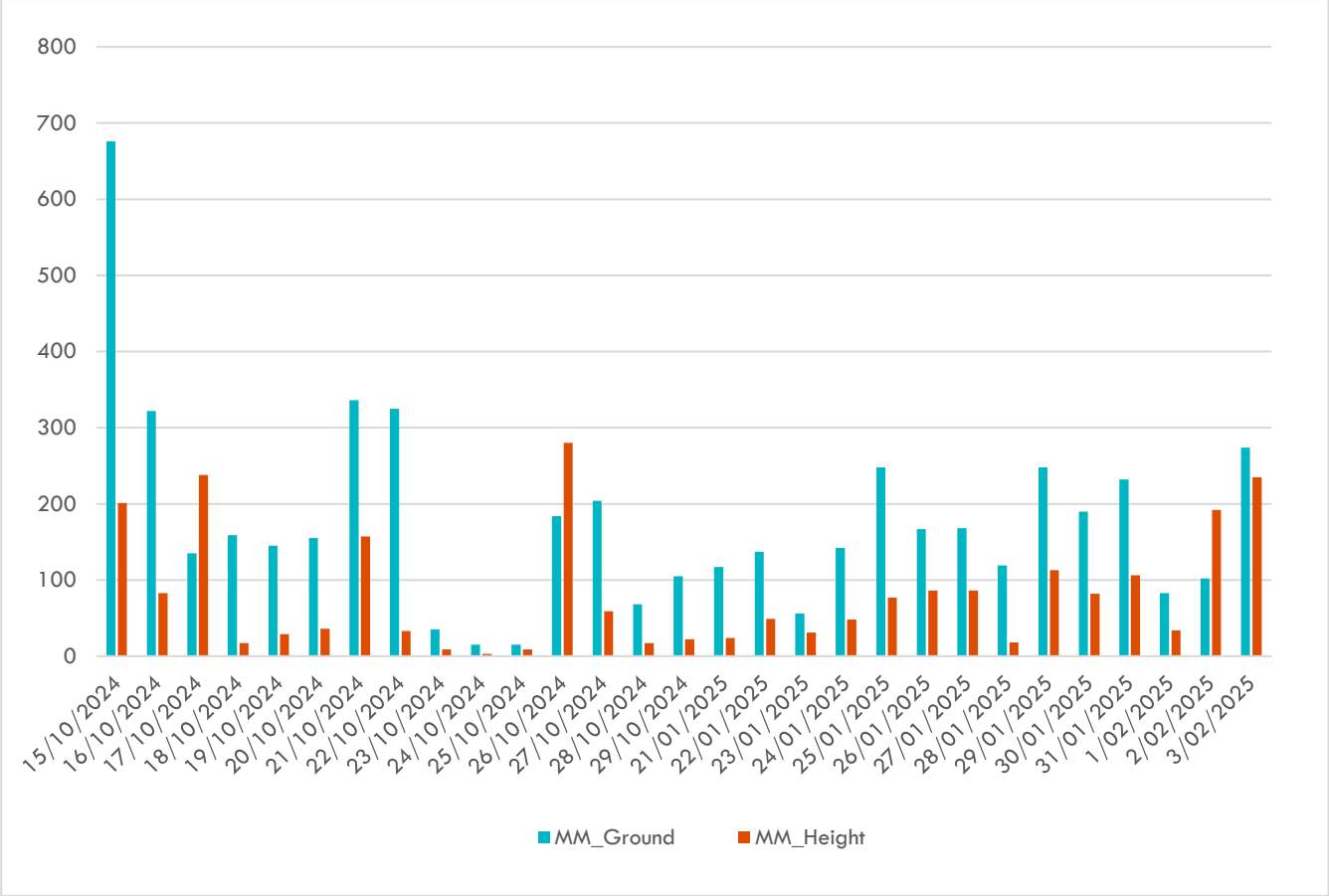
Bat activity at height was compared to activity at ground level using the paired detectors located at the met mast (ground level and approximately 70 metres above ground level). There was only a single met mast on the site, with no additional replicates collecting bat call data at height across the subject land.

In spring, activity at ground level was higher than that recorded at height on 13 nights out of 15 (87 % of nights), whilst in summer, activity at ground level was higher than that recorded at height on 13 nights out of 14 (93 % of nights) (Graph 1).

Overall, activity on the ground-level detector had an average of 154 passes per night while the detector at height had an average of 73 passes per night across the recording period. The maximum number of passes recorded at height was 192 passes 2 February 2025. The highest number of passes recorded at ground level was 248 the night of 25 January 2025.

Bat activity recorded was overwhelmingly concentrated in frequencies between 25-34 khz. At height, there was also minimal recorded activity of high-frequency species. Although it is acknowledged that high-frequency bat species can and do likely fly at height, the data suggests that this activity is much less than lower frequency species, and it is reasonable to assume that collision risk is therefore also lower.

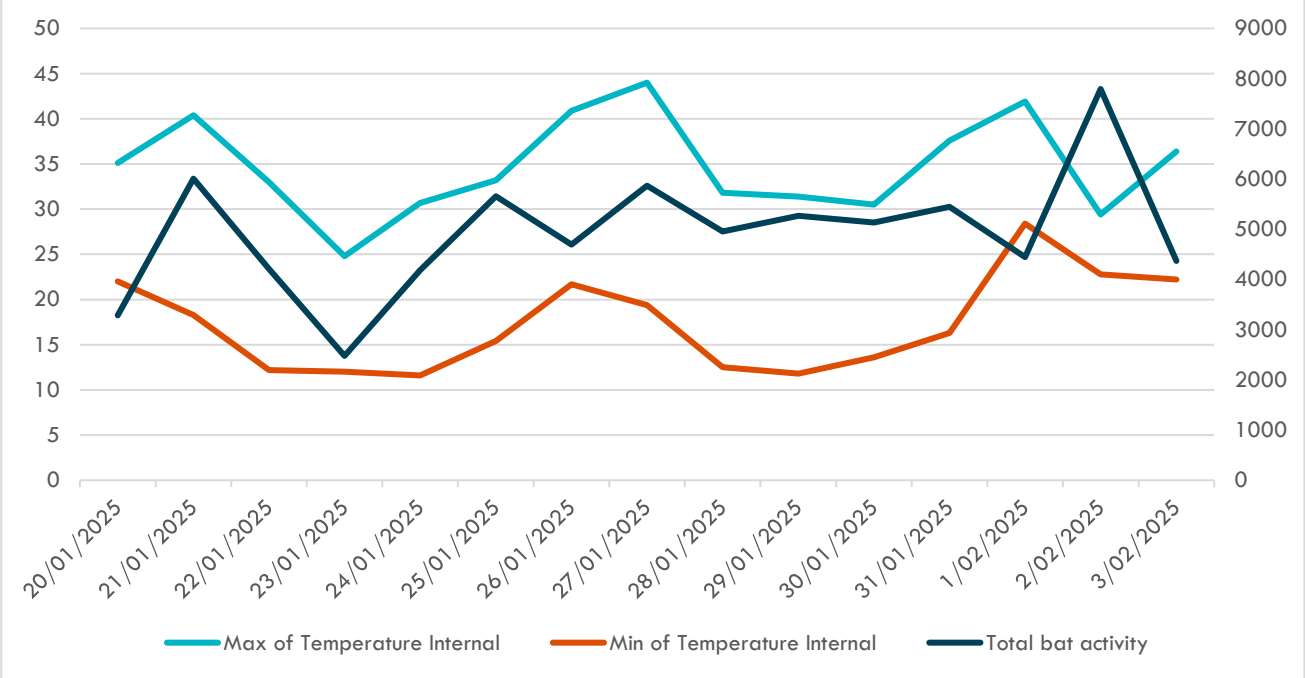
© Biosis 2023 | Leaders in Ecology and Heritage Consulting



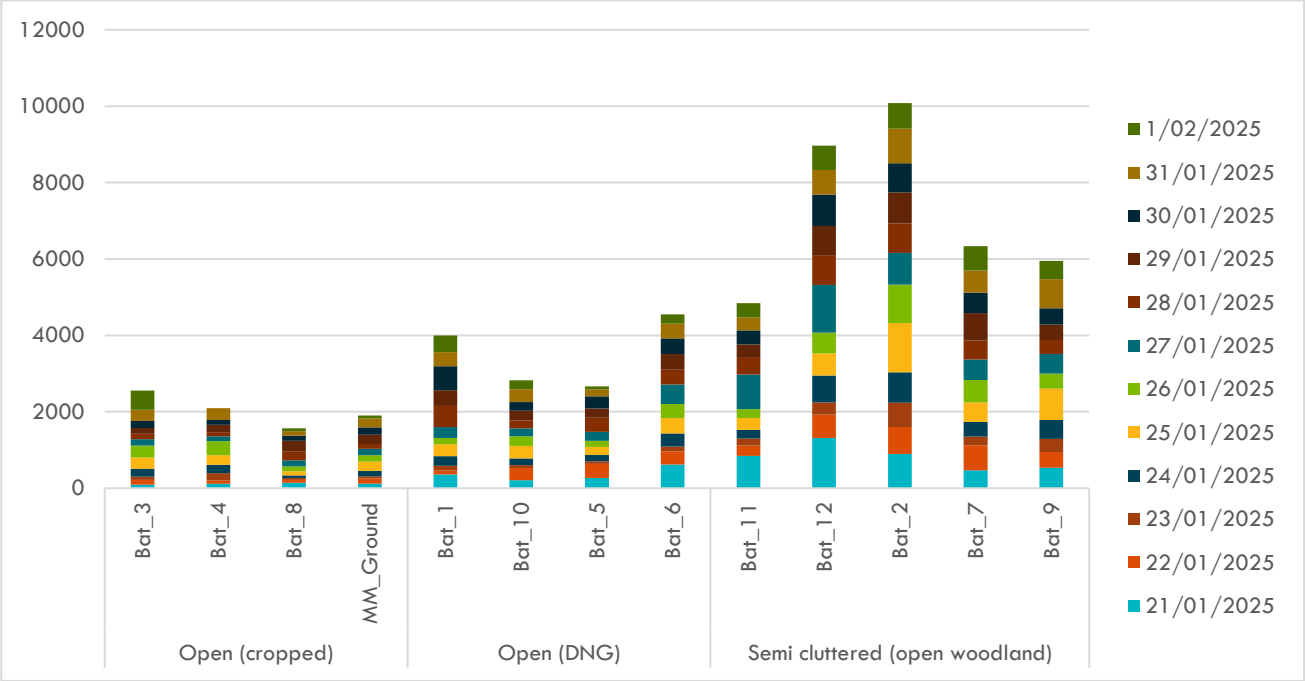
Graph 1 **Bat activity at height versus ground level per sampling date**

Bat activity

Bat activity was compared per night across all sites for data collected in January 2025. When compared with temperature recorded from detectors, there is a general trend towards higher activity during warmer temperatures, and reduced activity when temperatures are lower (Graph 2). When looking at activity per habitat unit, there is a trend towards lower activity at open sites compared to treed sites (Graph 3), with DNG sites showing slightly higher activity compared to cropped sites, which is likely to do with DNG areas being generally closer to treed habitats.



Graph 2 **Maximum, minimum and average nightly temperatures recorded by bat detectors**



Graph 3 **Total bat activity per site**

Activity at height was on average lower than activity recorded at ground level. This provides some evidence that bat activity is lower at height in this landscape. High-flying species of bats are also thought to forage closer to the ground in more open landscapes compared to taller eucalypt forests (Baker & Gynther 2023). It is reasonable to assume that where less passes are recorded for bats, there is less risk of collision. The data recorded on detectors placed at ground level and at height demonstrates that bat activity is lower at height. Collision risk for bats is likely to be highest on nights when activity at height is also high, and there are increased likelihood of interactions with turbines.

Data collected by Nature Advisory in autumn, winter and spring 2022, that was analysed by Biosis was not considered appropriate to be considered in the activity analysis. This is due to as the use of full spectrum (Biosis) recorders rather than zero crossing recorders (Nature Advisory) and due to a number of unsuccessful nights of data collection in the Nature Advisory data sets, resulting in nil bat detections. Due to the limitations with the data collected in 2021 and 2022, activity comparisons were not considered appropriate, or comparable with subsequent (Biosis) data collection.

Further details of the bat utilisation survey results can be found in Appendix 10 Biosis Microbat Analysis Technical Report.

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:

- Pink 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, the Inland Forest Bat has been recorded in the study area. A second species, Corben's Long-eared Bat is considered likely to occur based on identification of potential calls and suitability of habitat. Refer to Section 5.2.1 above for further information. Further assessment in accordance with the EPBC Act is provided in Section 12 and Appendix 5 for the Corben's Long-eared Bat. Inland Forest Bat is an ecosystem credit species under the BAM and is not listed under the EPBC Act.

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):

- Australasian Bittern *Botaurus poiciloptilus*
- Australasian Darter *Anhinga novaehollandiae*
- Australasian Shoveler *Spatula rhynchotis*
- Australian Pelican *Pelecanus conspicillatus*
- 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 *Trichoglossus 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*

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 42. The migratory movement of non-threatened species outside Australia are summarised below in Table 43.

Table 42 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	Dams and/or areas of large waterbodies such as Condoulpe Lake when water is present.

Species	Nomadic/Migratory movement description	Movement trigger	Habitat in subject land
		flies large distances at night between areas of suitable habitat.	
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.
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.

Species	Nomadic/Migratory movement description	Movement trigger	Habitat in subject land
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 43 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 2025a).	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

Twelve microbat species have been positively identified within the subject land. Three additional species may also be present but could not be confirmed through call analysis (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. No microbat species were identified as nomadic or migratory in the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) however, there is current research on the White-striped Free-tailed Bat that suggests this species may make seasonal movements in response to seasonal changes.

Table 44 below provides a review of behaviour and flight characteristics of microbat species recorded within the subject land.

Table 44 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, open areas, spaces between trees.	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).
Ride's Free-tailed Bat ***Ozimops Ridei***	Open/Edge	Fast, agile	Above canopy, open areas, forest gaps, spaces between trees.	Occupies a wide variety of habitats and predominantly fly in the spaces between trees.
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

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Species	Foraging space	Flight characteristics	Canopy	Overview
				not forage above the canopy.
Little Broad-nosed Bat ***Scotorepens greyii***	Edge	Moderately fast, agile	Below canopy, open habitat.	Continuous flight foragers that search for insects close to the tree tops but not above them, flying in the open spaces along the contour of vegetation within 2 metres of the foliage. Also forage over water, grasslands and other open habitat (Churchill 2008).
Inland Forest Bat ***Vespadelus baverstocki***	Edge	Manoeuvrable, agile	Below canopy	Widely distributed in arid and semi-arid Australia. Flies with rapid wing beats and forage over a wide area (Churchill 2008).
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.				

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

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 42. 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). Water Resource Management (WRM) undertook a frequency of inundation analysis for Condouple Lake as part of the project's Flood Impact Risk Assessment by reviewing aerial photography and satellite imagery from between 1986 and 2024. There were a total 416 observations collected, from which only 20 (5 %) detected water in the lake (WRM 2024). 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 42. 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 (or near-permanent) water sources such as wetlands in the Nimmie Caira, Yanga National Park and the greater Lowbidgee area, to the north, and the Edward River, Wakool River and Murray River, to the south. Whilst it is acknowledged that the project is likely to occur within broad potential flightpath for a range of waterbirds, longer range movements between these landscape scale habitat features are likely to be undertaken at height above RSA (Nature Advisory 2023e). Detailed information on the potential occurrence of water birds and their potential for collision risk has been assessed by Nature Advisory in their Regional Review of Waterbirds in the Riverina (Nature Advisory 2023e), and is summarised in Section 6.1.1 below.

It is considered that the most likely scenario where waterbirds will be at an increased risk of collision is during flood years, when potential habitat close to the operational wind farm, such as Condoulpe Lake hold water providing habitat. In these periods waterbirds are mor likely to ascend / descend through RSA height, and thus increase their potential to collide with turbines.

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 42. Figure 12 and Figure 13 depict indicative nomadic and local movements of aerial avian species.

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

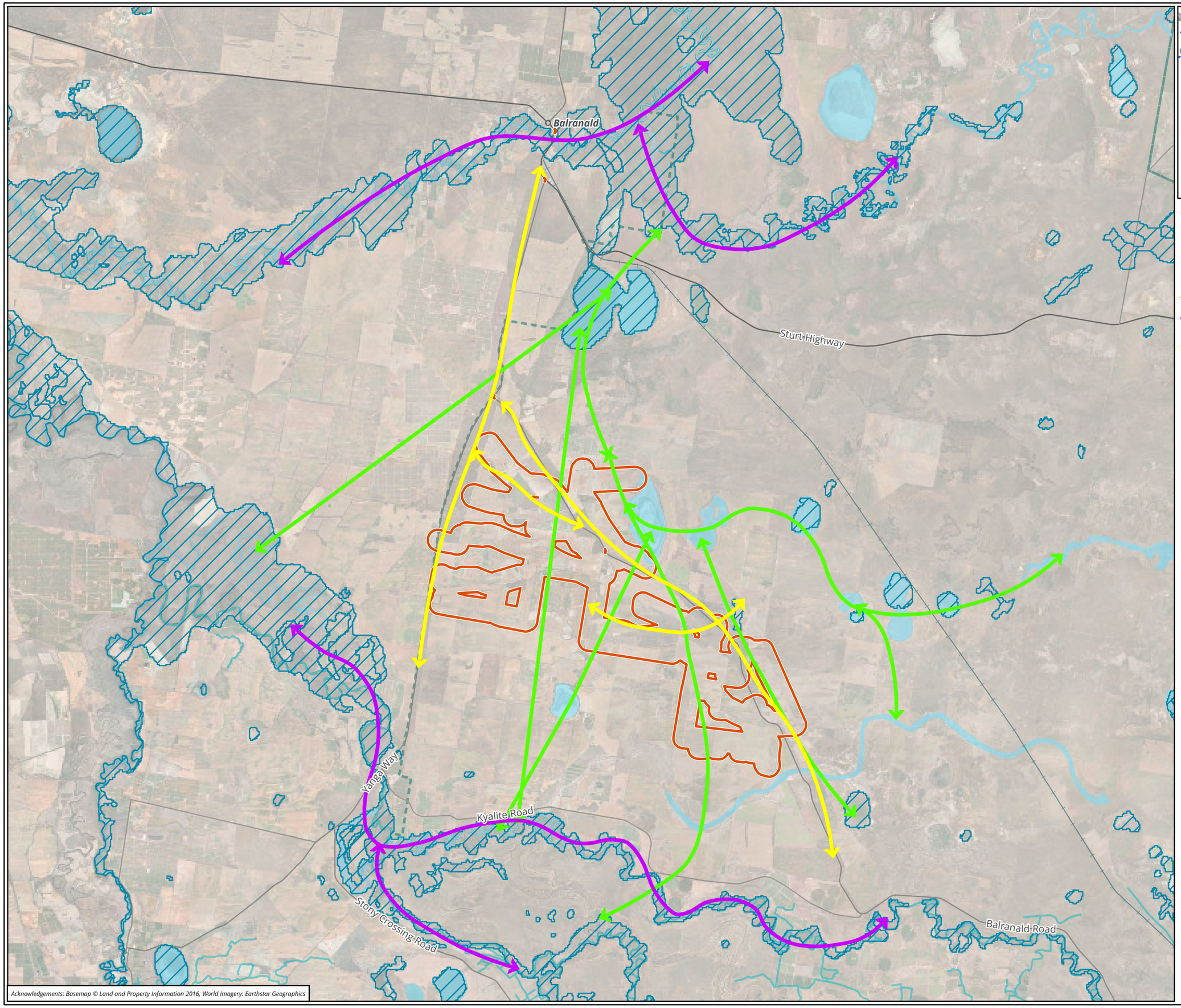
Coordinate System: GDA2020

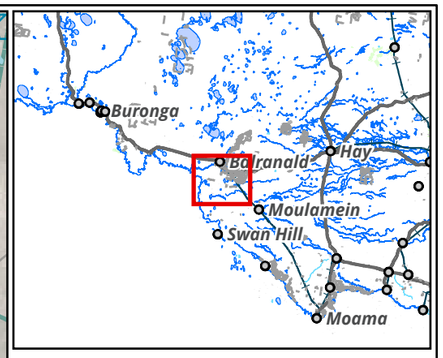
N

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_F12_Nomadicflight

Acknowledgements: Basemap © Land and Property Information 2016,





Legend

- Subject land
- NSW Wetlands (2006)

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

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F13_LocalFlight

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

Nature Advisory completed a number of location and species specific studies to better understand the avifauna of the subject land and its surrounds. This included a Regional Review of Waterbirds in the Riverina, a Literature review on habitat use of the Australasian Bittern, and a Regent Parrot targeted assessment report. The findings of these studies are summarised below (with full reports included as Appendix 9 below), and have been used to inform the qualitative risk assessments initially undertaken by Nature Advisory, and updated post Regulator feedback by Biosis (see Section 6.1.4 to Section 6.1.6).

6.1.1. 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 45 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 45.

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.

Table 45 Summary of literature review on waterbird collision risk (Nature Advisory 2023e)

Species	Risk conclusion and justification (Nature Advisory 2023e)
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. 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 (Nature Advisory 2023e)
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*	

Species	Risk conclusion and justification (Nature Advisory 2023e)
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.

6.1.2. 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.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

6.1.3. 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 6.1.5. The full assessment is presented in Appendix 9 of this BDAR.

6.1.4. 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.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Following review of the current assessment by NSW DCCEEW, the risk assessment was repeated by Biosis, utilising an updated background search and assessing all native bird species for collision risk. Revised results are provided below.

Likelihood of risks are ranked as Rare, Unlikely, Likely, Certain and Almost Certain (Table 46). 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 46).

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.

Further to the above, Biosis re-assessment included species that have been the subject of this risk assessment include bird and bat species recorded or predicted to occur within 60 kilometres of the subject land, based on database searches, including:

- Cth DCCEEW Protected Matters Search Tool for matters protected by the EPBC Act.
- NSW BioNet - the database for the Atlas of NSW Wildlife, Department of Planning and Environment (DPE), for species listed under the BC Act.
- BirdLife Australia, the New Atlas of Australian Birds.
- Atlas of Living Australia http://www.ala.org.au, accessed.
- Australasian Bat Society Bat map https://www.ausbats.org.au/batmap.html, accessed.

The risk assessment 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 46 below. Descriptions of likelihood and consequence factors for birds and bats are set out in Table 47. This risk

assessment is summarised in Section 6.1.5 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 46 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.
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 47 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

6.1.5. Risk matrices

The results of the qualitative risk assessment completed by Nature Advisory 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 48.

Chapter 2.3 of the Bird and Bat Baseline Report (Year 2) (Nature Advisory 2023a) completed in 2023 listed and discussed the following threatened species as at-risk birds:

- Black Falcon – Some collision risk with operating turbines and has been recorded at RSA height.
- Pink 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 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 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. 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).

Following comments received from NSW DCCEEW, a revised qualitative risk assessment by Biosis was undertaken, which identified that:

- A total of 12 exotic species do not require application of the qualitative risk assessment method.
- A total of 261 native species occurring within, or predicted to occur within, 60 km of the subject land were not assessed by Nature Advisory but were considered by Biosis to have a Negligible risk of collision and a Negligible risk of indirect or barrier effect risk, and as such are not addressed further. This includes Australian Hobby *Falco longipennis*, which was raised as a concern by NSW DCCEEW and as such, is discussed further below.
  - Seventeen of the 261 species considered by Biosis to have a Negligible risk of collision and indirect/barrier effect, were noted by Nature Advisory (Nature Advisory 2023e, Nature Advisory 2023a) as having potential risk (i.e. more than Negligible), despite not being assessed in the qualitative risk assessment (see Section 6.1.6).
- Four native species were considered by Biosis to have a collision risk that was lower than that assigned by Nature Advisory (Nature Advisory 2023f), however in these cases, the more precautionary rating provided by Nature Advisory has been retained. All four species were considered by Biosis to have the same indirect or barrier effect risk as assigned by Nature Advisory (Nature Advisory 2023f).
- A total of 40 native species were considered by Biosis to have the same collision risk and indirect or barrier effect risk as that assigned by Nature Advisory (Nature Advisory 2023f). This includes Black Falcon and Little Eagle, both raised as species of concern by NSW DCCEEW during response to submissions, and are discussed further below.
- Eight species were considered by Biosis to have a collision and/or indirect/barrier risk that was greater than that assigned by Nature Advisory (Nature Advisory 2023f), for which the more precautionary (greater) consequence has been applied herein (Table 48), including:
  - Five species for which both the collision risk and indirect/barrier risk was greater than assigned by Nature Advisory (Nature Advisory 2023f).
  - Three species for which only the collision risk was greater than assigned by Nature Advisory (Nature Advisory 2023f).

- Collision risk for Wedge-tailed Eagle has been increased from Moderate to High on the basis of collision likelihood being increased to 'Certain' (*It is very probable that the risk even could occur in any year [>95%]*). It is considered that based on the BUS results of the species being recorded 23 times over the two years, during which 47.8 % of their flights were observed at RSA height, combined with the species being one of the most vulnerable species to collision due to their soaring habits while hunting, an un-mitigated collision risk of >95 % in a given year is appropriate.
- Two subspecies were not assessed by Nature Advisory (Nature Advisory 2023f), but were considered to have a greater than Negligible risk of collision or indirect/barrier effect, and as such have been included in the risk assessment. These subspecies include Australian Nankeen Kestrel *Falco cenchroides cenchroides* and Pink Cockatoo (eastern) *Lophochroa leadbeateri leadbeateri*, for which the primary species, Nankeen Kestrel *Falco cenchroides* and Pink Cockatoo *Lophochroa leadbeateri*, were assessed. These two subspecies have been included in the risk assessment and are considered to have the same collision risk and indirect/barrier effect risk as the primary species.
- Biosis has reassessed the collision risk for Curlew Sandpiper and concluded the species to be at a Low risk from the project. This conclusion is largely based on the highly threated nature of the species (Critically Endangered, BC Act and EPBC Act) and a desire to ensure a conservative approach for the species. Based on a lack of existing records of the species close the subject land, as well as flight characteristics and habitat preferences (Nature Advisory 2023e), the species likelihood of occurrence is considered very low, however again to ensure a conservative assessment of collision risk, it has been included as an 'at-risk' species.

Australian Hobby, Black Falcon and Little Eagle were raised by NSW DCCEEW as not having "been probably overlooked during BBUS" and thus a sufficient risk level having not been applied (Nature Advisory 2023f). Bird Utilisation Surveys were completed by highly experienced ornithologists from Nature Advisory, led by ecologists with over 20 years of bird survey experience, with no staff with less than five years' experience (Table 30). Nature Advisory are well experienced in completing BUS and are unlikely to have missed or misidentified these characteristic and distinguishable target species. Furthermore, Black Falcon was identified incidentally during BUS work, suggesting the species is present only at low numbers within the subject land. Following reassessment of risk ratings applied by Nature Advisory, Biosis' risk assessment agreed with the likelihood and consequence of collision and indirect/barrier effect for both of these species. Further information to support the risk assessment is provided below.

Australian Hobby has been recorded on 76 occasions within 60 kilometres of the subject land, but no records occur within 20 kilometres of the subject land. The closest record for the species is 20.9 kilometres from the subject land from 2022. The species was not recorded during BUS or incidentally during biodiversity survey work across the subject land. Only one collision with wind turbines for Black Falcon has been reported to have occurred in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. As such, while there is potential for this species to fly at RSA height, collision with wind turbines is considered to be unlikely; occurring only during some circumstances. Indirect/barrier effect is considered to be rare. This species is not listed as threatened under the BC Act and therefore the consequence of collision is considered to be low, and thus the species' risk rating is negligible, and the consequence and risk of indirect/barrier effect is considered to be negligible.

Black Falcon has been recorded on only 29 occasions within 60 kilometres of the subject land, and only 5 occasions within 20 kilometres of the subject land. The closest record for the species is 6.1 kilometres from the subject land and the most recent record within 20 kilometres of the subject land was in 2022. The species was not recorded during BUS, but was recorded incidentally across the subject land. Only one collision with wind turbines for Black Falcon has been reported to have occurred in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. As such,

while there is potential for this species to fly at RSA height, collision with wind turbines is considered to be unlikely; occurring only during some circumstances. Indirect/barrier effect is considered to be rare. This species is listed as threatened under the BC Act and therefore the consequence of collision is considered to be moderate and the consequence of indirect/barrier effect is considered to be low. Risk matrix and overall ratings are provided in Table 48 below.

Little Eagle has been recorded on 111 occasions within 60 kilometres of the subject land, but only two occasions within 20 kilometres of the subject land. The closest record for the species is 14.1 kilometres from the subject land and the most recent record within 20 kilometres of the subject land was in 2002. The species was not recorded during BUS or incidentally during biodiversity survey work across the subject land. No collisions with wind turbines for Little Eagle have been reported to have occurred in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. As such, while there is potential for this species to fly at RSA height, collision with wind turbines is considered to be unlikely; occurring only during some circumstances. Indirect/barrier effect is considered to be unlikely. This species is listed as threatened under the BC Act and therefore the consequence of collision is considered to be moderate and the consequence of indirect/barrier effect is considered to be low. Risk matrix and overall ratings are provided in Table 48 below.

Results of the risk assessment for species deemed at-risk by Biosis following comments received by NSW DCCEEW and Nature Advisory (Nature Advisory 2023f) are outlined within Table 48, with the full assessments by Nature Advisory (Nature Advisory 2023f) presented in Appendix 9 of this BDAR.

The general approach was to ensure that the highest risk rating was concluded for all species assessed by either Nature Advisory or Biosis to ensure a conservative approach to the species risk assessment was undertaken. A summary of the species concluded to have more than a negligible risk is provided in Table 48 below.

Following completion of additional microbat surveys, including at-height monitoring for microbats in spring (2024) and summer (2025) the risk assessment process was revisited. The following five species have been assessed as being at more than a negligible risk from collision (i.e. at-risk species):

- Gould's Wattled Bat *Chalinolobus gouldii*
- Inland Forest Bat *Vespadelus baverstocki* (Vulnerable, BC Act)
- Southern Free-tailed bat *Ozimops planiceps*
- White-striped Freetail-bat *Austronomus australis*
- Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* (Vulnerable, BC Act)

Biosis qualitative risk assessment methodology

Assessment of potential impacts from turbine strike and barrier effect has 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. A risk matrix was applied for individual species of birds and bats that incorporates probability that the wind farm might impact birds or bats from habitats at the wind farm.

The species that have been the subject of this risk assessment include bird and bat species recorded or predicted to occur within 60 kilometres of the subject land, based on database searches, including:

- Cth DCCEEW Protected Matters Search Tool for matters protected by the EPBC Act.

- NSW BioNet - the database for the Atlas of NSW Wildlife, Department of Planning and Environment (DPE), for species listed under the BC Act.
- BirdLife Australia, the New Atlas of Australian Birds.
- Atlas of Living Australia http://www.ala.org.au.
- Australasian Bat Society Bat map https://www.ausbats.org.au/batmap.html.

The risk assessment was based on 96 turbines with:

- A rotor radius of 91 metres.
- Maximum upper RSA (blade tip) of 231 metres.
- Hub height of 140 metres.
- Minimum lower minimum RSA of 49 metres.

The risk assessments were undertaken as follows:

- Species of concern were assessed for their likelihood of occurrence at the site, including:
  - Non-threatened species.
  - Species listed as threatened under Commonwealth or state legislation.
- Two impact pathways have been assessed, including:
  - Collision with turbines.
  - Disturbance and barrier effects.
- Impact likelihood criteria have been developed and applied to each impact pathway for each species:
  - Flight behaviours of individual species were assessed to determine potential for collision with turbines, where:
    - The impact likelihood was considered to be greater for species whose flight behaviours put them at a risk of collision.
    - The impact likelihood was considered to be greater for species that are known to be vulnerable to collision with turbines based on collision data from other wind farms in New South Wales. Species that have been subject to a higher number of collisions were considered to be more at risk than those that have been historically subject to fewer collisions.
    - Species that are not likely to fly at rotor swept height were considered to be at negligible risk of collision.
- Impact consequence criteria have been developed and applied to each impact pathway for each species, where:
  - The consequence was considered to be greater for species that are threatened under Commonwealth or state legislation due to lower population numbers, compared to common species.
  - The consequence was considered to be greater for species of birds that are likely to fly in flocks due to greater likelihood of multiple simultaneous impacts, compared to other bird species.
- The risk level for each species or group of concern from the two impact pathways has been determined consistent with a risk matrix.

Biosis' risk assessment and results are provided in Appendix 4.2.

Table 48 Bird and bat collision risk likelihood consequence undertaken by Biosis and Nature Advisory (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								
Australasian Bittern *Botaurus poiciloptilus*	EN	EN	Rare	High	**Low**	Unlikely	Moderate	**Low**
Black Falcon *Falco subniger*	-	VU	Unlikely	Moderate	**Low**	Rare	Moderate	**Negligible**
Black Kite *Milvus migrans*			Almost certain	Moderate	**Moderate**	Likely	Low	**Low**
Black-shouldered Kite *Elanus axillaris*	-	-	Almost certain	Low	**Low**	Unlikely	Negligible	**Negligible**
Brown Falcon *Falco berigora*	-	-	Almost certain	Low	**Low**	Unlikely	Negligible	**Negligible**
Brown Goshawk *Accipiter fasciatus*	-	-	Almost certain	Low	**Low**	Unlikely	Negligible	**Negligible**
Curlew Sandpiper *Calidris ferruginea*	CE	CE	Rare	High	**Low**	Unlikely	Moderate	**Low**
Fork-tailed Swift *Apus pacificus*	-	-	Likely	Low	**Low**	Rare	Negligible	**Negligible**
Little Eagle *Hieraaetus morphnoides*	-	VU	Unlikely	Moderate	**Low**	Unlikely	Low	**Negligible**
Nankeen Kestrel *Falco cenchroides* (and *Falco cenchroides cenchroides*)	-	-	Likely	Moderate	**Moderate**	Unlikely	Negligible	**Negligible**
Peregrine Falcon *Falco peregrinus*	-	-	Almost certain	Low	**Low**	Unlikely	Negligible	**Negligible**
Pink Cockatoo *Lophochroa leadbeateri* (and *Lophochroa leadbeateri leadbeateri*)	EN	VU	Likely	Moderate	**Moderate**	Unlikely	Low	**Negligible**

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Species	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects		
	EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating
Regent Parrot (eastern subspecies) *Polytelis anthopeplus monarchoides*	Vu	EN	Unlikely	Moderate	**Low**	Rare	Moderate	**Negligible**
Spotted Harrier *Circus assimilis*	-	VU	Unlikely	Moderate	**Low**	Rare	Low	**Negligible**
Wedge-tailed Eagle *Aquila audax*	-	-	Certain	Moderate	**High**	Likely	Low	**Low**
Whistling Kite *Haliastur sphenurus*	-	-	Likely	Moderate	**Moderate**	Likely	Low	**Low**
White-bellied Sea-Eagle *Haliaeetus leucogaster*	-	VU	Likely	Moderate	**Moderate**	Unlikely	Low	**Negligible**
Bats								
Gould's Wattled Bat *Chalinolobus gouldii*	-	-	Almost certain	Low	**Low**	Unlikely	Negligible	**Negligible**
Inland Forest Bat *Vespadelus baverstocki*	-	VU	Unlikely	Moderate	**Low**	Unlikely	Negligible	**Negligible**
Southern Free-tailed bat *Ozimops planiceps*	-	-	Likely	Low	**Low**	Unlikely	Negligible	**Negligible**
White-striped Freetail-bat *Austronomus australis*	-	-	Almost certain	Low	**Low**	Unlikely	Low	**Negligible**
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	-	VU	Unlikely	Moderate	**Low**	Unlikely	Low	**Negligible**

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

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 Biosis and Nature Advisory assessments outlined above is summarised in Table 49 and Table 50.

A total of 39 species, including 34 species of birds and five species of bats, are considered to be at more than a negligible risk of impact from turbine collisions as a result of the project. This includes 17 species of birds and five species of bats concluded to be at-risk from application of the risk assessment matrices outlined above, and a further 17 species of birds concluded to be at-risk by Nature Advisory within their detailed studies on local avifauna ((Nature Advisory 2023e, Nature Advisory 2023a).

It should be noted that all but five 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. Five species considered to have a low risk of indirect/barrier effect risk are; Australasian Bittern, Black Kite, Curlew Sandpiper, Wedge-tailed Eagle, and Whistling Kite.

Table 49 Species determined to be at risk of impact from turbine collision through qualitative risk assessments by Biosis and Nature Advisory (Nature Advisory 2023f)

Species	Threat listing		Risk assessed species risk conclusion (collision)
	EPBC Act	BC Act	
Birds			
Australasian Bittern	EN	EN	Low
Black Falcon	-	VU	Low
Black Kite	-	-	Moderate
Black-shouldered Kite	-	-	Low
Brown Falcon	-	-	Low
Brown Goshawk	-	-	Low
Curlew Sandpiper*	CE	CE	Low
Fork-tailed Swift	Mi	-	Low
Little Eagle	-	VU	Low
Nankeen Kestrel (incl subsp.)	-	-	Moderate
Peregrine Falcon	-	-	Low
Pink Cockatoo (incl subsp.)	EN	VU	Moderate
Regent Parrot (eastern subspecies)	VU	EN	Low
Spotted Harrier	-	VU	Low
Wedge-tailed Eagle	-	-	High
Whistling Kite	-	-	Moderate
White-bellied Sea-Eagle	-	VU	Moderate

Species	Threat listing		Risk assessed species risk conclusion (collision)
	EPBC Act	BC Act	
Bats			
Gould's Wattled Bat	-	-	Low
Inland Forest Bat			
Southern Free-tailed bat			
White-striped Freetail-bat	-	-	Low
Yellow-bellied Sheathtail-bat	-	VU	Low

Biosis has reassessed the collision risk for Curlew Sandpiper and concluded the species to be at a Low risk from the project. This conclusion is largely based on the highly threated nature of the species (Critically Endangered, BC Act and EPBC Act) and a desire to ensure a conservative approach for the species. Based on a lack of existing records of the species close to the subject land, as well as flight characteristics and habitat preferences, the species likelihood of occurrence is considered very low, however again to ensure a conservative assessment of collision risk, it has been included as an 'at-risk' species.

Table 50 Species not subject to qualitative risk assessment determined to be at-risk (Nature Advisory 2023e, Nature Advisory 2023a)

Species	Threat listing		Recorded in subject land
	EPBC Act	BC Act	
Australasian Darter (Arrgarrg)			No
Australasian Shoveler			No
Australian Pelican			Yes
Black Swan			Yes
Black-and-white Shag (Pied Cormorant)			No
Blue-billed Duck		VU	No
Caspian Tern	Mi		No
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 outlined above in Section 6.1, and summarised in Table 49 and Table 50. Further assessment is provided to determine which turbines present the highest risk of potential collisions to allow for targeted mitigation to be applied to reduce the potential risk and consequences of strikes that may occur. This assessment considered the likelihood of each turbine resulting in potential strikes, largely dependent on surrounding habitat types, the subsequent flyways between habitat patches, proximity to operational turbines, and the potential consequence of collisions on species and populations, which is largely driven by the 'at-risk' and conservation status of those species.

Specific flight path mapping was not collected during BUS, however this is not considered to be a material limiting factor to the risk assessment process. Flight paths illustrated on Figure 13 are indictive based on local scale habitat features. The use of habitat features including woodland / wetland habitats, waterbodies, hollow-bearing trees and stick nests, and assessment of their proximity and orientation to proposed turbines and other habitat features, is a sufficient surrogate for mapped flightpaths. This is particularly relevant at the subject land where habitat largely occurs as isolated patches surrounded by agricultural areas. Movements (flights) between habitat features at a patch, site and landscape scale have all be assessed using GIS, and provide suitable inputs for the risk assessment model and provide suitably conservative results. It is proposed that additional flight path mapping be completed in preparation of, and during implementation of, the project's BBAMP, once the final turbine layout is known. This mapping will ensure any locations where potential collision risk may be increased due to high levels of activity within RSA of operational turbines can be sufficiently monitored during mortality surveys, and allow for suitable adaptive management strategies to be employed, and allow ongoing assessment of turbine risk ratings.

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 51 below.

Table 51 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 52 below.

Table 52 Turbine strike consequence for at-risk species

Species	Threat status	Turbine strike consequence rating	Key habitats (refer Figure 6)
Birds			
Australasian Bittern	Endangered – BC Act and EPBC Act	Major*	Wetlands - PCT 238
Australasian Darter (Arrgarrg)	At-risk	Minor*	Wetlands - PCT 238
Australasian Shoveler	At-risk	Minor*	Wetlands - PCT 238
Australian Pelican	At-risk	Minor*	Wetlands - PCT 238
Black Falcon	Vulnerable – BC Act	Minor	Treed PCTs - 15, 16, 21, 23, 57, 58, 170
Black Kite	At-risk	Minor	Treed PCTs - 15, 16, 21, 57, 58, 170
Black Swan	At-risk	Minor*	Wetlands - PCT 238
Black-and-white Shag (Pied Cormorant)	At-risk	Minor*	Wetlands - PCT 238

Species	Threat status	Turbine strike consequence rating	Key habitats (refer Figure 6)
Black-shouldered Kite	At-risk	Minor	Treed PCTs - 15, 16, 21, 23, 57, 58, 170
Blue-billed Duck	Vulnerable – BC Act	Minor*	Wetlands - PCT 238
Brown Falcon	At-risk	Minor	Treed PCTs - 15, 16, 21, 23, 57, 58, 170
Brown Goshawk	At-risk	Minor	Treed PCTs - 15, 16, 21, 23, 57, 58, 170
Caspian Tern	Migratory – EPBC Act	Minor*	Wetlands - PCT 238
Curlew Sandpiper	Critically Endangered – BC Act, Critically Endangered – EPBC Act	Major*	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
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
Peregrine Falcon	At-risk	Minor	Treed PCTs - 15, 16, 21, 23, 57, 58, 170
Pink Cockatoo	Vulnerable – BC Act, Endangered – EPBC Act	Major	Treed PCTs - 15, 16, 21, 57, 58, 170
Pink-eared Duck	At-risk	Minor*	Wetlands - PCT 238
Regent Parrot (eastern subspecies)	Endangered – BC Act, Vulnerable – EPBC Act	Moderate	Treed PCTs - 15, 16, 58, 170
Spotted Harrier	Vulnerable – BC Act	Minor	Treed PCTs - 15, 16, 21, 57, 58, 170
Straw-necked Ibis	At-risk	Minor*	Wetlands - PCT 238

Species	Threat status	Turbine strike consequence rating	Key habitats (refer Figure 6)
Wedge-tailed Eagle	At-risk	Moderate	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
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
Inland Forest Bat	Vulnerable – BC Act	Moderate	Treed PCTs - 15, 16, 21, 57, 58, 170
Southern Free-tailed 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 52 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 53 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 6 below.

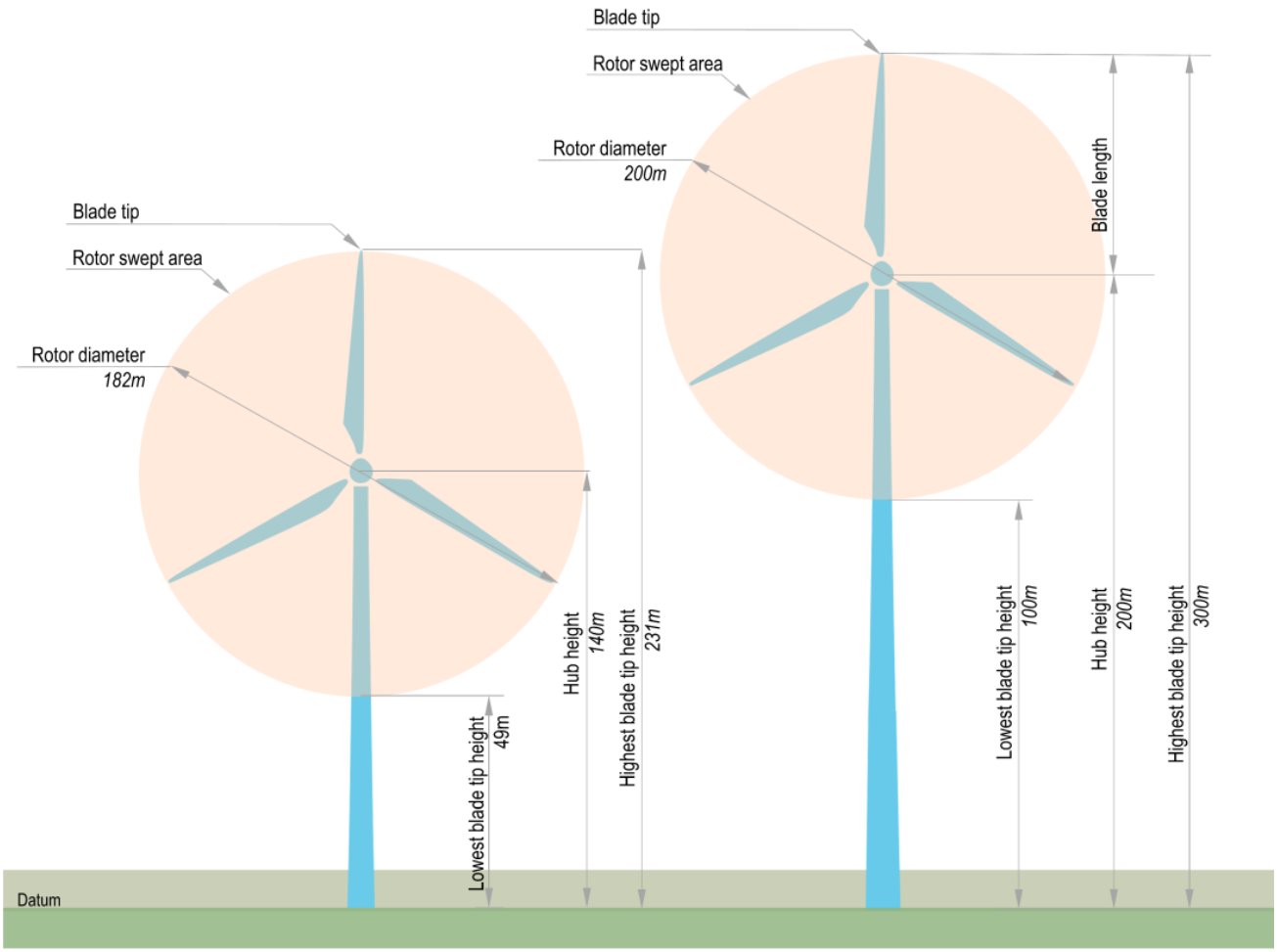


Plate 6 Turbine model comparison schematic diagram of options assessed in the EIS

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 53 below.

Table 53 Turbine strike likelihood criteria

Key habitat features	
• Key wooded habitats for at-risk species that occur on one, or both sides of a turbine, such that flights between habitat features/patches are more likely to occur within, or in close proximity to, RSA. • 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. • Lakes, wetlands and larger watercourses on one, or both sides of a turbine increasing the risk of collisions from fauna flying into or out of the habitat feature. Relevant for flood years only. • Habitat point features such as raptor nests and tree hollows occur in close proximity to turbines. • Migratory or nomadic species habitual flight path, or key local flyways (where known).	
Buffer distance to habitat feature	**Likelihood of turbine strike**
• Key habitat within 200 m buffer from WTG blade tip, on both sides • Stick nest or HBT occurs <200 m from WTG blade tip within habitat patch	**Probable** An event is expected to occur in most circumstances (>95%).
• Key habitat within 200 m buffer from WTG blade tip, on one side only • Key habitat within 200-500 m buffer from WTG blade tip, on both sides • Stick nest or HBT occurs <500 m from WTG blade tip within habitat patch • Minor deviations from the above rule set where habitats align with 'possible' likelihood assessment	**Possible** An event could occur during most circumstances (>50% - <95%).
• Key habitat within 200-500 m buffer from WTG blade tip, on one side only • Key habitat within >500 m buffer from WTG blade tip, on both sides • Stick nest or HBT occurs <500 m from WTG blade tip within habitat patch • Minor deviations from the above rule set where habitats are particularly small, isolated, or degraded	**Unlikely** An event could occur during some circumstances (>5 - <50%).
• Limited habitat features <1000 m from WTG blade tip	**Rare** 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). These criteria are considered to better represent the likelihood of individuals potentially interacting the turbines as a result of movements between, or into / out-of, suitable habitats. 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, 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 standardised criteria account for flightpaths of aerial species both observed on-site during field investigations and predicted based on the presence of habitat features utilised by at-risk species and the locations of the operational turbines in relation to those habitat features. The likelihood of a species colliding with an operational turbine, based on proximity to suitable habitat features and the probability of individuals undertaking flights that put them at risk of colliding with a turbine is considered, and when combined with the consequences of those potential collisions give each turbine its overall risk rating.

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).

'Avoidance' is recognised at different spatial scales, with commonly used definitions provided by Cook et al. (2014). These different scales of avoidance include: (1) macro-avoidance, when a bird or bat responds to the presence of the entire wind farm by flying around or over it; (2) meso-avoidance, refers to the response in which birds or bats fly within the overall wind farm but avoid collisions by choosing to fly only in the airspace between turbines; and (3) micro-avoidance, when a bird or bat flying in close proximity to a turbine and that is otherwise on a collision course, does not in fact collide with the turbine (Smales 2017).

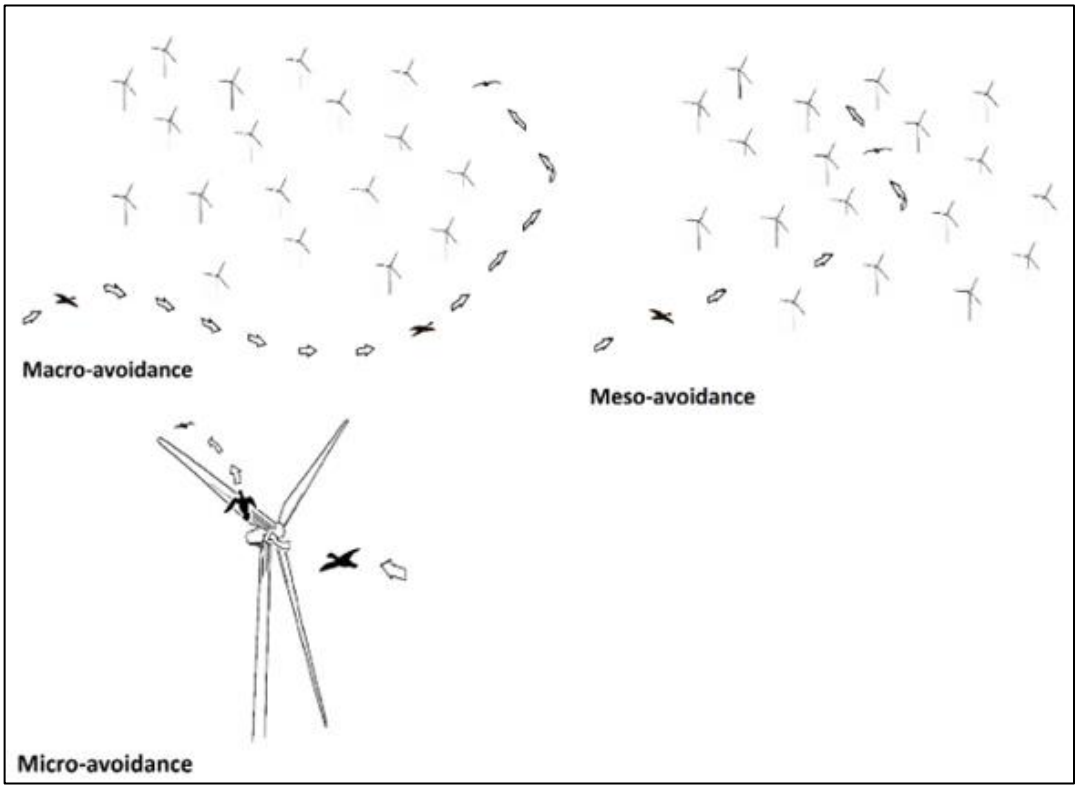


Plate 7 Three spatial scales at which avoidance of collision may occur (Smales 2017)

Meso-avoidance forms the main consideration in this turbine strike likelihood assessment, with micro-avoidance also relevant, and macro-avoidance to a lesser extent. The ability of bird and bat to avoid collision with operating (and to a lesser extent stationary) turbines is key to allowing the continued use of habitats within an operational wind farm. 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. Evidence from studies at wind farms abroad suggests that birds have displayed a preference for flight routes taken between turbines spaced between at least 200 – 400 metres apart (Tulp et al. 1999, Percival 2001), which suggests that meso-scale avoidance is likely to be possible within the turbine layout as currently assessed in this BDAR. It should be noted that these studies are based on seabirds and offshore wind farms, however directly comparable data is lacking (i.e. Australian studies), and they do illustrate that birds will fly between turbines where sufficient space exists.

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 51 have been used to complete the turbine risk assessment for this BDAR.

WTG locations, pinch points and flyways

Figure 14 and Table 54 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 54 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.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

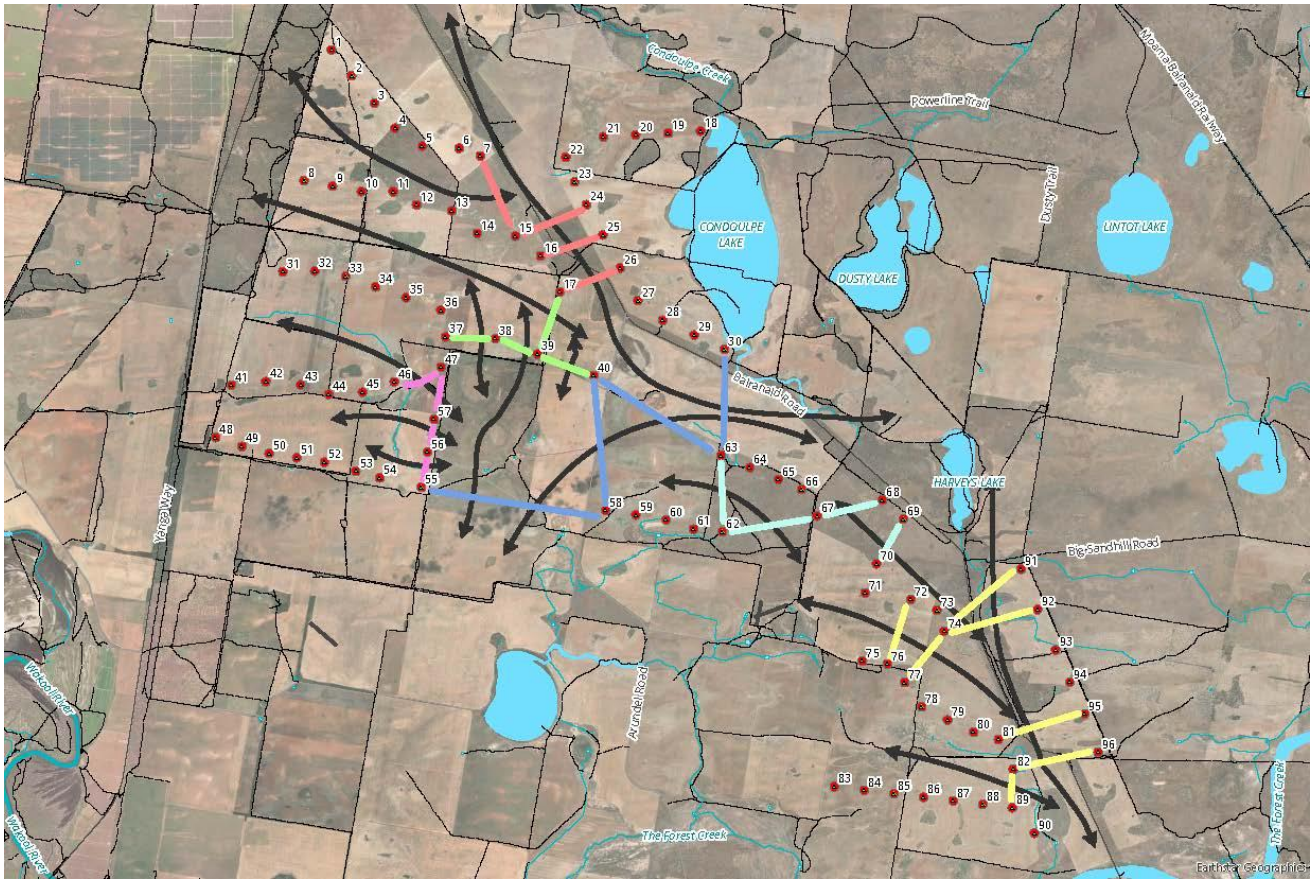


Figure 14 WTG location, pinch points and flyways

Table 54 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	-
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

From WTG	To WTG	RSA gap distance (m)	Avg gap at pinch point (m)
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 14 and Table 54 above that pinch point separation distances between RSAs are no less than 520 metres along turbine strings (between WTG56-57), 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 14).

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 15 below).

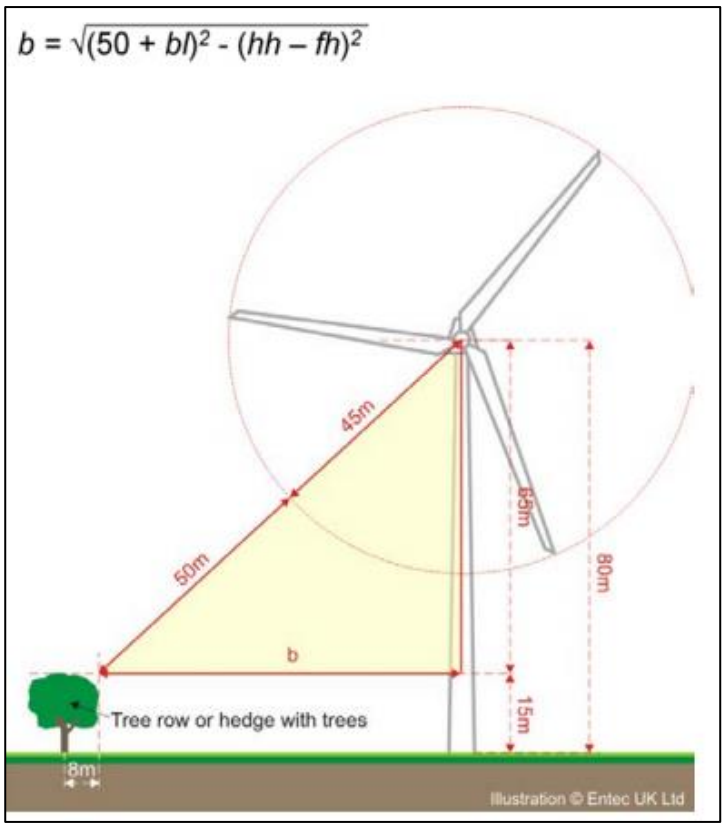


Figure 15 **Extract from Technical Information Note TIN051 Bats and onshore wind turbines, showing how buffer distance is determined from top of canopy to blade tip**

The above formula was used calculate the buffer distances outlined in Table 53 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.

Aviation lighting

Following Agency feedback on the EIS, aviation lighting has been determined as required to be installed on 35 turbines, spaced at 900 metre intervals (further information is provided in Section 7.1 and Section 8.2 below). Aviation lighting has the potential to attract the insect prey of microbats, and potentially microbats themselves, and as such has been considered in the updated turbine risk assessment.

The account for the potential increased collision risk, no turbines that support aviation lighting have been assessed as presenting less than an Unlikely strike likelihood (i.e. no less than, an event could occur during some circumstances [>5 - <50%]). This has increased the strike likelihood of two turbines from Rare to Unlikely (WTGs 21 and 38).

The results of this analysis are presented in Table 55 below.

Table 55 Turbine strike likelihood results

WTG	Strike likelihood	Justification	At-risk species
1	Possible	Woodland, Nest, HBT 200-500m, 1 side only	Pink Cockatoo
2	Unlikely	Woodland 200-500m, 1 side only	Wedge-tailed Eagle
3	Unlikely	Woodland 200-500m, 1 side only	Wedge-tailed Eagle
4	Possible	HBT w/in 200m, 1 side only	Pink Cockatoo
5	Unlikely	Woodland (both sides), HBT (1 side), >500m	Wedge-tailed Eagle
6	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
7	Possible	Woodland w/in 200m, 1 side only, nests 200-500m	Wedge-tailed Eagle
8	Possible	Woodland, Nest, HBT 200-500m, 1 side only	Pink Cockatoo
9	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
10	Possible	Woodland, Nest, HBT 200-500m, 1 side only	Wedge-tailed Eagle
11	Possible	Woodland, Nest, HBT 200-500m, 1 side only	Pink Cockatoo
12	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
13	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
14	Unlikely	Woodland >500m, both sides	Wedge-tailed Eagle
15	Unlikely	Woodland, Nest, HBT 200-500m, 1 side only	Wedge-tailed Eagle
16	Possible	Woodland, Nests, HBTs w/in 200m, 1 side only	Pink Cockatoo
17	Possible	HBT w/in 200m, 1 side only	Pink Cockatoo
18	Possible**	Woodland w/in 200m, 1 side only, Wetland >500m	Australasian Bittern / Curlew Sandpiper
19	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
20	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
21*	Unlikely	Woodland >500m, one side only	Wedge-tailed Eagle / Inland Forest Bat
22	Rare	Woodland >500m, one side only	Wedge-tailed Eagle
23	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
24	Possible	Woodland (both sides), HBT (1 side), 200-500m	Pink Cockatoo
25	Unlikely	Woodland, HBTs 200-500m, 1 side only	Wedge-tailed Eagle
26	Possible	Woodland, Nest 200-500m, 1 side only	Wedge-tailed Eagle
27	Possible	Woodland, Nests w/in 200m, 1 side only	Wedge-tailed Eagle
28	Unlikely	Woodland (both sides), Nest (1 side), >500m	Wedge-tailed Eagle
29	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
30	Probable**	Woodland and Wetland w/in 200m	Australasian Bittern / Curlew Sandpiper
31	Unlikely	Woodland 200-500m, 1 side only	Wedge-tailed Eagle

WTG	Strike likelihood	Justification	At-risk species
32	Rare	Woodland >500m, one side only	Wedge-tailed Eagle
33	Rare	Woodland >500m, one side only	Wedge-tailed Eagle
34	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
35	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
36	Rare	Woodland >500m, one side only	Wedge-tailed Eagle
37	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
38*	Unlikely	Limited habitat <1km	Wedge-tailed Eagle / Inland Forest Bat
39	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
40	Possible	Woodland, Nest 200-500m, 1 side only	Wedge-tailed Eagle
41	Possible	Woodland, HBTs w/in 200m, 1 side only	Pink Cockatoo
42	Unlikely	Woodland (small patches), 200-500m, both sides	Wedge-tailed Eagle
43	Unlikely	Woodland (small, isolated) w/in 200m, 1 side only	Wedge-tailed Eagle
44	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
45	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
46	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
47	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
48	Possible	Woodland 200-500m, 1 side	Pink Cockatoo
49	Possible	Woodland (1 side), HBTs (both sides), 200-500m	Pink Cockatoo
50	Possible	Woodland (narrow strip), HBT, w/in 200m 1 side only	Pink Cockatoo
51	Unlikely	Woodland (narrow strip), w/in 200m 1 side only	Wedge-tailed Eagle
52	Possible	Woodland (narrow strip), Nest, w/in 200m 1 side only	Wedge-tailed Eagle
53	Unlikely	Woodland, Nest 200-500m, 1 side only	Wedge-tailed Eagle
54	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
55	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
56	Unlikely	Woodland, HBTs 200-500m, 1 side only	Wedge-tailed Eagle
57	Possible	Woodland, HBTs w/in 200m, 1 side only	Pink Cockatoo
58	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
59	Unlikely	Woodland (both sides), Nest (1 side), 200-500m	Wedge-tailed Eagle
60	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
61	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
62	Probable	Woodland w/in 200m, both sides	Wedge-tailed Eagle
63	Unlikely	Woodland, Nest 200-500m, 1 side only	Wedge-tailed Eagle
64	Possible	Woodland, Nest, w/in 200m 1 side only	Wedge-tailed Eagle
65	Probable	Woodland (both sides), HBT and Nest (one side), w/in 200m	Pink Cockatoo

WTG	Strike likelihood	Justification	At-risk species
66	Probable	Woodland w/in 200m, both sides	Pink Cockatoo
67	Probable	Woodland (both sides), HBT and Nest (one side), w/in 200m	Pink Cockatoo
68	Probable	Woodland (both sides), Nest (one side), w/in 200m	Pink Cockatoo
69	Probable	Woodland (both sides), Nest (one side), w/in 200m	Pink Cockatoo
70	Possible	Woodland, Nest, w/in 200m, one side only	Pink Cockatoo
71	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
72	Unlikely	Woodland 200-500m, both sides	Wedge-tailed Eagle
73	Possible	Woodland w/in 200m, both sides	Pink Cockatoo
74	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
75	Unlikely	Woodland 200-500m, 1 side only	Wedge-tailed Eagle
76	Unlikely	Woodland w/in 200m, 1 side only	Wedge-tailed Eagle
77	Unlikely	Woodland w/in 200m, 1 side only	Wedge-tailed Eagle
78	Possible	Woodland (both sides), HBT (1 side), 200-500m	Pink Cockatoo
79	Unlikely	Woodland, HBTs 200-500m, 1 side only	Wedge-tailed Eagle
80	Unlikely	Woodland (both sides), HBT (1 side), >500m	Wedge-tailed Eagle
81	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
82	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
83	Unlikely	Woodland (both sides), HBT (1 side), 200-500m	Wedge-tailed Eagle
84	Unlikely	Woodland 200-500m, both sides	Wedge-tailed Eagle
85	Possible	Woodland w/in 200m, 1 side only	Pink Cockatoo
86	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
87	Possible	Woodland w/in 200m (small patch), 1 side only	Wedge-tailed Eagle
88	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
89	Unlikely	Woodland 200-500m, 1 side	Wedge-tailed Eagle
90	Possible	Woodland w/in 200m (small patch), 1 side only	Wedge-tailed Eagle
91	Possible	Woodland w/in 200m, 1 side only, nests 200-500m	Wedge-tailed Eagle
92	Possible	Woodland, Nests w/in 200m, 1 side only	Wedge-tailed Eagle
93	Possible	Woodland, Nests w/in 200m, 1 side only	Wedge-tailed Eagle
94	Possible	Woodland, Nest, w/in 200m, both sides	Wedge-tailed Eagle
95	Possible	Woodland, Nests w/in 200m, 1 side only	Wedge-tailed Eagle
96	Possible	Woodland w/in 200m (small patches), both sides	Wedge-tailed Eagle

* Turbine strike likelihood increased due to the presence of aviation lighting.

** Turbine strike likelihood relates to flood years, when larger numbers of waterbird species/individuals are present in the region.

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 fauna, and movements patterns within the subject land, as well as the conclusions of the risk assessments undertaken for all at-risk species.

Turbine risk is being mainly driven by four at-risk species (Table 55, Table 57); Wedge-tailed Eagle (High risk, Moderate consequence), Pink Cockatoo (Moderate risk, Major consequence), Australasian Bittern and Curlew Sandpiper (both Low risk, Major consequence) (refer Table 49 and Table 52). The risk assessment for each turbine is based on an assessment of habitats present, including vegetation types, mapped hollow-bearing trees and stick nets, waterbodies, proximity to habitat features, species flight characteristics, and strike consequence ratings. Where turbines occur further from habitat patches, Wedge-tailed Eagle is considered the species most 'at-risk' from collision due to its soaring habits while hunting, and therefore is more likely to come into contact with more isolated turbines than Pink Cockatoo, Australasian Bittern or Curlew Sandpiper. As such, for WTGs with Unlikely or Rare strike likelihoods values (Table 55), which have been attributed on the basis of being more isolated from habitat patches, turbine risk is based on collisions with Wedge-tailed Eagles. Whereas where turbines are closer to habitat patches, and each species has similar potential to come into contact with operational turbines, the species with the higher consequence rating has been conservatively selected to drive turbine risk. Where habitat closer to turbines includes mapped stick nests, Wedge-tailed Eagle is considered the species most at-risk, and where habitat relates to mapped hollow-bearing trees, Pink Cockatoo is more at-risk. Australasian Bittern and Curlew Sandpiper are considered the most at-risk species for the two turbines closest to Condoulpe Lake (WTG 18 and WTG 30), however this heightened risk level is only relevant to flood years when habitat for the species is present.

As outlined in Section 5.2.3 increased risk for waterbirds is highest when local habitat features such as Condouple Lake hold water providing habitat for waterbirds and species ascend or descend through RSA height as they fly into or out of the habitat. This is likely to occur around 5 % of the time, or once every 10-20 years, based on historical observations between 1986 and 2024 (WRM 2024). It is during these times when turbine risk, for turbines closest to potential wetland habitat, will be driven by wetland species, with the species with the highest consequence of collisions being Australasian Bittern and Curlew Sandpiper. No other wetland species have been assessed as having a consequence of collision higher then Minor (refer Table 51) and thus do not drive turbine risk ratings for any turbines.

Turbines 21 and 38 have increased in stroke likelihood from Rare to Unlikely on the basis of aviation lighting potentially attracting microbats, thus increasing collision risk. This has resulted in the overall turbine risk for these two turbines increasing from Low to Moderate. In this case Inland Forest Bat can be considered the species driving the final risk assessment for these two turbines.

The turbine risk assessment matrix applied to the project is outlined in Table 56.

Table 56 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

57 Table 57 Turbine risk assessment results

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk
1	Possible	Major	High
2	Unlikely	Moderate	Moderate
3	Unlikely	Moderate	Moderate
4	Possible	Major	High
5	Unlikely	Moderate	Moderate
6	Unlikely	Moderate	Moderate
7	Possible	Moderate	Moderate
8	Possible	Major	High
9	Unlikely	Moderate	Moderate
10	Possible	Moderate	Moderate
11	Possible	Major	High
12	Unlikely	Moderate	Moderate
13	Unlikely	Moderate	Moderate
14	Unlikely	Moderate	Moderate
15	Unlikely	Moderate	Moderate
16	Possible	Major	High
17	Possible	Major	High
18	Possible	Major	High*
19	Unlikely	Moderate	Moderate
20	Possible	Major	High
21	Unlikely	Moderate	Moderate
22	Rare	Moderate	Low
23	Unlikely	Moderate	Moderate
24	Possible	Major	High
25	Unlikely	Moderate	Moderate

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk
26	Possible	Moderate	Moderate
27	Possible	Moderate	Moderate
28	Unlikely	Moderate	Moderate
29	Possible	Major	High
30	Probable	Major	Very high*
31	Unlikely	Moderate	Moderate
32	Rare	Moderate	Low
33	Rare	Moderate	Low
34	Unlikely	Moderate	Moderate
35	Unlikely	Moderate	Moderate
36	Rare	Moderate	Low
37	Unlikely	Moderate	Moderate
38	Unlikely	Moderate	Moderate
39	Unlikely	Moderate	Moderate
40	Possible	Moderate	Moderate
41	Possible	Major	High
42	Unlikely	Moderate	Moderate
43	Unlikely	Moderate	Moderate
44	Unlikely	Moderate	Moderate
45	Possible	Major	High
46	Possible	Major	High
47	Unlikely	Moderate	Moderate
48	Possible	Major	High
49	Possible	Major	High
50	Possible	Major	High
51	Unlikely	Moderate	Moderate
52	Possible	Moderate	Moderate

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk
53	Unlikely	Moderate	**Moderate**
54	Unlikely	Moderate	**Moderate**
55	Unlikely	Moderate	**Moderate**
56	Unlikely	Moderate	**Moderate**
57	Possible	Major	**High**
58	Unlikely	Moderate	**Moderate**
59	Unlikely	Moderate	**Moderate**
60	Unlikely	Moderate	**Moderate**
61	Possible	Major	**High**
62	Probable	Moderate	**High**
63	Unlikely	Moderate	**Moderate**
64	Possible	Moderate	**Moderate**
65	Probable	Major	**Very high**
66	Probable	Major	**Very high**
67	Probable	Major	**Very high**
68	Probable	Major	**Very high**
69	Probable	Major	**Very high**
70	Possible	Major	**High**
71	Unlikely	Moderate	**Moderate**
72	Unlikely	Moderate	**Moderate**
73	Possible	Major	**High**
74	Possible	Major	**High**
75	Unlikely	Moderate	**Moderate**
76	Unlikely	Moderate	**Moderate**
77	Unlikely	Moderate	**Moderate**
78	Possible	Major	**High**
79	Unlikely	Moderate	**Moderate**

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

WTG #	Turbine strike likelihood	Maximum consequence	Turbine risk
80	Unlikely	Moderate	**Moderate**
81	Unlikely	Moderate	**Moderate**
82	Unlikely	Moderate	**Moderate**
83	Unlikely	Moderate	**Moderate**
84	Unlikely	Moderate	**Moderate**
85	Possible	Major	**High**
86	Unlikely	Moderate	**Moderate**
87	Possible	Moderate	**Moderate**
88	Unlikely	Moderate	**Moderate**
89	Unlikely	Moderate	**Moderate**
90	Possible	Moderate	**Moderate**
91	Possible	Moderate	**Moderate**
92	Possible	Moderate	**Moderate**
93	Possible	Moderate	**Moderate**
94	Possible	Moderate	**Moderate**
95	Possible	Moderate	**Moderate**
96	Possible	Moderate	**Moderate**

* Turbine risk rating relates to flood years, when larger numbers of waterbird species/individuals are present in the region.

Table 58 below summarises then number of turbines within each risk category for the project.

Table 58 Turbine risk assessment summary

Turbine risk	No. of turbines
Very High	6
High	24
Moderate	62
Low	4

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.

It should be noted that the project's overall turbine risk profile has increased from the risk assessed as part of the EIS (2024). This is due largely to the reassessment of the overall risk ratings of Pink Cockatoo and Wedge-tailed Eagle, as well as the incorporation of additional field data on the presence of nests and hollow-bearing trees, and the inclusion of aviation lighting as part of the project. This reassessment is considered to address CPHR's feedback on the generally low levels of risk previously assessed, and will ensure sufficient operational monitoring and adaptive mitigation strategies are employed where required.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

STAGE 2 — IMPACT ASSESSMENT

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

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 17 shows 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 59 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.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Table 59 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. • Priorities for consideration that resulted in the outcomes listed below included: – Avoidance of threatened species populations/habitat and TECs. – Avoidance of hollow-bearing trees and stick nests. – Preferential location of infrastructure on Category 1 – Exempt Land and areas of existing disturbance. – Maximising separation between WTGs / RSA and tree canopies. – Maximising separation gaps between RSAs. – Minimising required disturbance areas through further designs, and minimising the widths required for access tracks and other linear infrastructure components. – 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). • 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. • Avoidance of impact to known Regent Parrot movement corridor and forage habitat (Nature Advisory 2023d). • Avoidance of impacts to approximately 12.5 ha of native vegetation, comprising PCT 170 and PCT 58 in various condition states.	Early project planning	Proponent

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
	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. • Avoidance of around 4.5 ha of PCT 58 in various condition states. • 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. • 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. • 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. • 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
	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. • Impacts have been avoided to PCT 16 and PCT 170 in this location.	Early project planning	Proponent

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
	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. • 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. • 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. • Of the 252 hollow-bearing trees mapped during Pink Cockatoo habitat assessment, only 14 occur within (+/- 10 m) 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 3 occur within the development footprint. • A total of 70 mapped hollow-bearing trees are expected to be removed by the project. • The above avoidance of paddock trees also directly avoided potential breeding habitat for Pink 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.	Early project planning	Proponent
	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	Early project planning	Proponent

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
		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. • Minimisation of impacts to the Lillas Dam & Myall Yards TSR, noted as a High conservation value TSR (LLS 2017).		
	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. • 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). 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). • 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. • 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.	Early project planning	Proponent
	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:	Early project planning	Proponent

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
		– 4 % of WTGs with a blade strike likelihood rating of 'Rare' – 49 % of WTGs with a blade strike likelihood rating of 'Unlikely' – 40 % of WTGs with a blade strike likelihood rating of 'Possible' – 7 % of WTGs with a blade strike likelihood rating of 'Probable'		
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. • Use of existing tracks, roads and fencelines to delineate sections of the project and used preferentially for locating access tracks and linear infrastructure. • As outlined above, route selection for access to Collector Substation #2 has minimised impacts to PCTs and TEC vegetation and associated habitats. • 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
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. • 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

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
	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. • 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. • 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 14 and Table 54 below). • 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 13 and Figure 14). Further detail and analysis of WTG locations, pinch pints and flyways is provided below.	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	Specific WTGs relocated resulting in increased spacing between turbines include: • Relocation of WTGs 37 and 38 increased the RSA separation from approximately 700 m to approximately 850 m. • Relocation of WTGs 47 and 57 increased the RSA separation from approximately 680 m to approximately 900 m. • 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	Early project planning	Proponent

Avoid and minimise component	Action	Outcome	Timing	Responsibility
		turbines (see Section 6.3), increasing RSA separation in this location illustrates considerable effort to minimise potential barrier effect ad collision risk impacts. • 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.		
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. • 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. • 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. • 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).	Operational project	Proponent and operator
	Impact minimisation and mitigation strategies	• 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.	Operational project	Proponent and operator

Avoid and minimise component	Action	Outcome	Timing	Responsibility
		– Establishment of aviation lighting systems that reduce insect (prey) attraction by minimising the numbers of lights installed, maximising shielding, minimising brightness, and using red lights. – Minimising availability of raptor perches on infrastructure within close proximity to turbines and overhead powerlines. – Prompt animal carcass removal within the 200 m of a turbine (within 24 hrs of discovery) to minimise raptor scavenging opportunities and reviewed annually. – Changes to land use practices such as stubble burning that might attract raptors. – Annual reporting requiring accounting for all events over the preceding 12 months and reinvestigation the effectiveness of the current mitigation strategy.		
	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, ultrasonic or thermal imaging technologies, to induce turbine shutdowns, with such technologies expected to develop greatly over the life of the project. technology based impact minimisation strategies outlined in the BBAMP include: – SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics. – Consideration of radar (or optical sensor) or live camera, including thermal camera, technologies for automatic, reactive and temporary curtailment of turbines, such as the IdentiFlight avian detection system and Wildlife Imaging Systems smart curtailment systems. – Limiting the use of artificial lighting (synchronising flashing red light if required) on turbines and other infrastructure within close proximity to turbines. – Consider novel deterrent techniques related to blade visibility.	Operational project	Proponent and operator
Habitat connectivity				
Project design		• The proposed design was sited, where possible within areas of non-native vegetation to avoid and minimise impacts to native vegetation.	Early project planning	Proponent

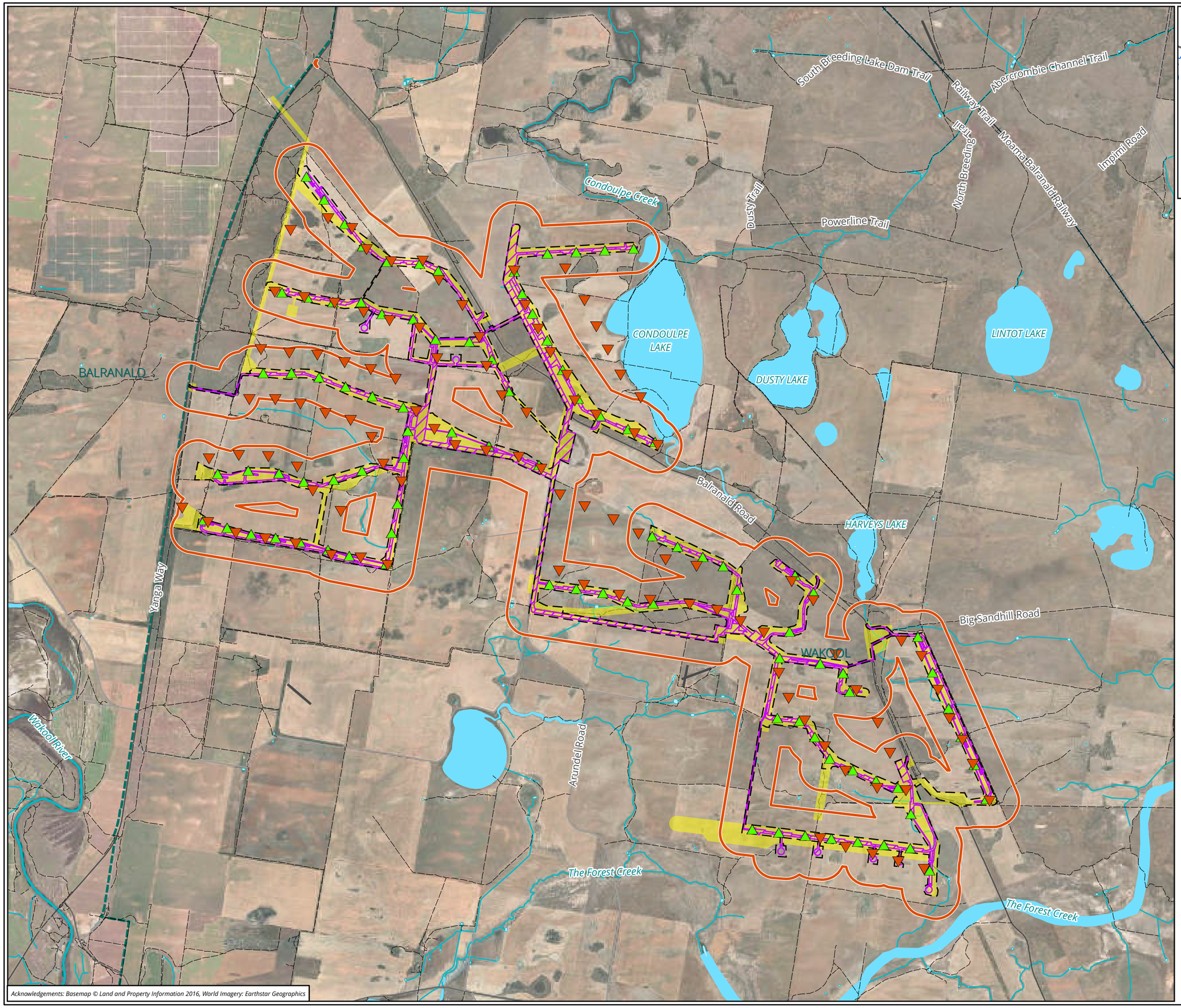
Avoid and minimise component	Action	Outcome	Timing	Responsibility
	Minimising impacts to habitat connectivity has been considered during project design	• Impacts to key movement corridors and TSRs have been avoided and minimised to the fullest extent possible. This includes avoidance of impacts through 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. • 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, including removal of infrastructure within 2.5km of Yanga SCA and Yanga NP. • 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.		
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. • 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

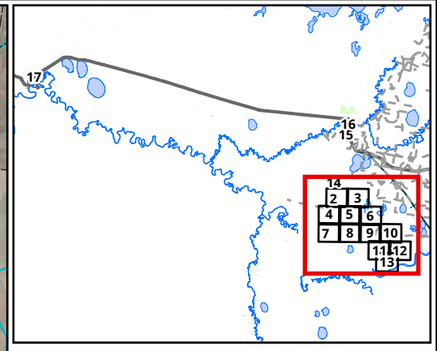
© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
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. • 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. • 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. – 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.	From project approval and in perpetuity within the Biodiversity Stewardship Site.	Proponent, Operator and Biodiversity Stewardship Site Owner
Lighting impacts				
Minimising the impacts of required aviation lighting	Required aviation lighting has been designed to minimise impacts to biodiversity	• Aviation lighting has the potential to directly impact upon biodiversity through the potential increases to collision risk with microbats and/or their insect prey being attracted to the lights and thus into RSA, and the increased levels of artificial light at night impacting upon terrestrial fauna. The following impact minimisation strategies have been incorporated into the required aviation safety lighting plan: – Red light has been used, over other more potentially harmful colours. – Intensity has been reduced to 200 candela (cd), from the international standard of 2000 cd lighting intensity. – Shielding has been added that will ensure no more than 5% of the nominal light intensity is emitted at or below 5° below the horizontal, and no light is emitted at or below 10° below horizontal. – 32 WTGs (91 %) with aviation lighting installed occur outside native vegetation patches.	During project design	Proponent and Operator

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Avoid and minimise component	Action	Outcome	Timing	Responsibility
		– Three WTGs with lights installed are >500m from woodland habitat, one of which is >1km from woodland. – A further 14 WTGs are 200-500m from woodland habitats. – The 18 WTGS within 200m of woodland vegetation shed minimal light on to the adjacent patches of habitat as a result of shielding detailed above. This ensure only very low intensity light shines of retained habitat patches.		





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

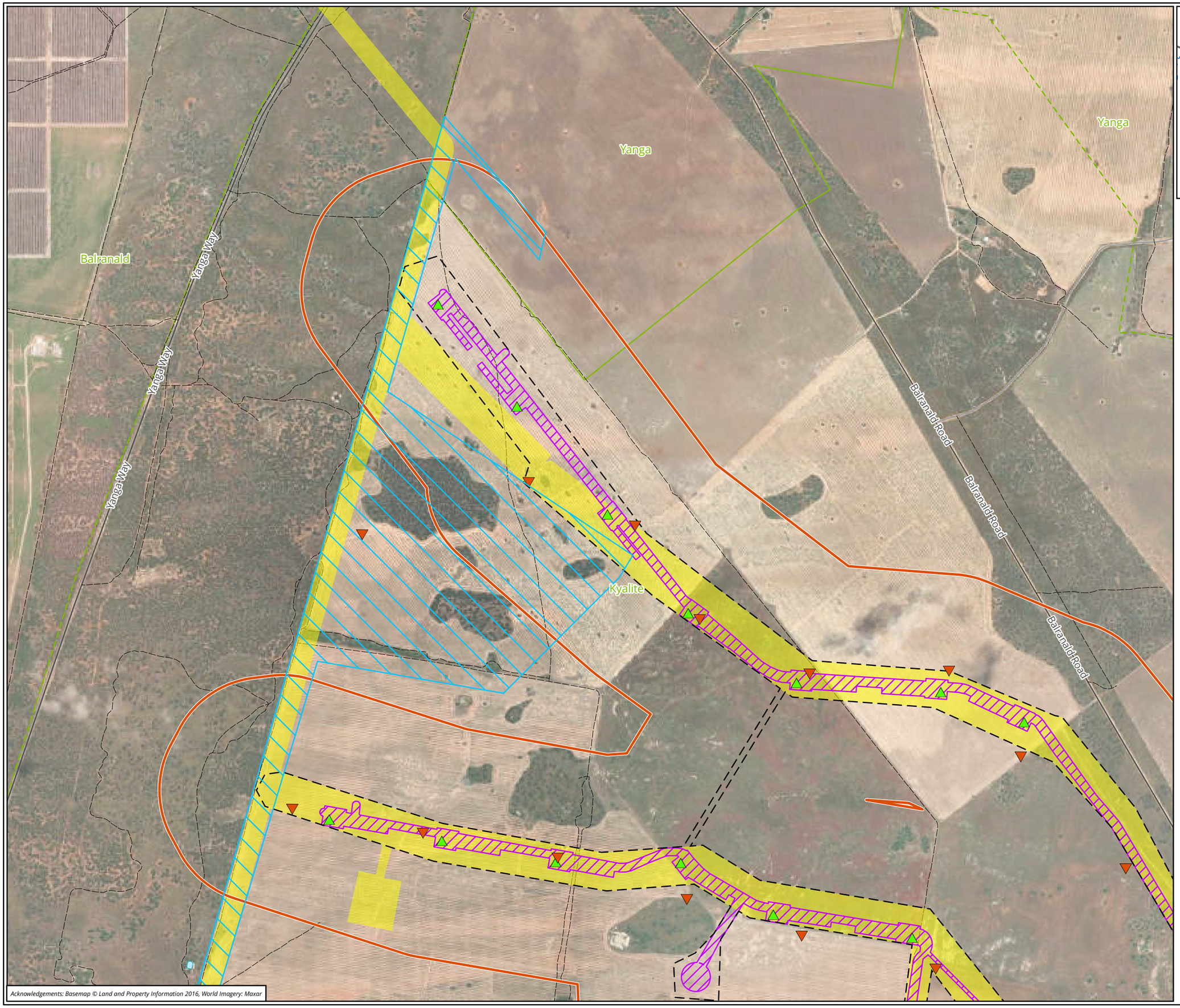
Meters

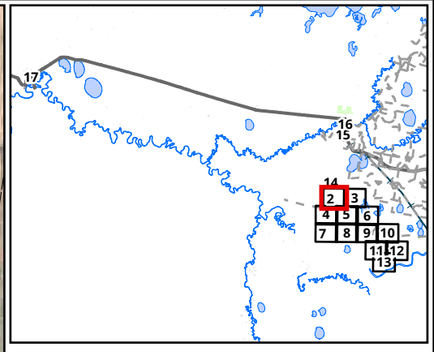
Scale: 1:80,000 @ A3

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
- 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

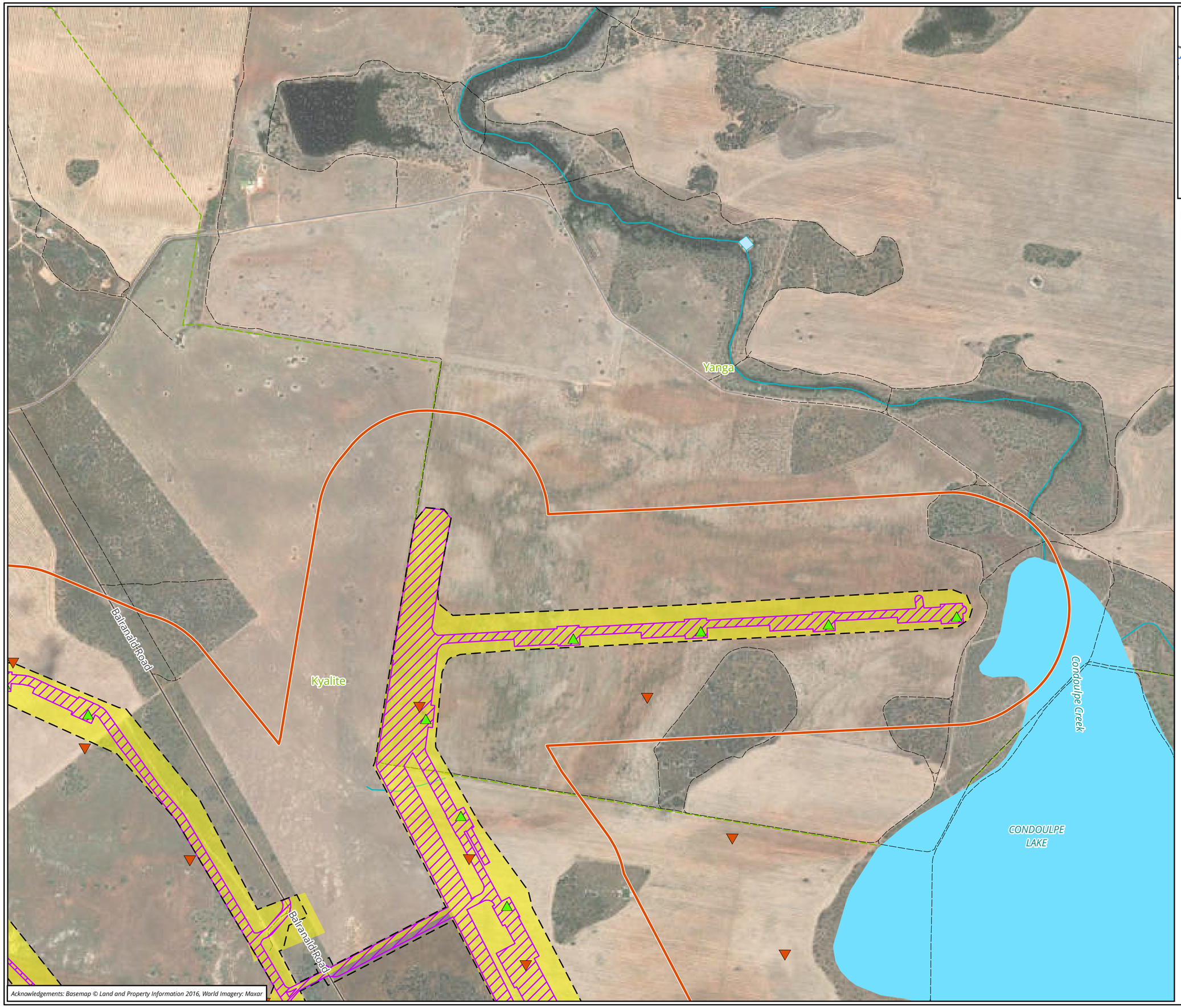
Meters

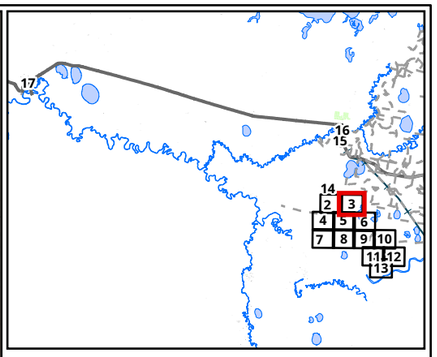
Scale: 1:18,000 @ A3

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

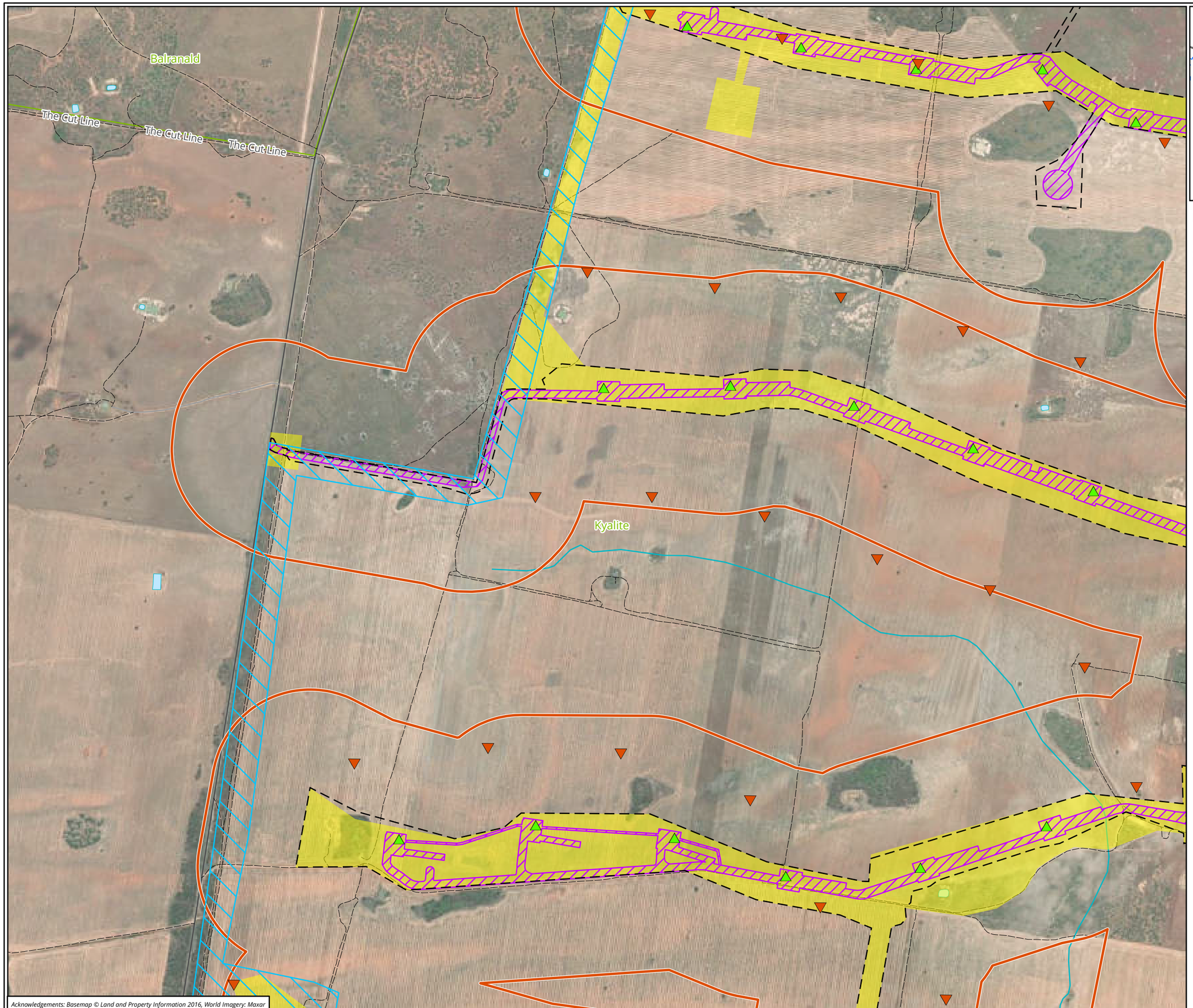
Figure 16.3 Alternate options and avoidance

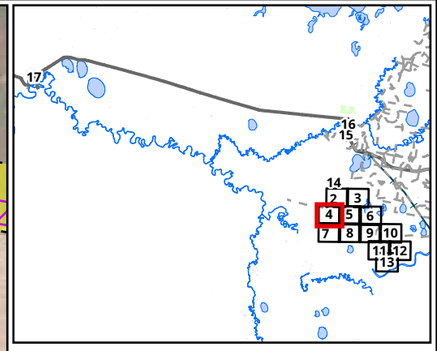
0 230 460 690 920 N

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
- Regent Parrot habitat buffer
- Current 96 WTG layout
- Project scoping 107 WTG

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

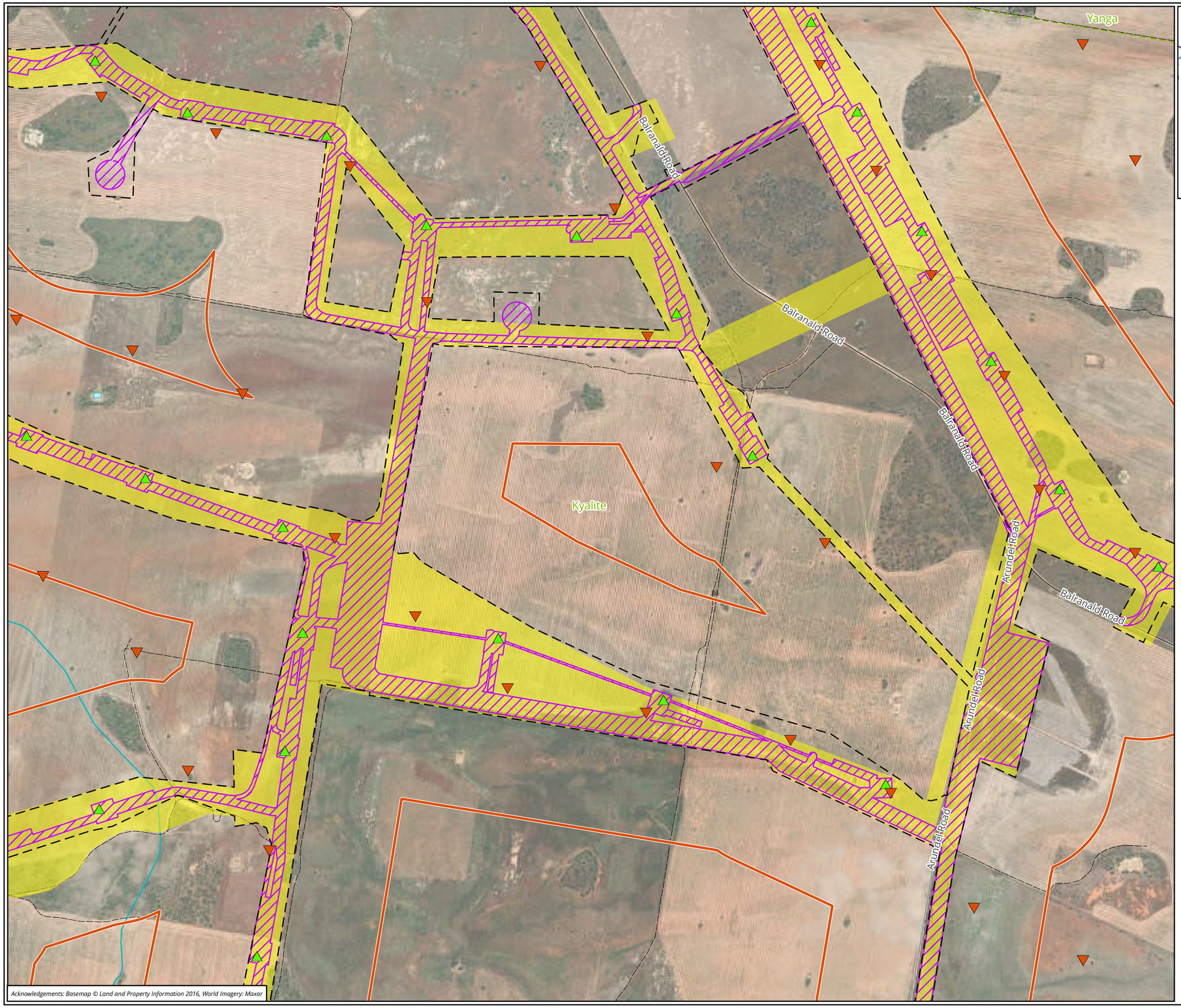
Figure 16.4 Alternate options and avoidance

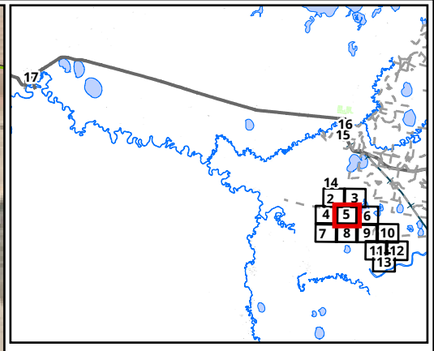
0 230 460 690 920 N

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

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

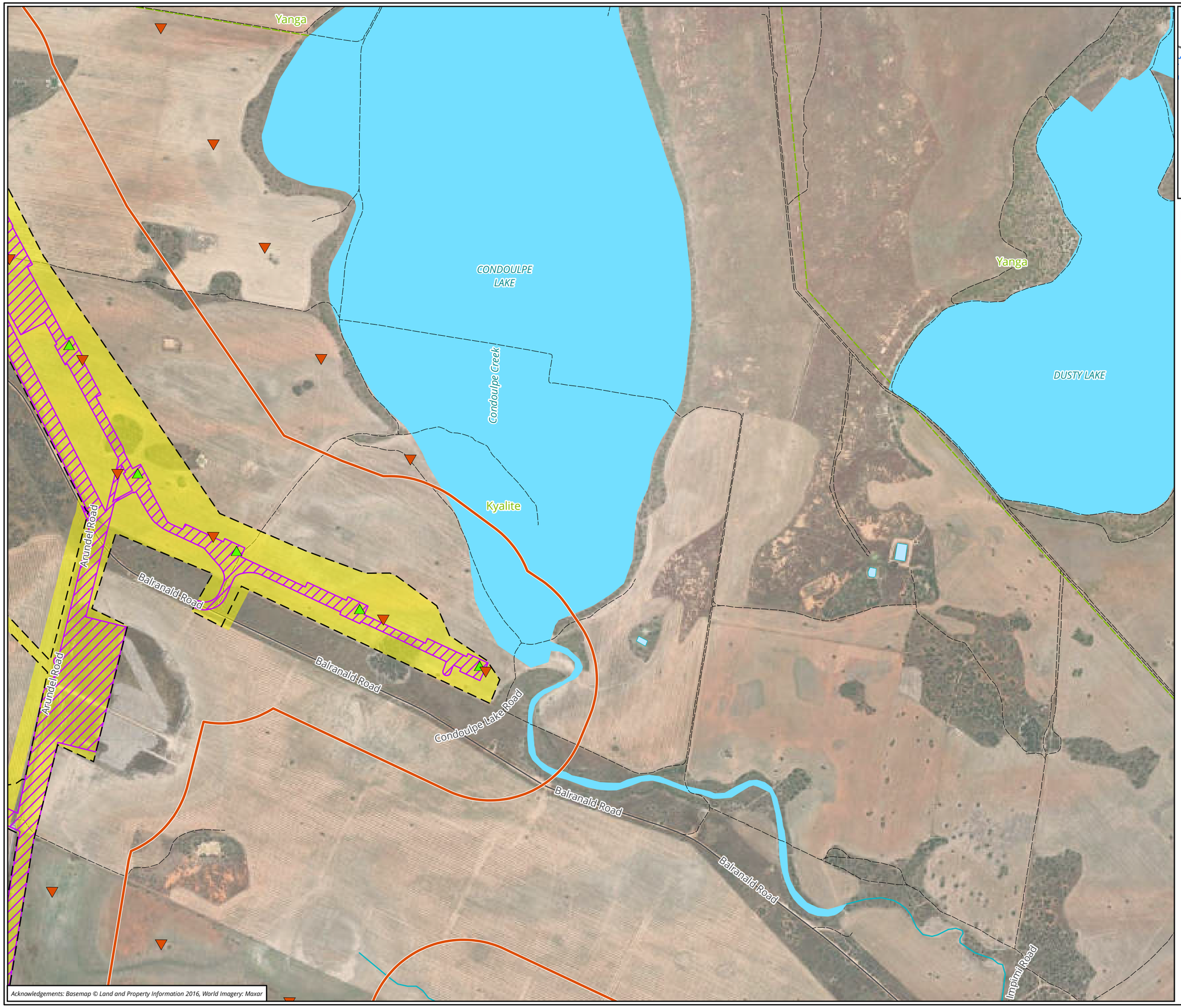
Figure 16.5 Alternate options and avoidance

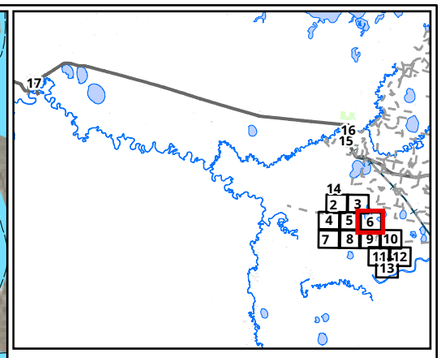
0 230 460 690 920 N

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

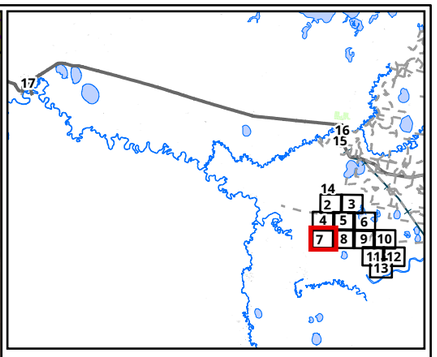
Figure 16.6 Alternate options and avoidance

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
- 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

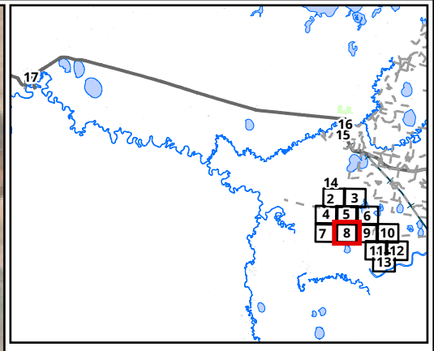
Meters

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 16.8 Alternate options and avoidance

0 230 460 690 920 N

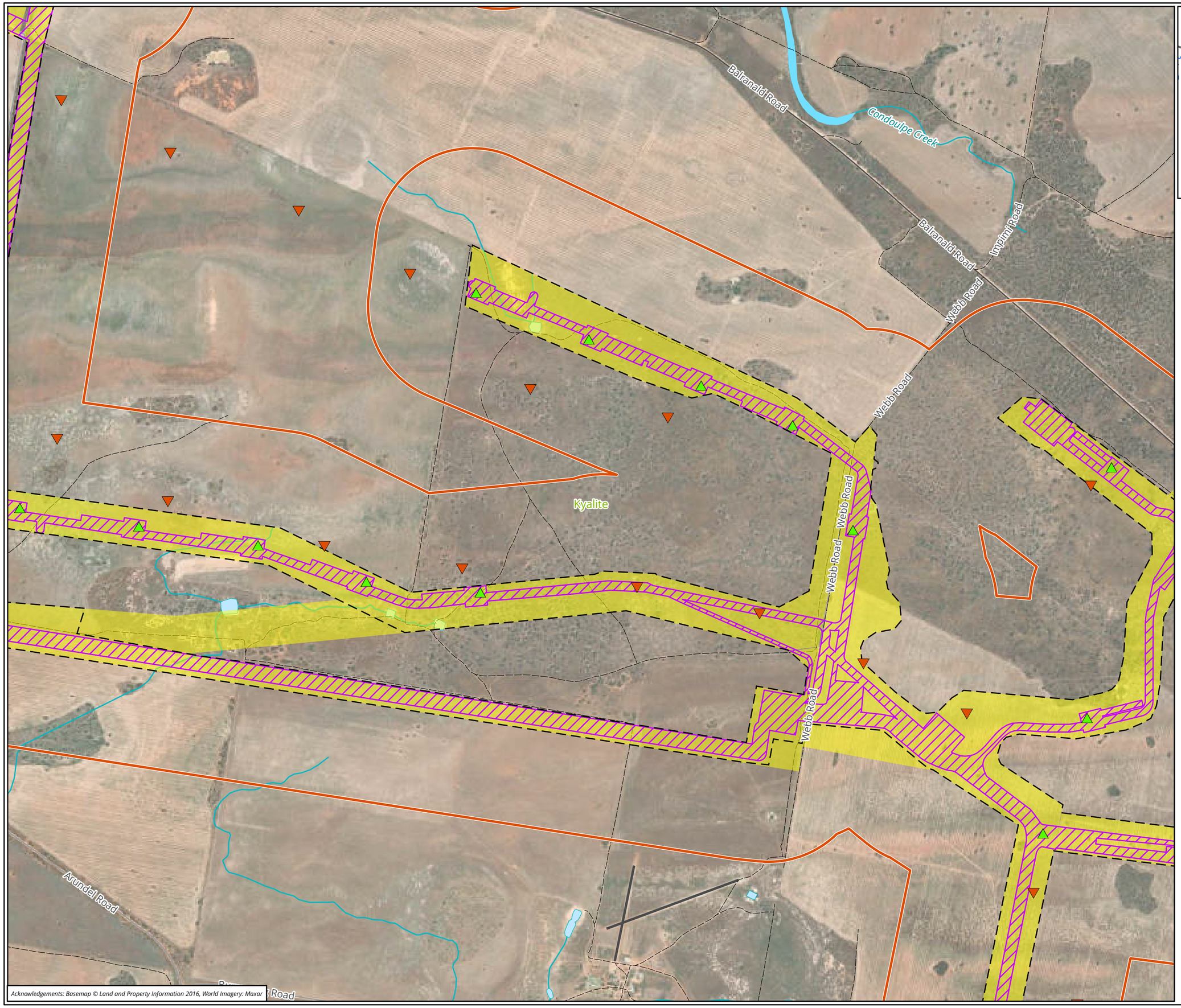
Meters

Scale: 1:18,000 @ A3

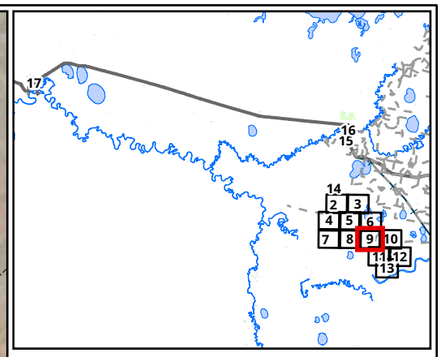
Coordinate System: GDA2020 MGA Zone 54

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

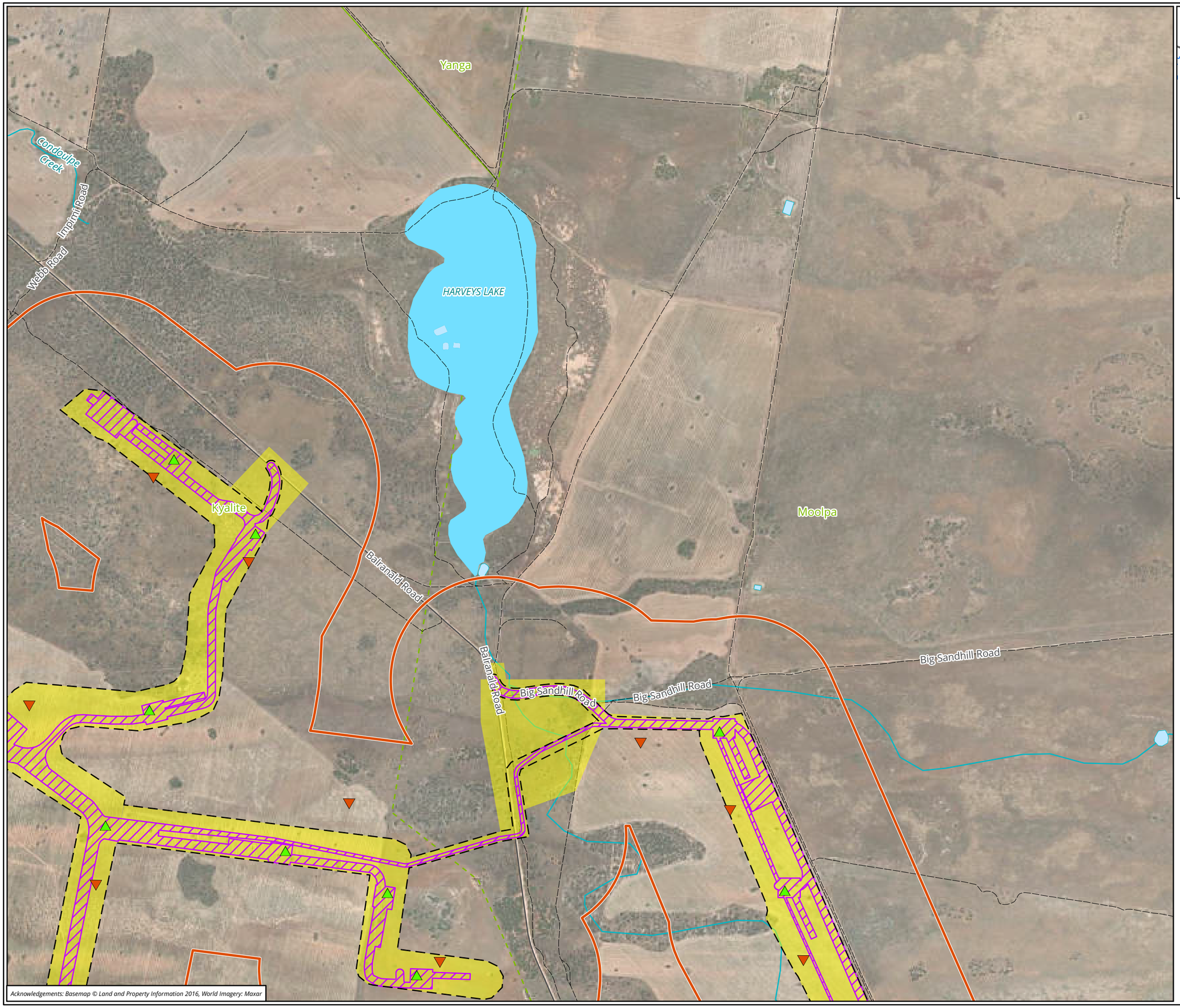
Scale: 1:18,000 @ A3

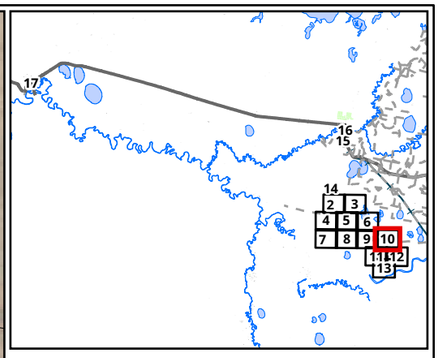
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 15 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 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

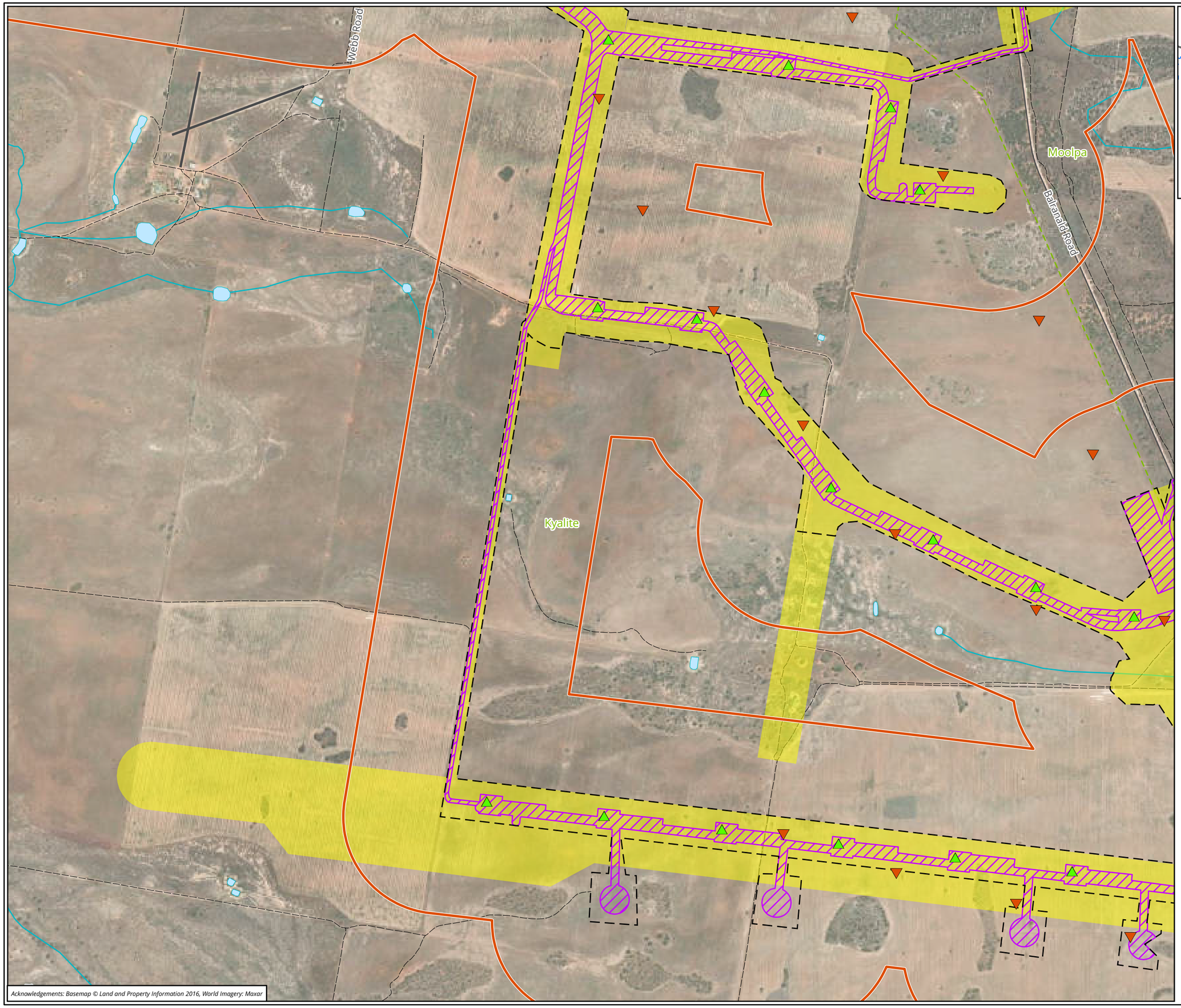
Meters

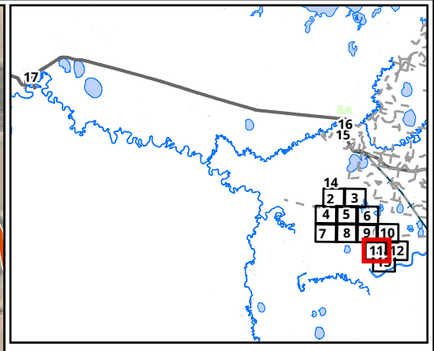
Scale: 1:18,000 @ A3

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

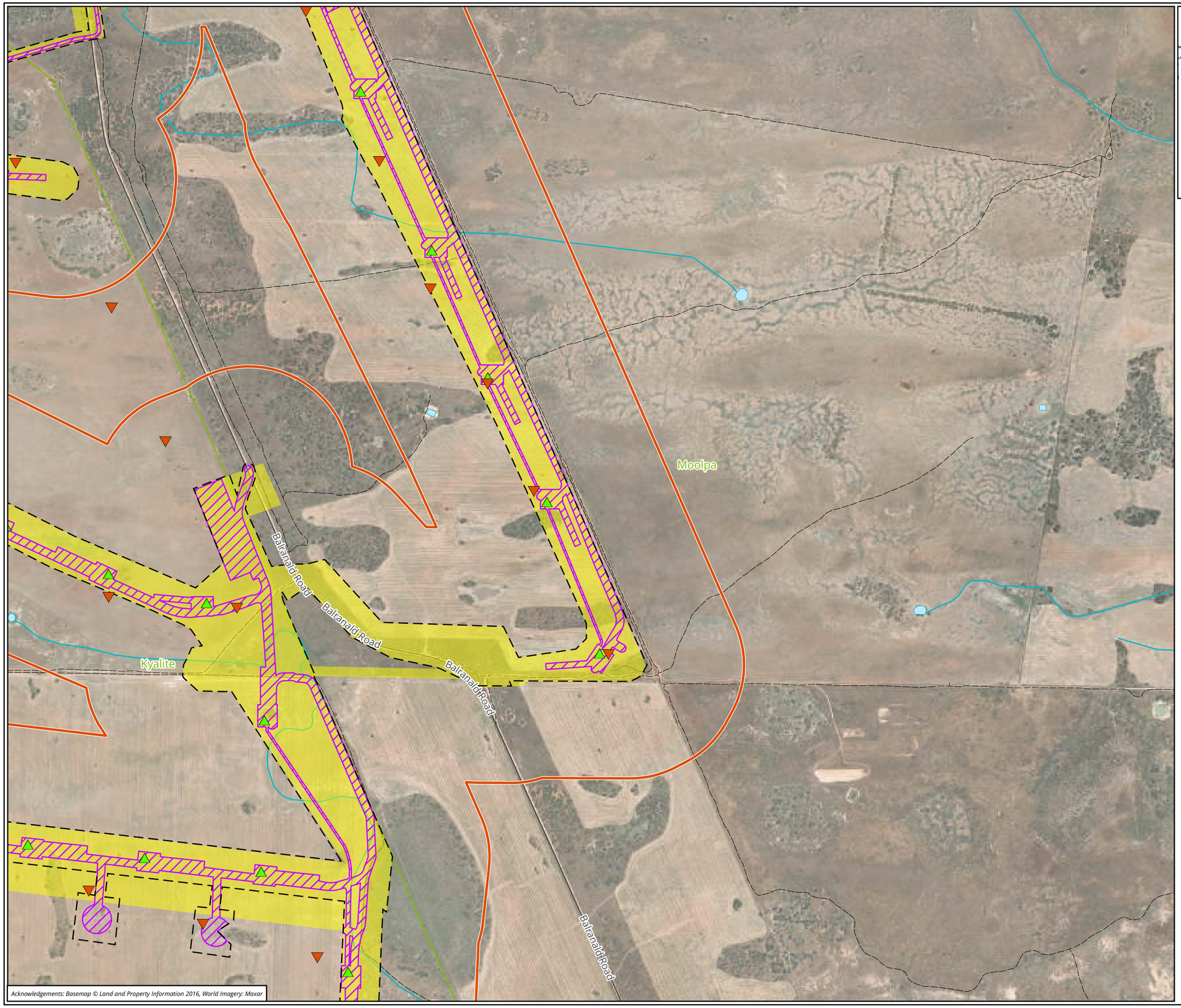
0 230 460 690 920 N

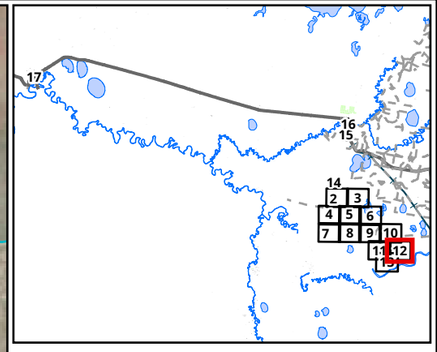
Meters
Scale: 1:18,000 @ A3
Coordinate System:
GDA2020 MGA Zone 54

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

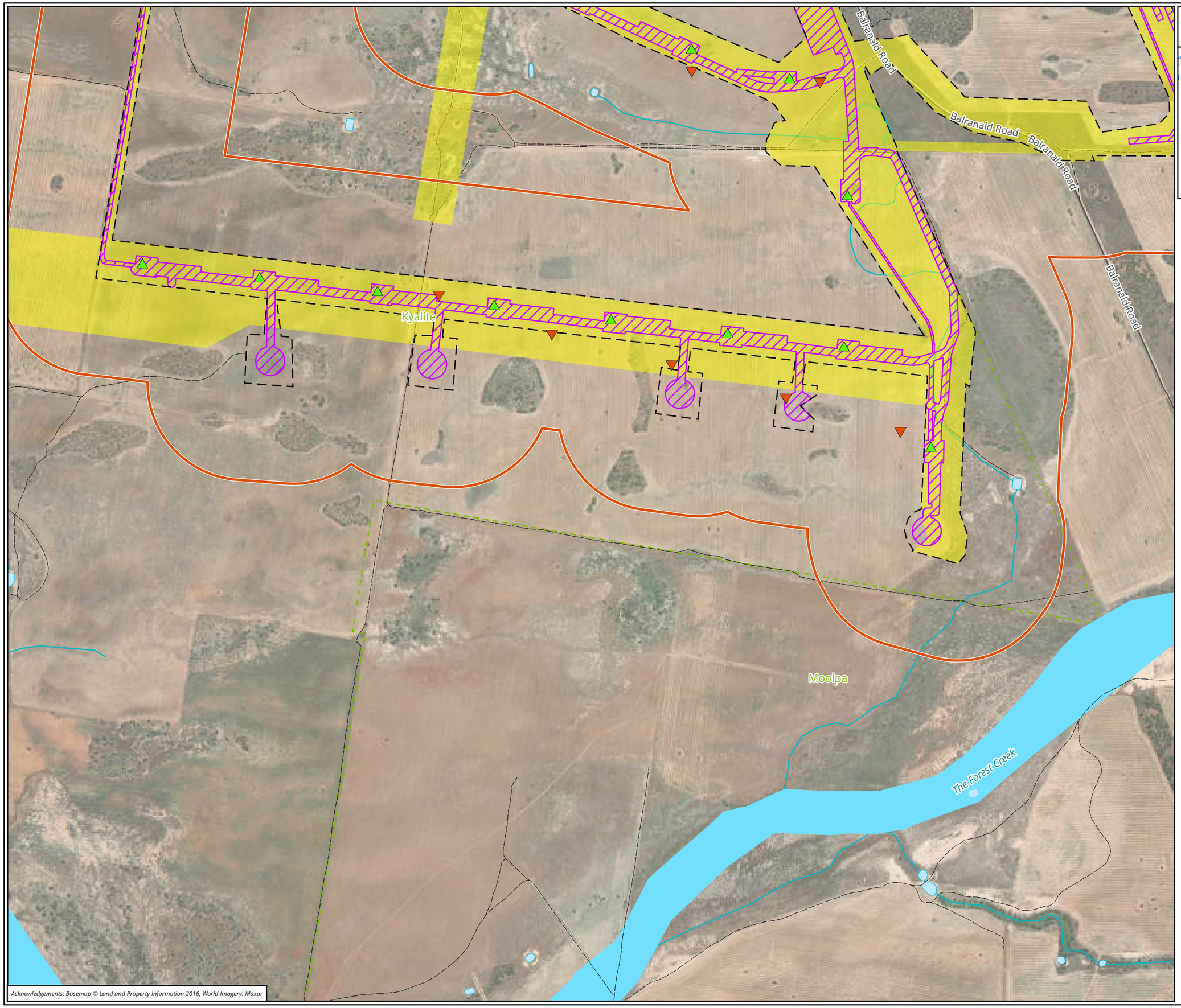
Figure 16.12 Alternate options and avoidance

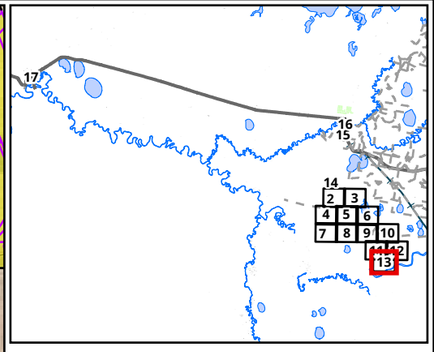
0 230 460 690 920 N

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

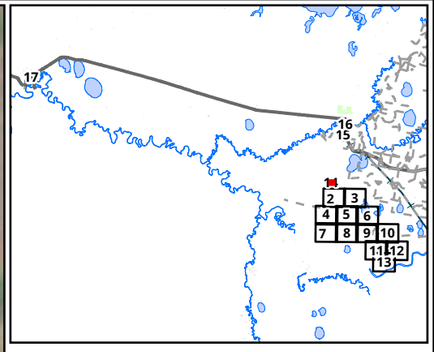
Meters

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

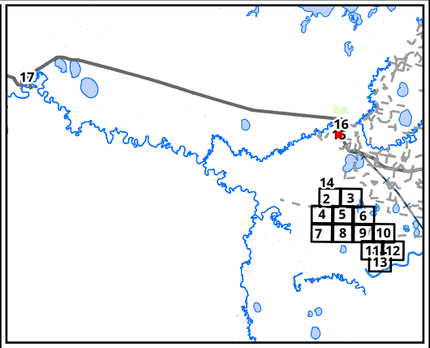
Scale: 1:2,000 @ A3

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

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



Legend

- Subject land
- Development footprint

Figure 16.15 Alternate options and avoidance

0 25 50 75 100 N

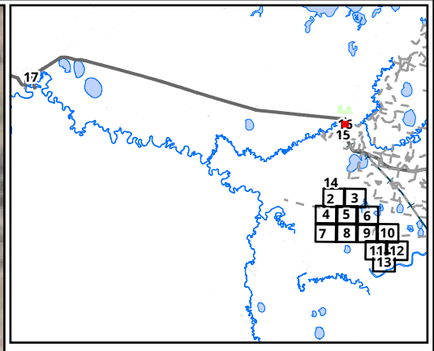
Meters

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

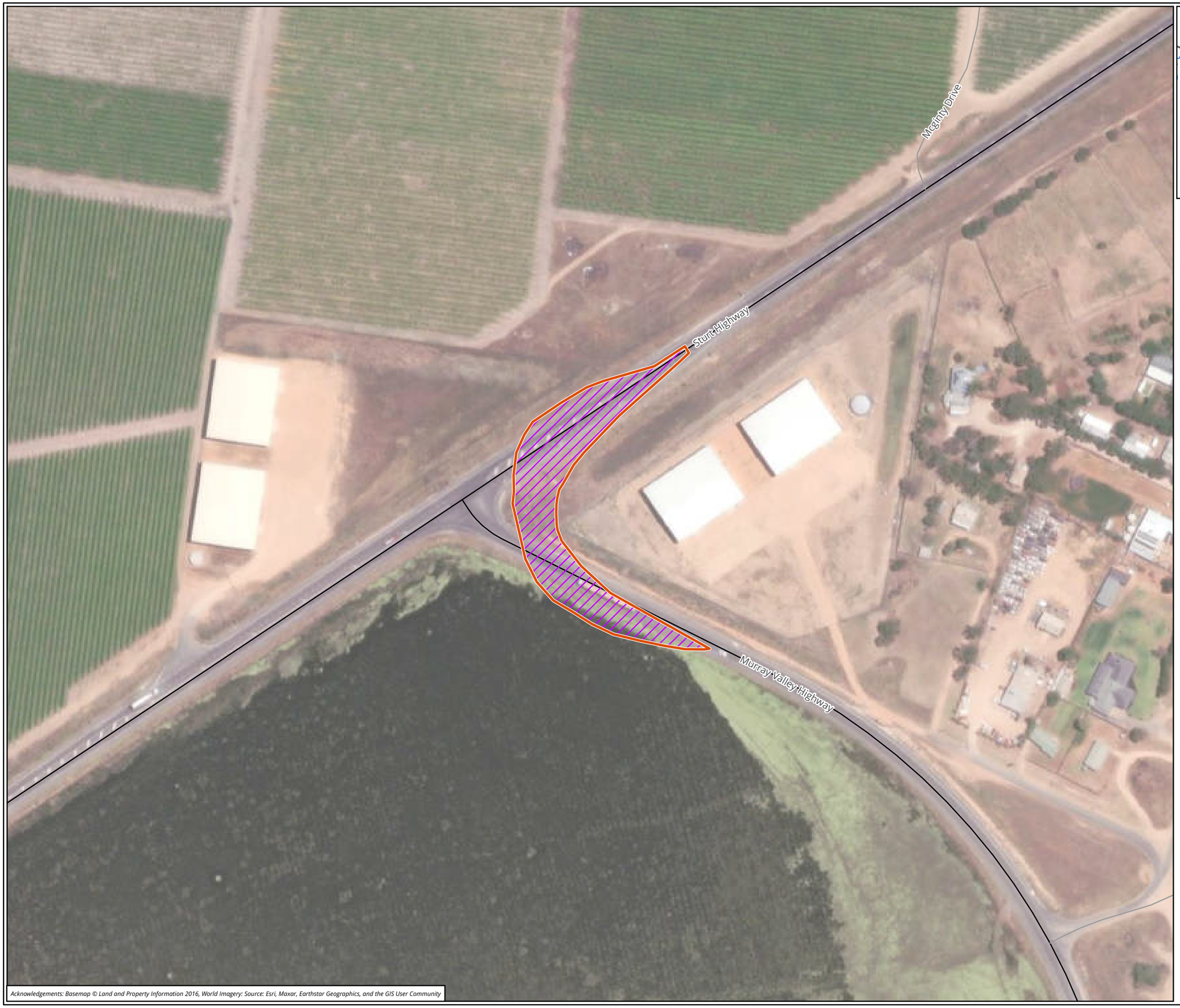
Scale: 1:2,000 @ A3

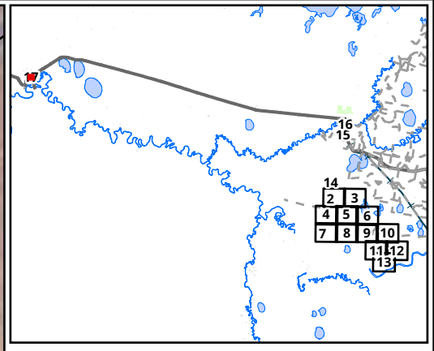
Coordinate System: GDA2020 MGA Zone 54

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

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





Legend

- Subject land
- Development footprint

Figure 16.17 Alternate options and avoidance

0 25 50 75 100 N

Meters

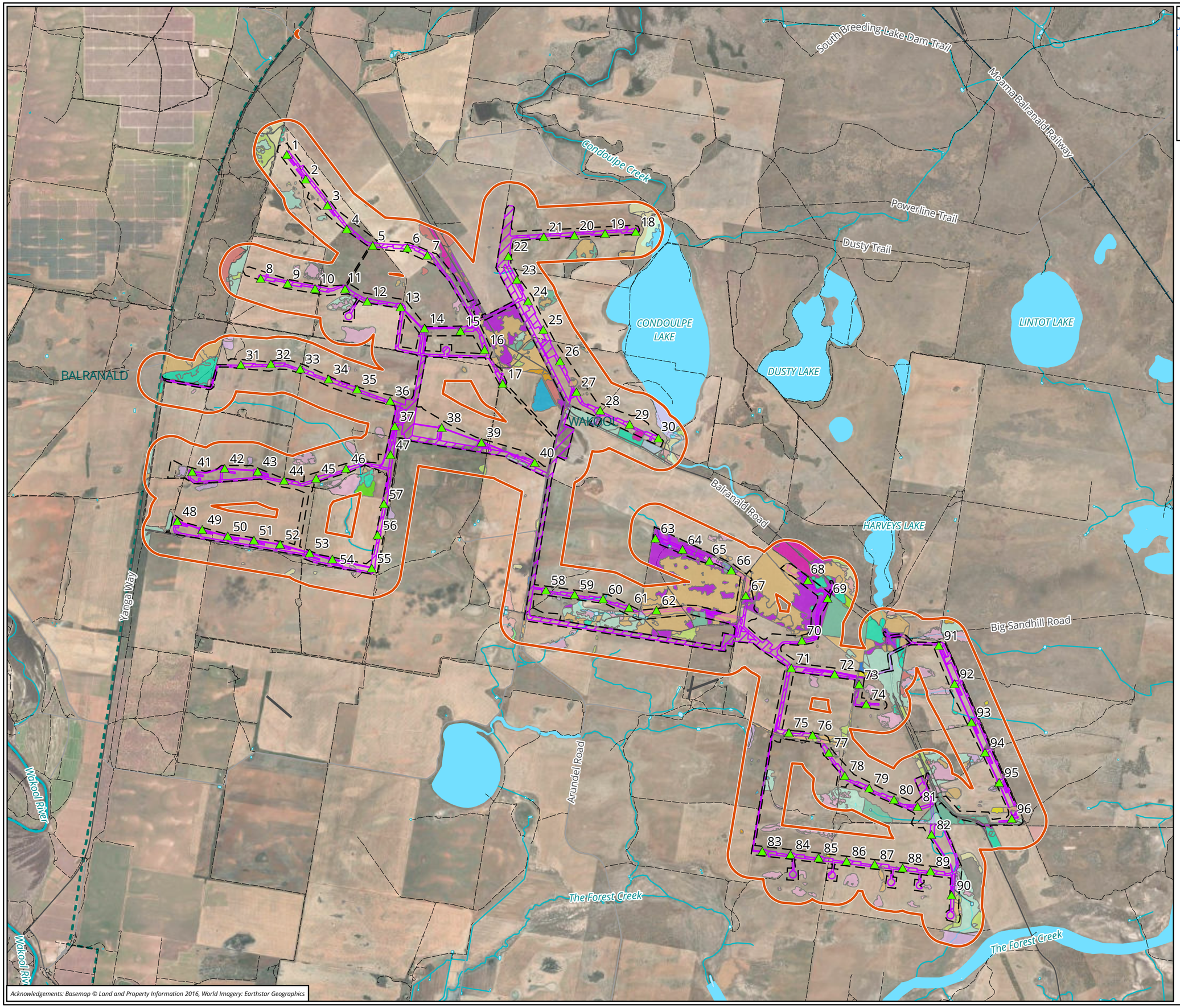
Scale: 1:2,000 @ A3

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

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



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

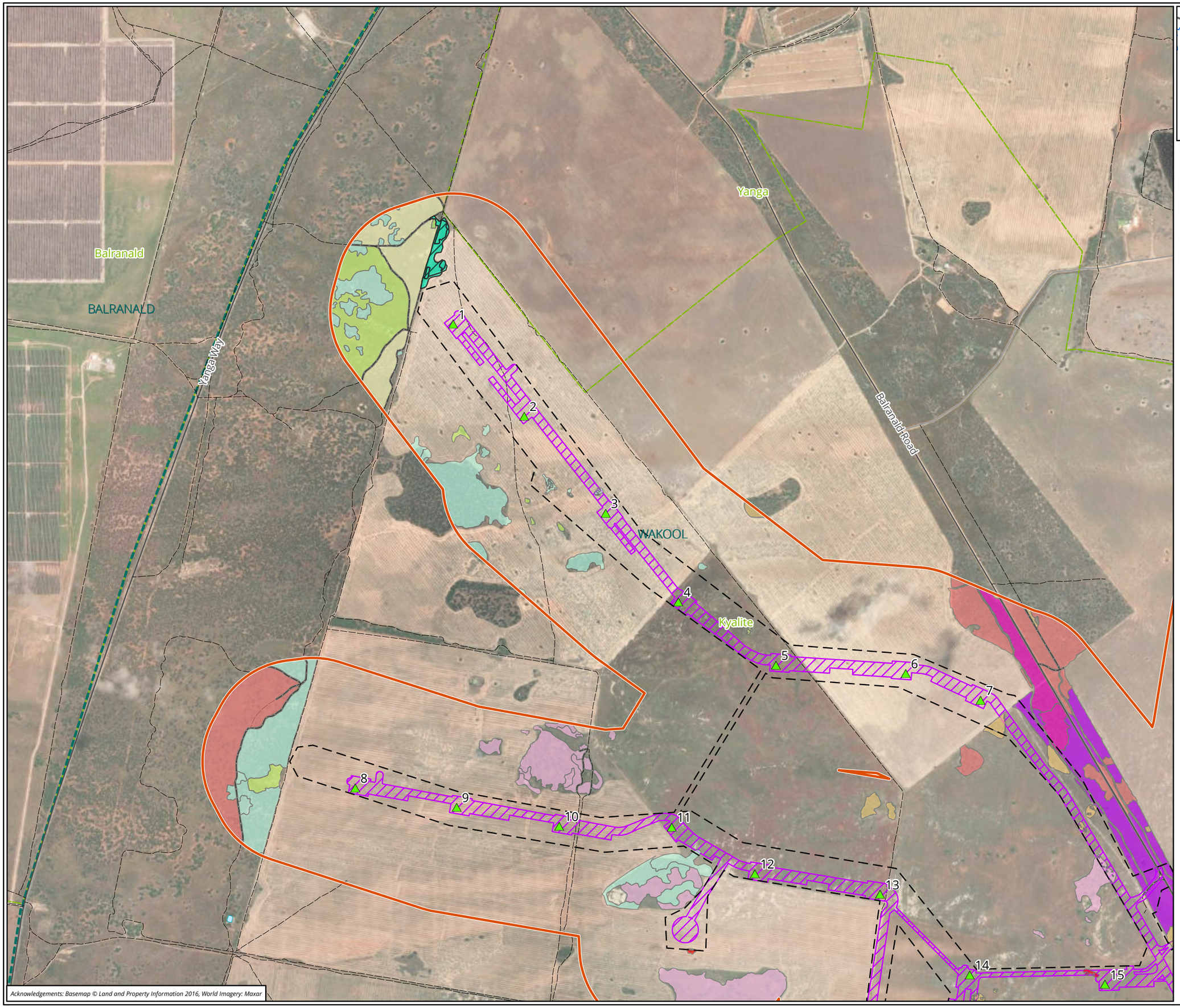
Scale: 1:75,000 @ A3

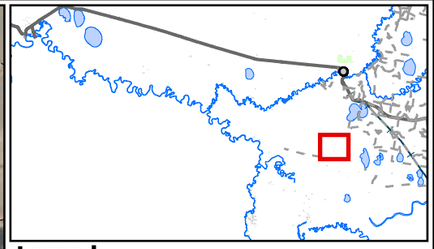
Coordinate System: GDA2020 MGA Zone 54

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 - 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

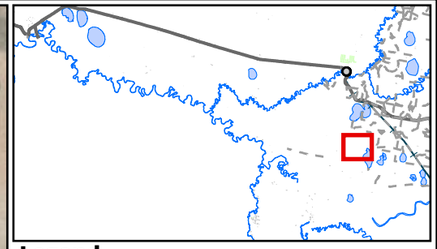
Scale: 1:20,000 @ A3

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

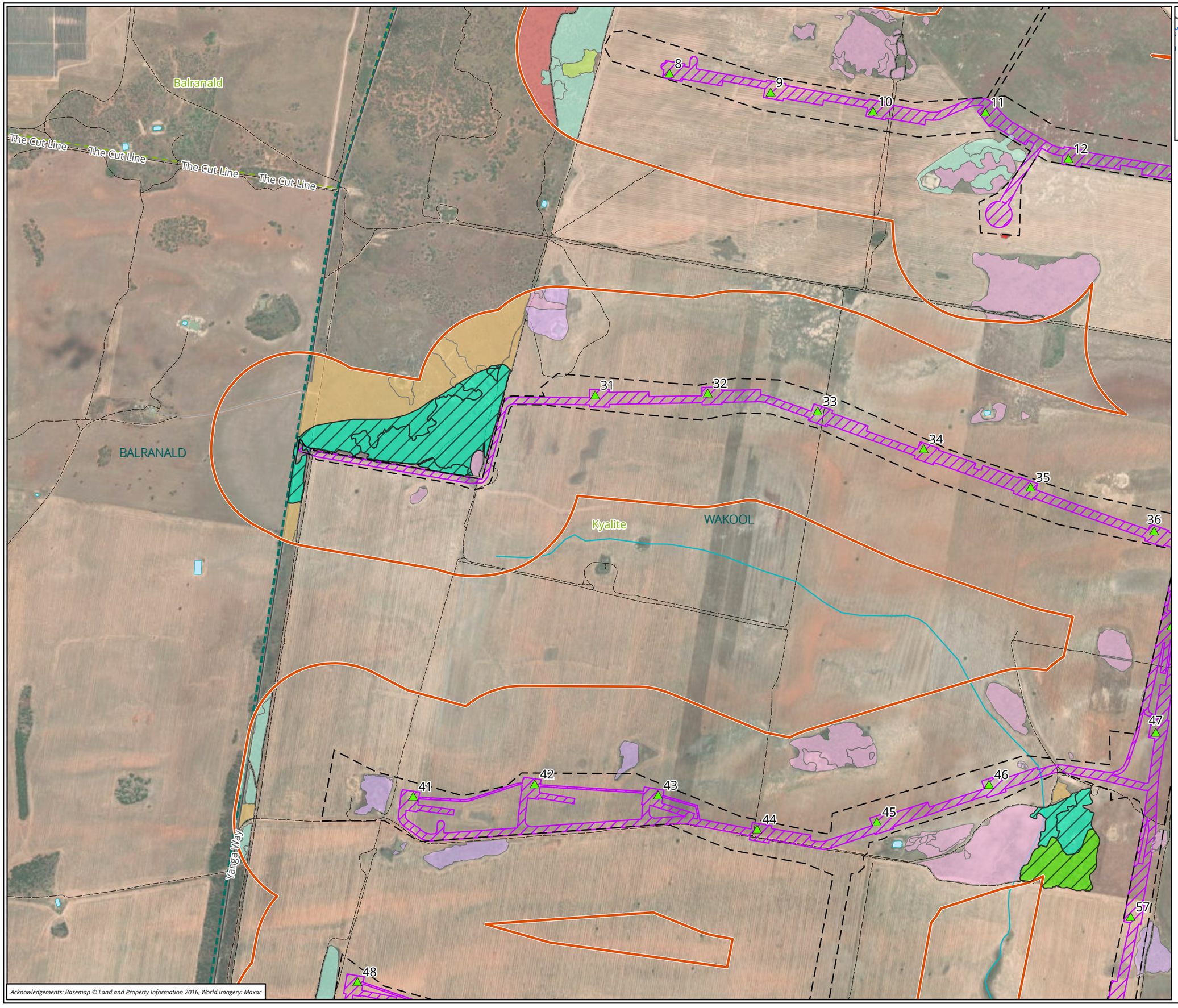
Coordinate System: GDA2020 MGA Zone 54

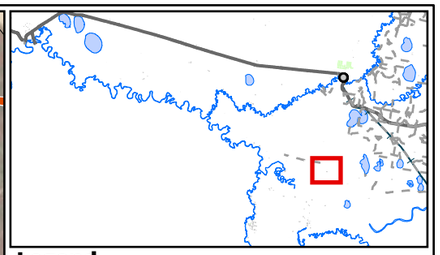
N

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

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

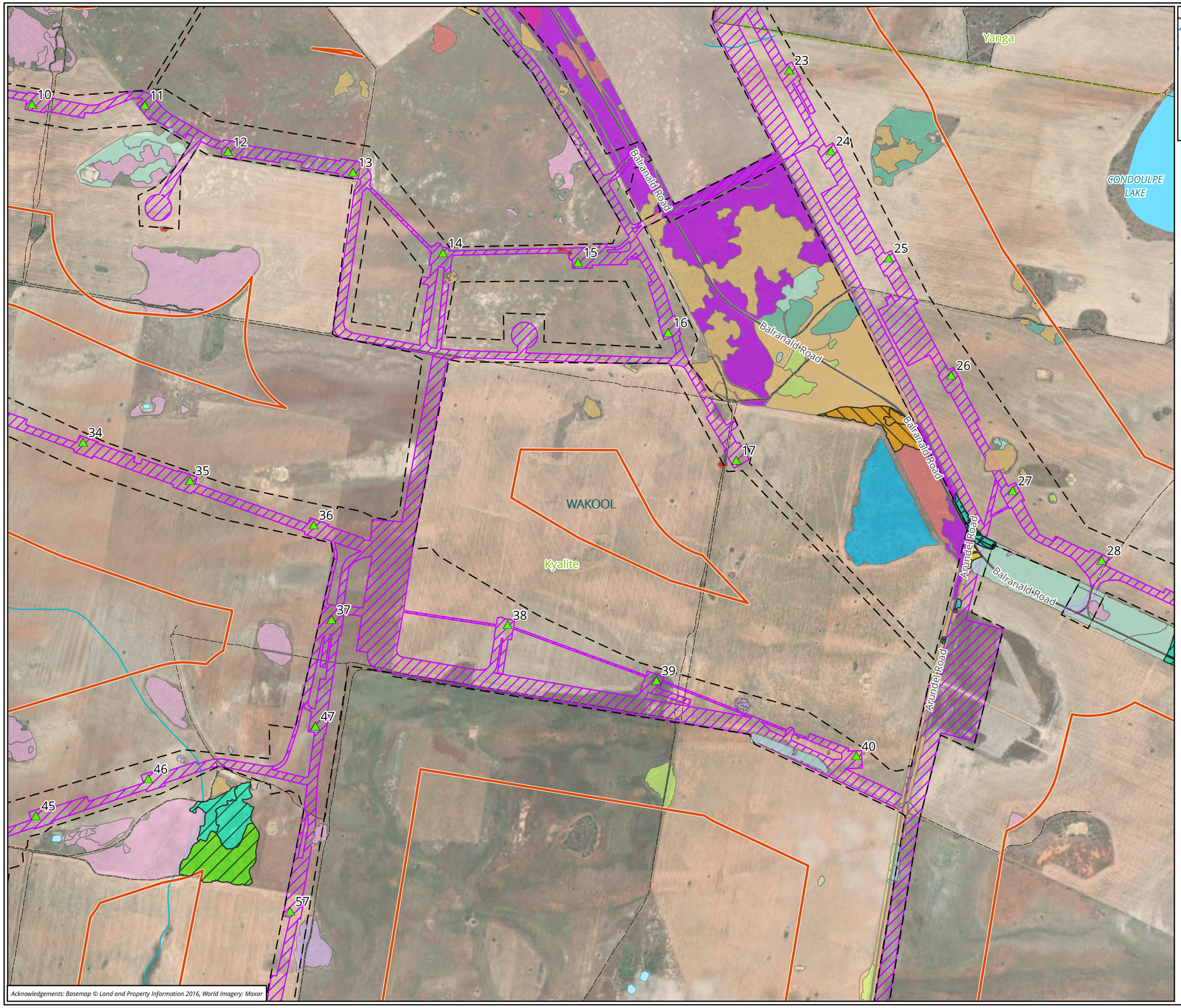
Scale: 1:20,000 @ A3

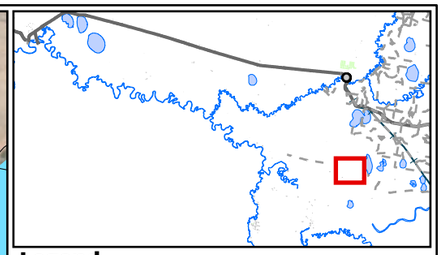
Coordinate System: GDA2020 MGA Zone 54

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

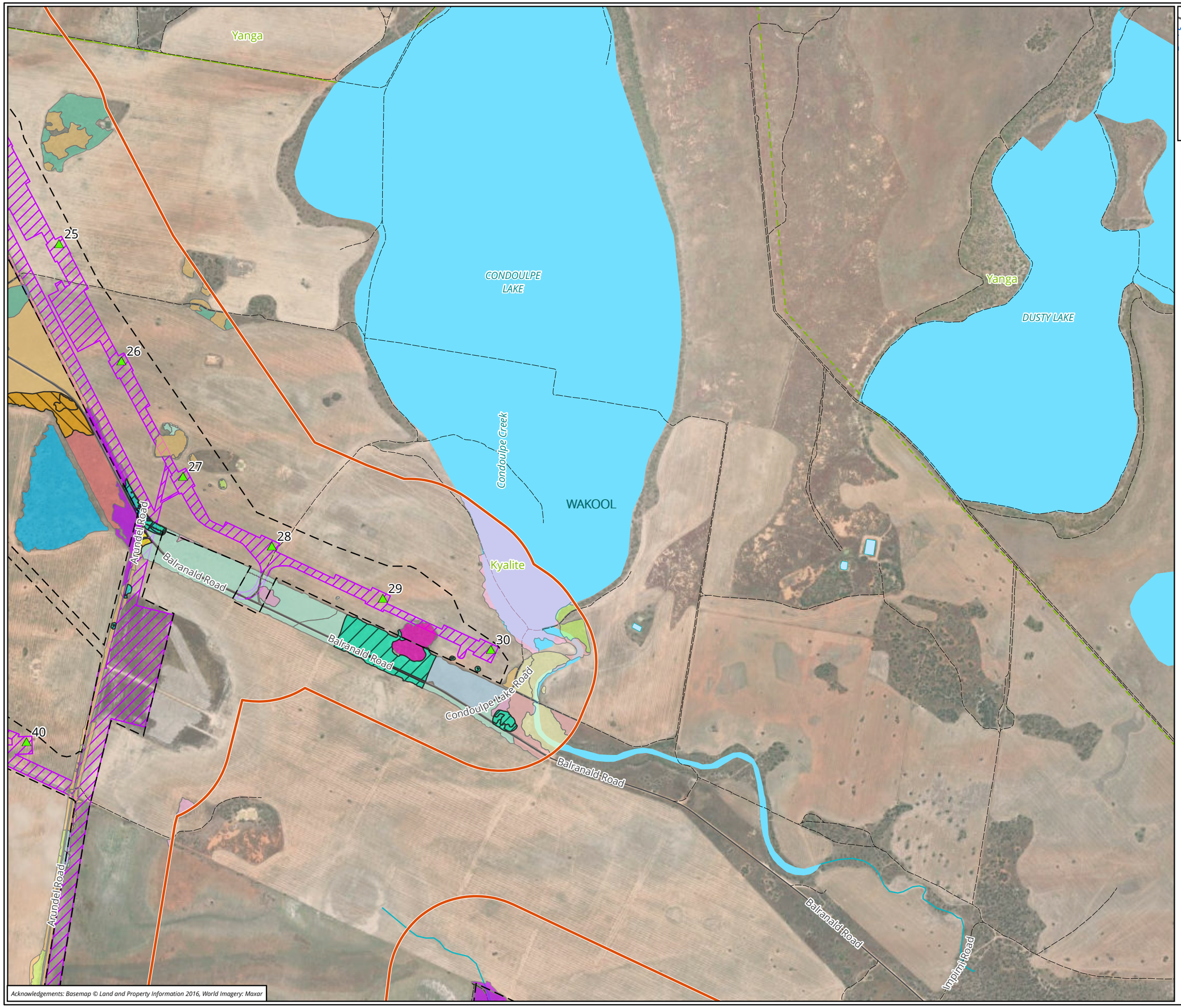
Scale: 1:20,000 @ A3

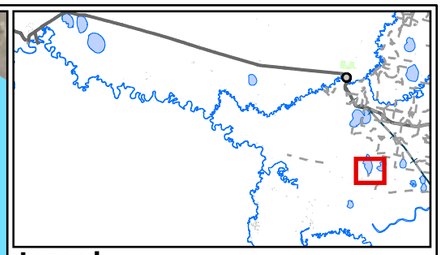
Coordinate System: GDA2020 MGA Zone 54

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

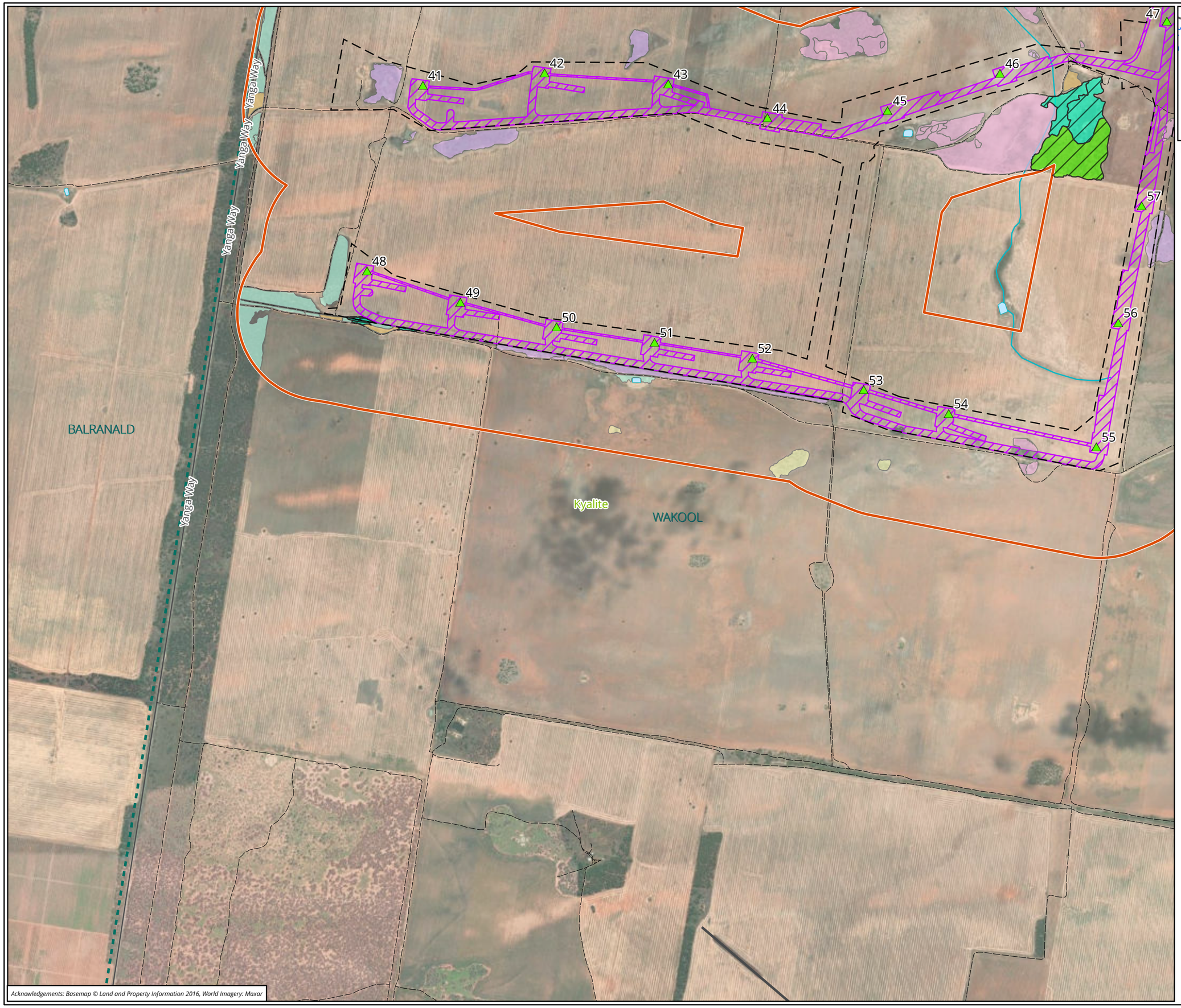
Scale: 1:20,000 @ A3

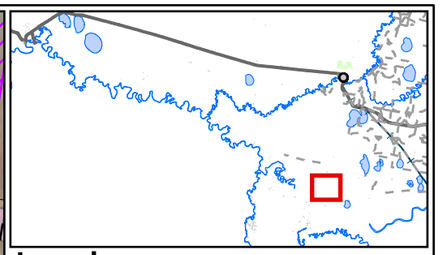
Coordinate System: GDA2020 MGA Zone 54

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

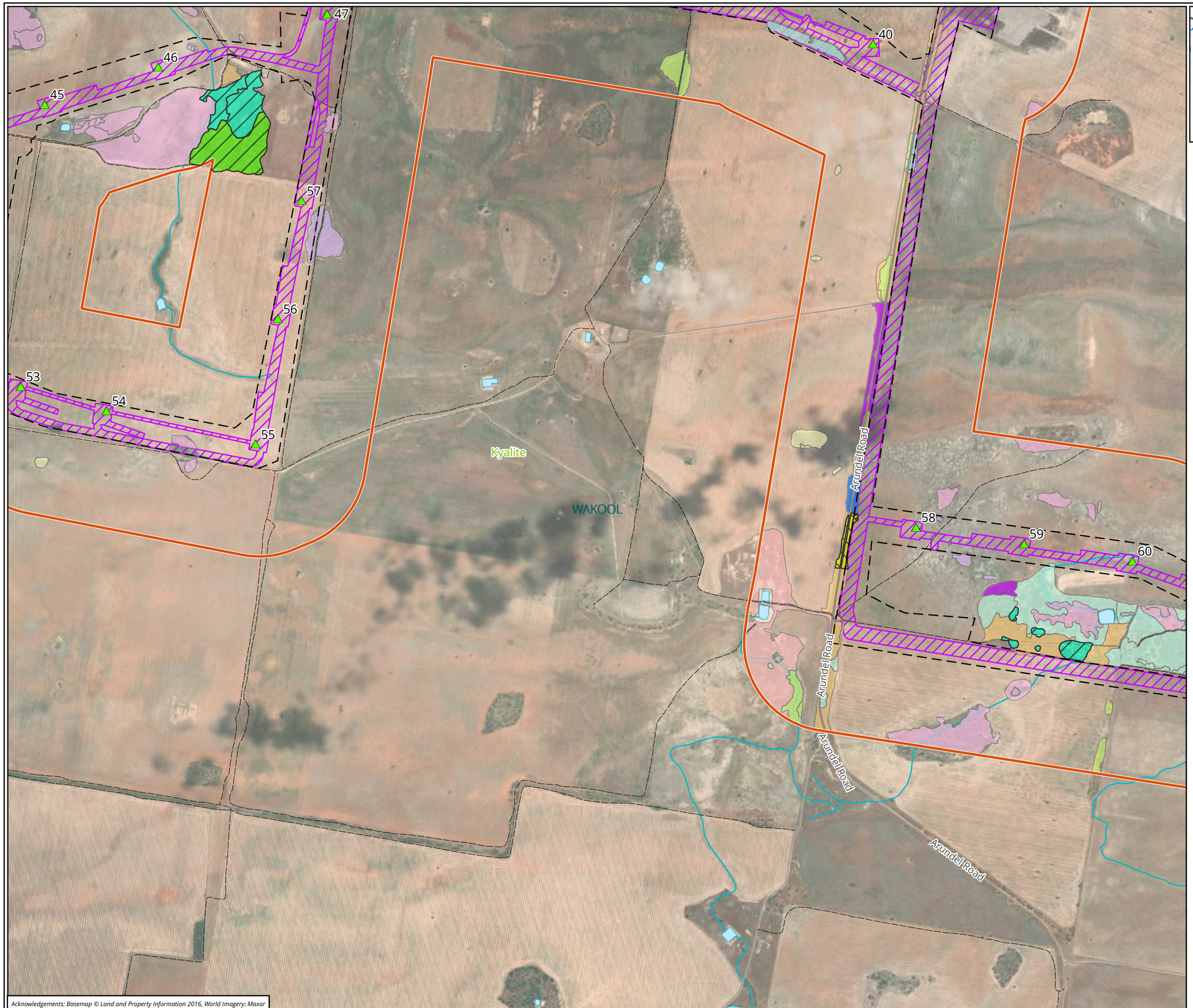
Scale: 1:20,000 @ A3

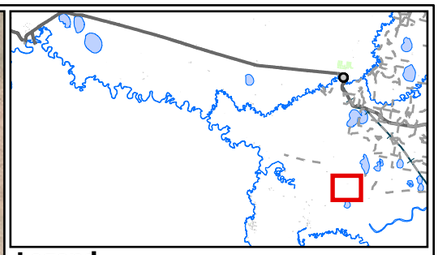
Coordinate System: GDA2020 MGA Zone 54

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

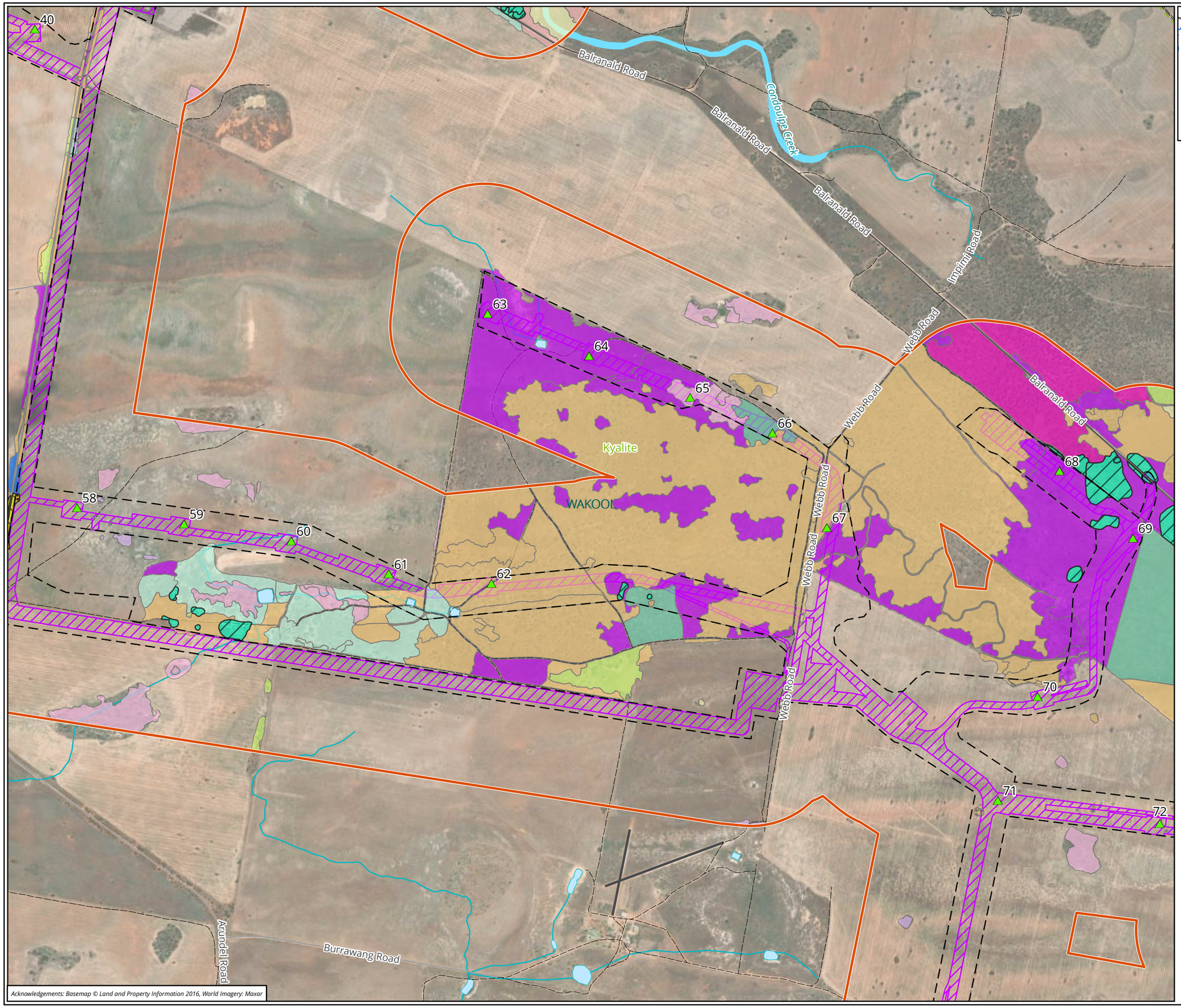
Scale: 1:20,000 @ A3

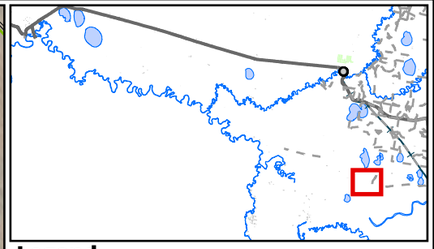
Coordinate System: GDA2020 MGA Zone 54

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 - 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

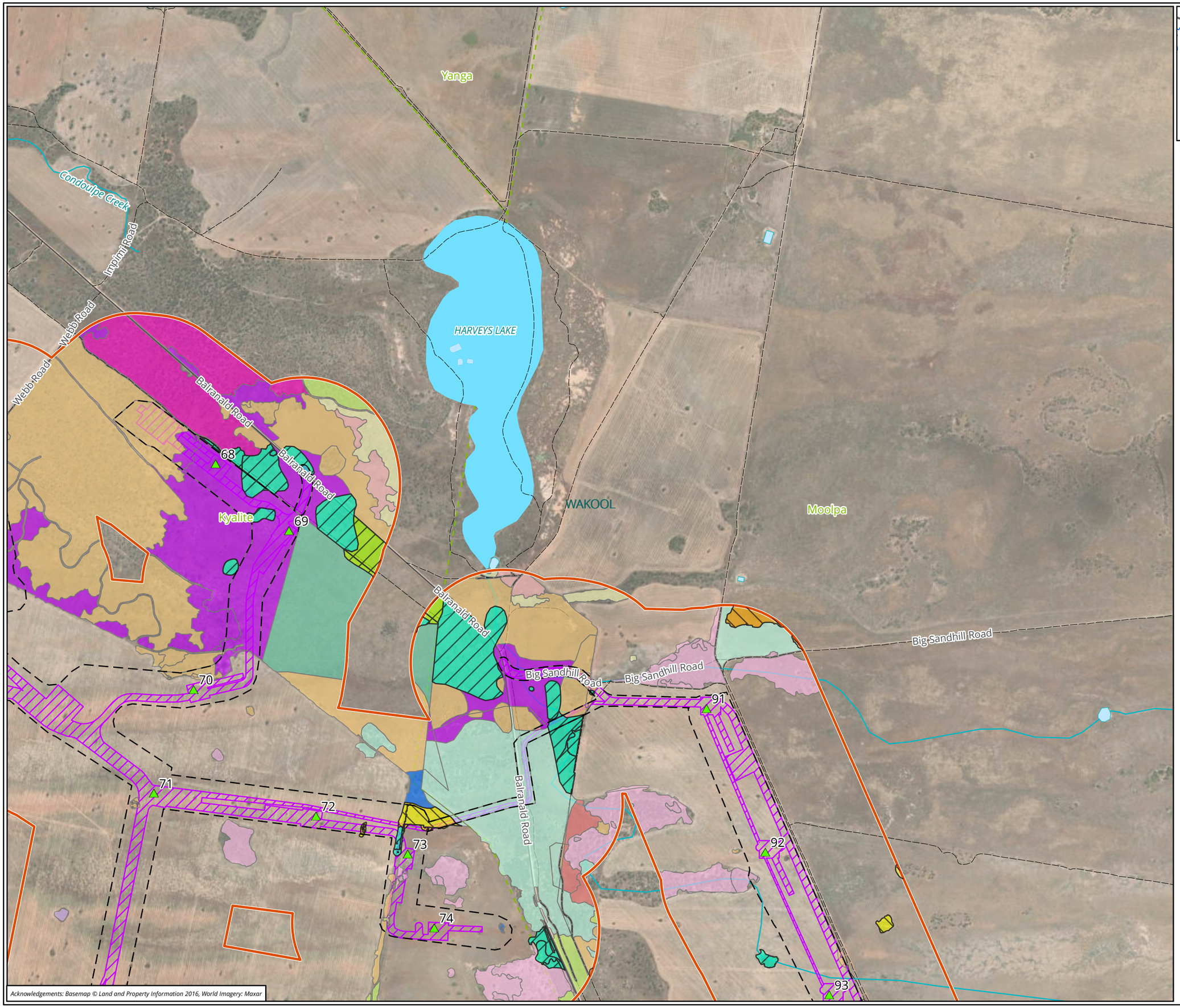
Scale: 1:20,000 @ A3

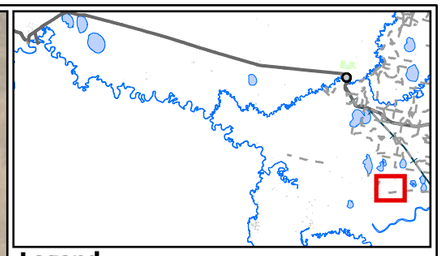
Coordinate System: GDA2020 MGA Zone 54

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 - 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

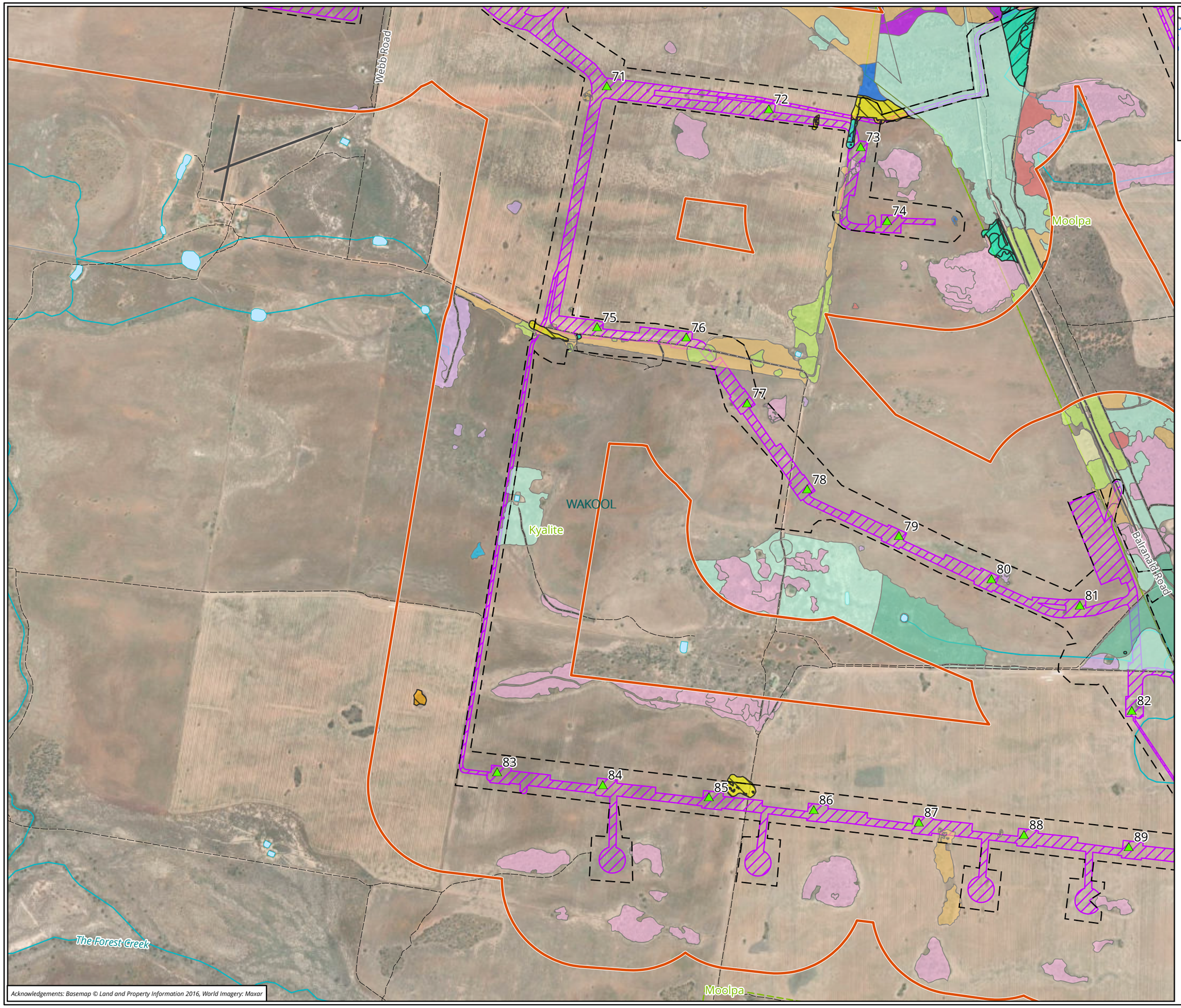
Scale: 1:20,000 @ A3

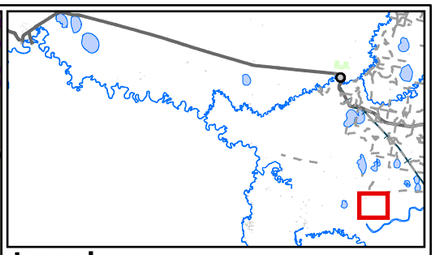
Coordinate System: GDA2020 MGA Zone 54

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
- 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

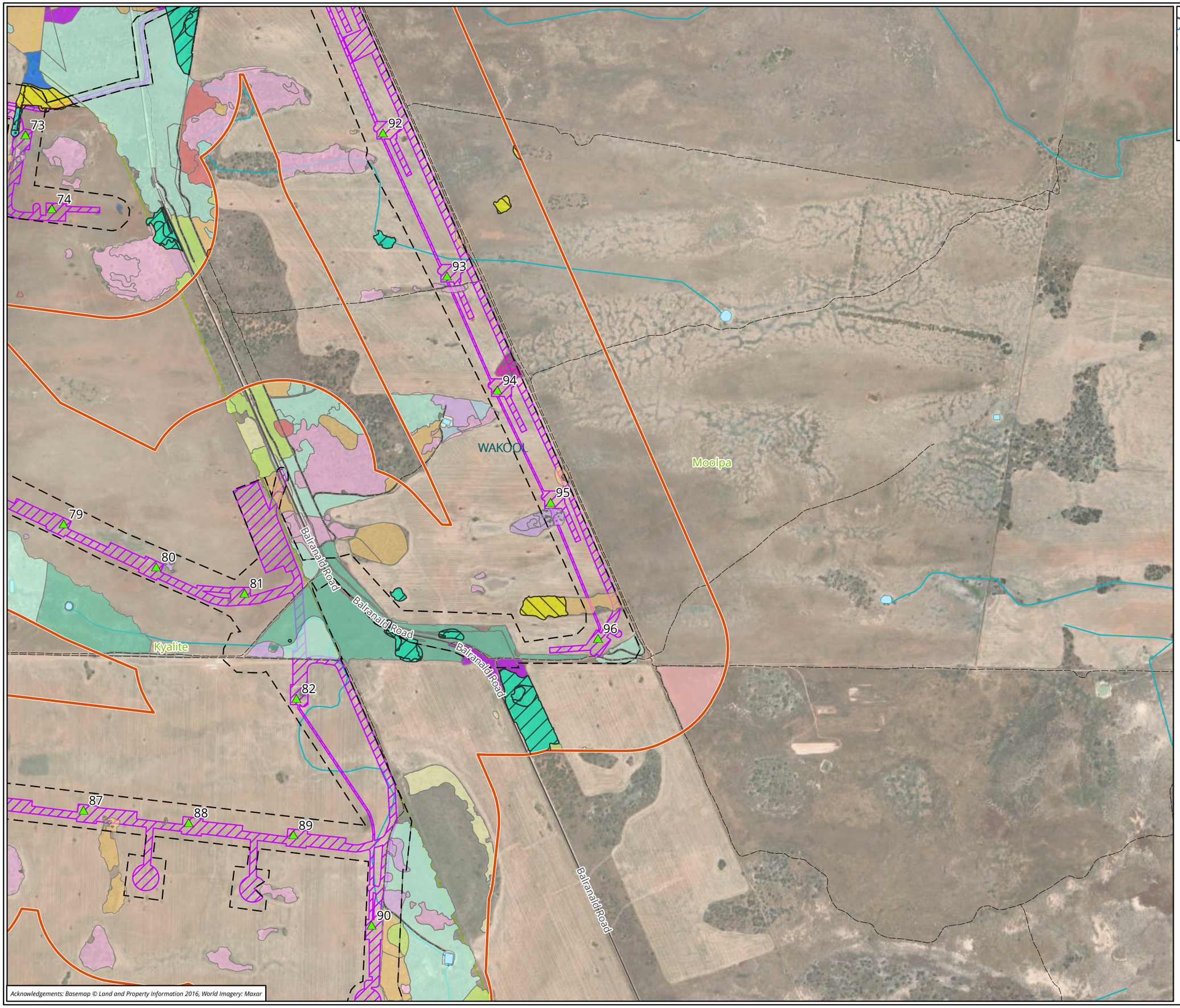
Coordinate System: GDA2020 MGA Zone 54

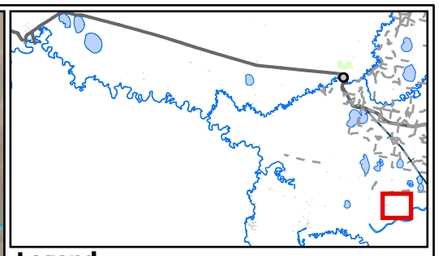
N

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

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
- 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

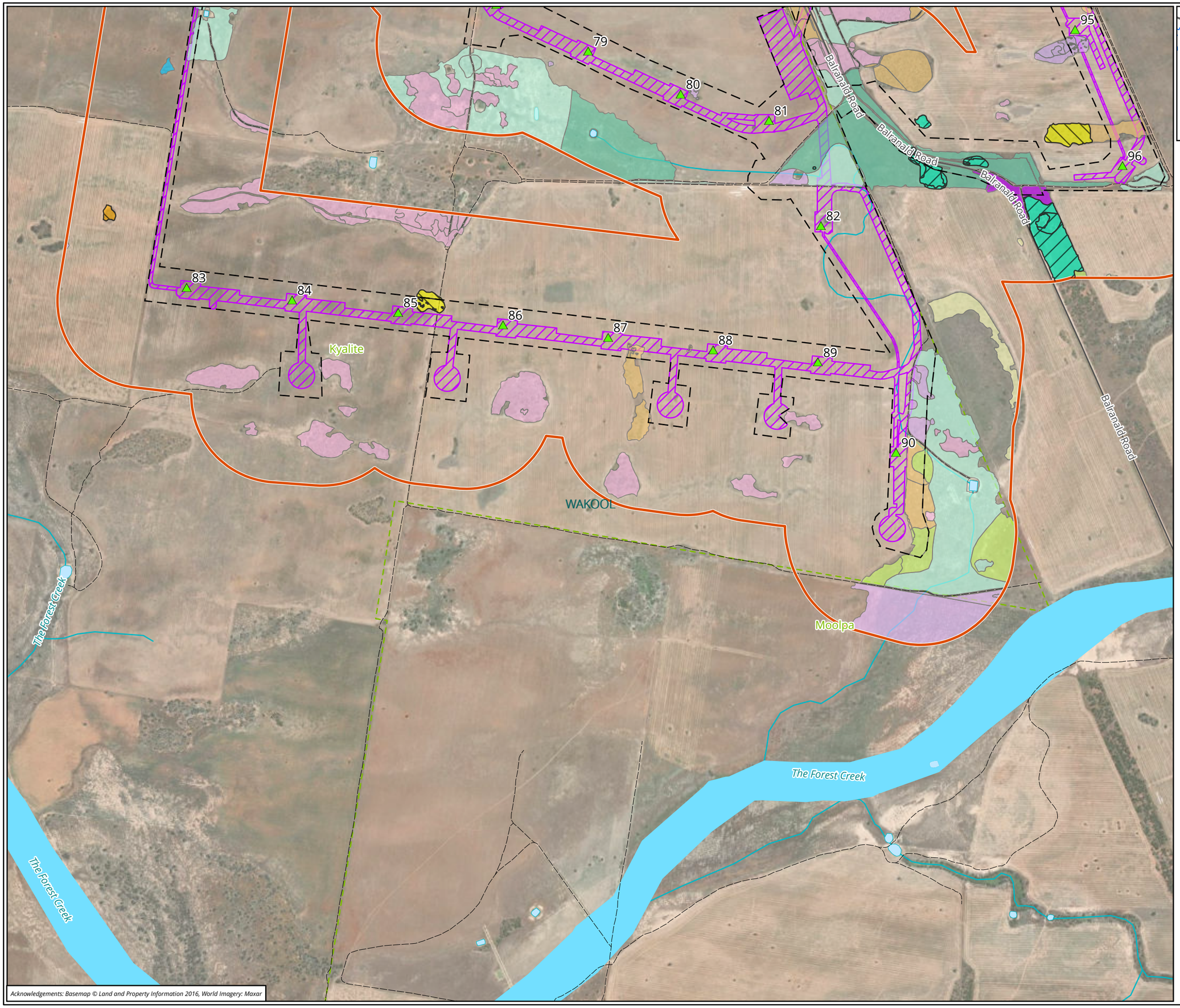
Coordinate System: GDA2020 MGA Zone 54

N

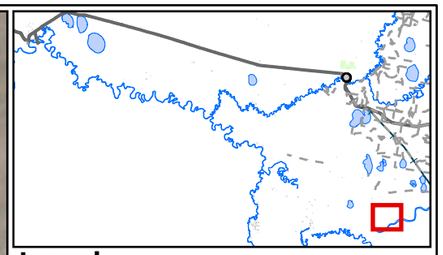
biosis

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

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

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

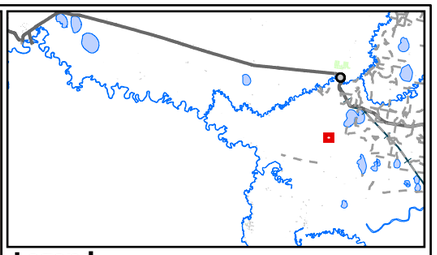
Scale: 1:20,000 @ A3

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
- 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

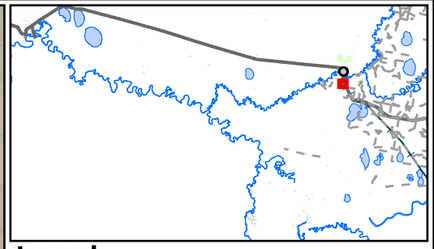
Coordinate System: GDA2020 MGA Zone 54

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

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



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

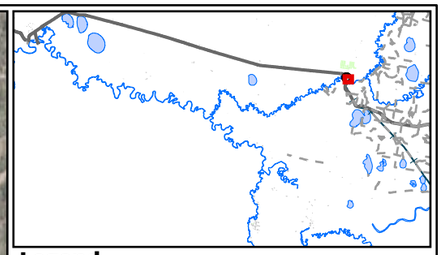
Coordinate System: GDA2020 MGA Zone 54

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

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



Legend

- Subject land
- Development footprint
- Wind turbine generators

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

Figure 17.16 Final development footprint

0 50 100 150 200

Meters

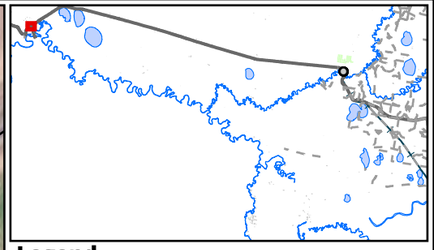
Scale: 1:5,000 @ A3

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
- 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

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

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 60 and Table 61 and Table 63, 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 60 below.

Table 60 Summary of direct impacts to vegetation

Zone	PCT	TEC	Area impacted (ha)	VI Score	Future VI score
VZ1	16_Moderate		3.80	53.4	0.0
VZ2	16_Low		0.36	28.6	0.0
VZ3	16_DNG		2.78	14.7	0.0
VZ4	16_Paddock Trees		0.21	10.7	0.0
VZ5	21_Moderate	Sandhill Pine Woodland	1.17	64.6	0.0
VZ6	23_Moderate	*Acacia melvillei* Shrubland	2.03	62.7	0.0
VZ7	57_Moderate		0.19	61.1	0.0
VZ8	58_High		0.85	91.0	0.0
VZ9	58_Moderate		20.91	74.8	0.0

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Zone	PCT	TEC	Area impacted (ha)	VI Score	Future VI score
VZ10	58_DNG		31.01	17.7	0.0
VZ11	58_Paddock Trees		0.07	46.6	0.0
VZ12	163_Moderate		3.58	59.5	0.0
VZ13	170_Moderate		4.67	59.5	0.0
VZ14	170_Low		0.56	29.7	0.0
VZ15	170_DNG		3.50	15.0	0.0

Table 61 Summary of direct impacts species credit habitat or individuals

Species	Biodiversity Risk Weighting	Area impacts (ha)
Atriplex infrequens	2.0	14.34 (Assumed present)
Crowned Gecko	2.0	8.74 (Assumed present)
Painted Burrowing Frog	2.0	17.92 (Assumed preset)
Pink Cockatoo	2.0	37.40

Table 62 Summary of direct impacts to Scattered Paddock 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**

Hollow-bearing tree removal

A total of 70 mapped hollow-bearing trees are expected to be removed by the project.

8.1.2. Assessment of direct impacts

An assessment of the unavoidable direct impacts as a result of the project is provided in Table 63 below.

Table 63 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: • 0.85 ha of vegetation in high condition with a VI Score of 91.0 • 36.35 ha of vegetation in moderate condition states with VI Scores ranging from 74.8 to 53.4 • 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 • Impacted vegetation is generally patchy, highly fragmented and edge effected, being in the most part surrounded by cleared agricultural cropping land. 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: • Approximately 79% of the subject land (8,500 ha of 10,800 ha total area). • Approximately 86% of the development corridor (1,800 ha of 2,100 ha total area). • Approximately 90% of the development footprint (690 ha of 768 ha total area). 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. 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. A total of 70 mapped HBTs are expected to be impacted by the project. No additional areas, outside the 75.68 ha of native vegetation, will be directly impacted, such as areas of clearing of mowing for asset protection zones. All such areas have been captured in the project's 'development footprint'. 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.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Direct impact	Description of impact	Assessment of impact
Removal of BC Act TECs	The project will result in the removal of the following TECs: • 2.03 ha of *Acacia melvillei* Shrubland, and 5 Yarran individuals occurring as scattered paddock trees • 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. 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: • 37.40 ha of native vegetation supporting forage and assumed breeding habitat for Pink Cockatoo. The project will result in the removal of the known habitat for the following threatened fauna ecosystem credit species: • 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. Pink 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. 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 Pink 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. 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

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

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. 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) Regent Parrot was commonly recorded by Nature Advisory during their biodiversity surveys within the subject land. As outlined in Section 6.1.3 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. 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). As with Pink 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 unimpacted by the

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Direct impact	Description of impact	Assessment of impact
		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. 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). 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 and species	The project will result in the removal of the assumed habitat for: • *Atriplex infrequens* – 14.34 ha (assumed) • Crowned Gecko – 8.74 ha (assumed) • Painted Burrowing Frog – 17.92 ha (assumed)	The three species assumed present are considered to have a low likelihood of occurrence within the subject land based on information provided in BioNet and the TBDC. Presence has been assumed in all cases as surveys were unable to be completed in accordance with the required guidelines (refer Section 4.3.1). Impacted areas assume habitat is present in all condition states for each species, which is unlikely to be the case and microhabitats have not been considered in the assumed presence polygons. As such the area of habitat that could foreseeably be considered to support potential habitat for the species is smaller than the areas of habitat considered for impacts and offsets. Painted Burrowing Frog assumed habitat has been restricted to the 1% AEP flood extent, which is considered to be the maximum flood level likely to occur within the subject land during the life of the project. This is considered suitable the frog, if present, would require a substantial rainfall and flood event to utilise habitats within the subject land. Further assessment of the suitability of the habitats present within the subject land to support Painted Burrowing Frog, by the approved BAM Species Expert Dr John Read is likely, and impacts are expected to be reduced.
Loss of hollow bearing trees	The project will result in the removal of 17 mapped hollow-bearing trees in vegetation patches The project will result in the removal of 53 mapped hollow-bearing trees that meet the BAM definition of Scattered Paddock Trees	The project will remove up to 17 mapped hollow-bearing trees from within vegetation patches (based on GPS location within 10 m of the development footprint), and a further 53 hollow-bearing scattered paddock trees. A total of 70 mapped hollow-bearing trees are expected to be removed by the project. It is likely that more hollow-bearing trees will be impacted, as many Black Box and Black Oak trees support small hollows that have not been mapped. Targeted hollow tree mapping occurred in areas most likely to be subject to indirect impacts to tree dependent species, and was not undertaken across the entire development footprint..

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Direct impact	Description of impact	Assessment of impact
		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. Substantial efforts have been made to avoid impacts to these important habitat resources including those outlined in Table 59 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 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). 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 59 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.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

8.2. Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 64 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. A detailed risk assessment, evaluation of movement of waterbird species through the subject land has occurred. The results of this assessment have included rigorous avoidance, minimisation and mitigation measures to ensure connectivity remains within the broader landscape. Refer to section 8.3.3.

© Biosis 2023 | Leaders in Ecology and Heritage Consulting

Table 64 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. • 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. • 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs. • 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.	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. • 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.	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.	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

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. • 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). There is the potential for impacts such as the spread of weeds along new access tracks creating new edges within large, more intact, vegetation patches, however weed incursions will be managed through regular weed control as part of the CEMP and OEMP.
Reduced viability of adjacent habitat due to noise, dust or light spill	• 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. • 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs. • 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. Most substantial during construction.	Temporary and permanent	Construction and operation	Low-Moderate. It is predicted that the adjacent habitat may be impacted way by noise, dust, vibration and light spill, during construction and operation. Dust is likely to be an issue for vegetation adjacent to existing (i.e. Balranald Road and Arundel Road) and newly created access tracks, and dust suppression and/or sealing of these areas will be required. 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. However, there is some consideration of the noise produced by operational turbine continuing to impact upon fauna species utilising maintained habitats. Studies have indicated that narrow space foraging bats have been found to have a decreased presence of 50% within 80 -450 m of wind turbines, due to rotor noise, although open space foragers and edge space foragers where

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
						not shown to have any decrease in habitat use due to turbines (Ellerbrook et al. 2022). With an increase in wind speed, rotor speed increases and therefore noise. As wind speed increased a decrease in activity for forest bats near turbines was recorded due to increased noise (Ellerbrook et al. 2024). In birds ongoing noise from operational wind turbines has been shown to decrease breeding success, chick survival, displacement of individuals and reduce quality of foraging habitat (Tolvanen et al. 2023). Turbine noise has been found by Teff-Seker et al. (2022) to alter the natural acoustic environment by introducing airborne load broadband sound which is within the hearing range of a variety of fauna, including most bird species. It has been shown that noise pollution affects species demography and may promote habitat avoidance. The paper goes on to note that turbine size does not correlate with noise level, as smaller turbines are actually noisier for their size, because the rotational speed of the blade tips is faster, and because more research and resources have been invested in reducing noise from large turbines. Therefore the larger turbines proposed for the project may result in comparatively less impacts. Furthermore there may be a potential benefit of the noise being generated by the turbines reducing potential collisions from birds. However, despite the large size of the operational site, significant areas of commensurate habitat will remain in the immediate locality, that can continue to be utilised by fauna species, away from noise

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
						impacts, or away from the most substantial areas impacted. Buffers have been established between known nest locations and operational turbines, and as such nesting is unlikely to be substantially impacted by operational noise. Less mobile species have the potential to be more impacted than other more mobile species, however the large areas of unaffected habitat that will remain will still reduce the significance of the potential impacts. Operational (non-aviation) lighting systems will be designed to minimise light spill onto adjacent retained habitats. Aviation lighting is addressed further below. Impacts of this nature will be managed via best practices outlined in a BMP and CEMP or similar. Improve and maintain principles will apply within the BMP to ensure retained areas of adjacent habitat do not decline or are subjected to adverse impacts. Ongoing monitoring will ensure any unexpected impact are realised early on (if they occur), rectified, and measures put in-place to minimise the possibility of reoccurrence.
Transport of weeds and pathogens from the site to adjacent vegetation	• All PCT / vegetation zones • All ecosystem credit species assumed present. • Known threatened fauna species habitat. • Avoided Bitter Quandong population.	Within the retained vegetation surrounding the final development footprint within an approximate 30 m – 50 m	Ongoing for the life of the project. Highest potential for occurrence is during construction.	Temporary and permanent	Construction and operation	Low-moderate. Weeds occurring within the disturbance footprint are consistent with those occurring within adjacent vegetation to be retained. However there is likely to be a substantial increase in traffic movement through the subject land during the construction phase of the project, and an ongoing increase in traffic through operation. This increase in vehicle

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
	• Avoided *Austrostipa metatoris* population. • Avoided *Acacia melvillei* Shrubland and Sandhill Pine Woodland TECs. • 10 Mile, Lillas Dam & Yards, 19 Mile Balranald-Moulamein Road TSRs. • Avoided hollow-bearing trees.	buffer, and potentially along watercourses.				movements, with many vehicles coming from other construction sites, has the potential to spread novel weed species tin the subject land and strict biosecurity protocols will need to be established and adhered to prevent outbreaks of weeds. Biosecurity measures will be outlined in the BMP and CEMP or similar. During both the construction and the operational phases of the project regular monitoring and management (weed control) will occur within retained areas adjacent to the disturbance footprint.
Increased risk of starvation, exposure and loss of shade or shelter	• All ecosystem credit species assumed present. • 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 .	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. • Known threatened fauna species habitat.	Within the retained vegetation surrounding the final development footprint within an approximate	Ongoing for the life of the project.	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.

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
		30 m – 50 m buffer, as well as an additional 45 m (approx. half a blade length) from the end of the turbine blades.				Where nests occur adjacent to the construction and operational footprint of the wind farm indirect impact may occur. No impacts to Important Mapped Areas of habitat will occur as a result of the project. Impacts will be managed and mitigated through monitoring and adaptive management via the 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 extent *Austrostipa metatoris* identified within the subject land.	Areas of known and potential habitat within retained vegetation.	Ongoing for the life of the project.	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. Principles 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
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. Grazing is still active in some areas. Current cropping regimes are expected to be reduced marginally through the reduction of cropping land during the construction phase. Furthermore Windlab have assessed the potential risk from herbicide spray drift, which was concluded to be negligible as a result of the project.
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. 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

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
						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 Pink Cockatoo and Regent Parrot.	Adjacent to the development footprint and potential into the broader landscape.	Ongoing for the life of the project. 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*. A change in the general landscape, such that an 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	Low. Fire mitigation procedures will be implemented for the future development and the project will not result in a substantially increased risk of fire. There may be a minor reduction in the frequency of fire that would ignite from within the subject land, with operational teams more likely to extinguish these types of fires than

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
						would likely occur under the current agricultural management practices. However large fires moving through the site are unlikely to be controlled by operational teams and as such the frequency of these larger, higher intensity, fires is likely to remain unchanged. Any asset protection zones (APZs) required for the project have been included within the direct impact footprint of the development, so indirect impacts relating to the establishment of APZs are not relevant.
Fragmentation of movement corridors	• All ecosystem credit species assumed present. • Known threatened fauna species habitat. • Avoided Bitter Quandong population. • 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. 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 Area, Yanga Nature Reserve and/or Murray	• Yanga National Park, Yanga State Conservation Area, Yanga Nature Reserve comprise a total area of 71,711 ha. Supports River Red Gum forests, Black Box Woodland, Lignum, Shrubland, Nitre Goosefoot Shrubland, Sandhill Pine Woodland EEC, Acacia	Potential indirect impacts associated with movement of species in/out and between conservation areas.	Ongoing for the life of the project.	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 barriers to movements at this landscape scale due to the large perimeter and areas each reserve supports. The portion of the Murray

Indirect impact	Impacted entities	Extent	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
Valley Regional Park	melvillei Shrubland EEC and Myall Woodland EEC. 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) • 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. 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)					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. 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. Additional assessment requested by NPWS in their response to the EIS is provided in Section 8.3.5 below.

Indirect impact – Aviation lighting

Aviation obstacle lighting is required due to the proximity of the subject land to aerodromes and other semi-regular flightpaths. The lighting will result in increased artificial night spill into retained habitats and may potentially attract microbats and/or insect prey into RSA height.

Impacted entities

Nocturnal fauna generally consisting of non-threatened arboreal mammals, nocturnal birds, as well as threatened and non-threatened microbat species. Some potential for impacts to diurnal species, particularly birds.

Extent, frequency and duration

The extent of the lighting impacts will be variable within and across the subject land based on proximity to turbines with lights installed, and level of benefit from shielding. The aviation lighting will comprise low-intensity obstacle lighting on 35 selected turbines at 900 meter intervals. Each turbine will be fitted with two fixed, steady red lights, operating at 200 candela (cd). The intensity of the lighting has been reduced to 200 cd from the international standard of 2000 cd lighting intensity. Shielding has been added such that no more than 5% of the nominal light intensity is emitted at or below 5° below the horizontal, and no light is emitted at or below 10° below horizontal (Aviation Project 2025).

Thirty-two of the total 35 turbines (91 %) proposed to support aviation lights occur outside patches of native vegetation. Three of these turbines are >500 metres from woodland habitat, one of which is >1 kilometre from woodland habitats. A further 14 of the nominated turbines are between 200 – 500 metres from woodland habitats. Eighteen turbines that will support aviation lighting are within 200 meters of native vegetation.

Lighting will be required each night over the life of the wind farm, until such a time as the turbines are decommissioned.

Likelihood and consequences

Plate 8 below illustrates the proposed layout of the aviation lighting. As noted above 91 % of the turbines nominated for lighting installation occur outside patches on native vegetation, however the amount of light spill into adjacent vegetation patches does not directly correlate to proximity to the turbines/lights. This is due to the shielding added to lights that ensures no more than 5% of the nominal light intensity is emitted at or below 5° below the horizontal, and no light is emitted at or below 10° below horizontal. The shielding ensures that the most intense light, from nearest the source, is shielded from the nearest habitat patches, however due to the height of the lights (installed on the turbines' nacelle) multiple light sources may be observable from each patch of retained habitat.

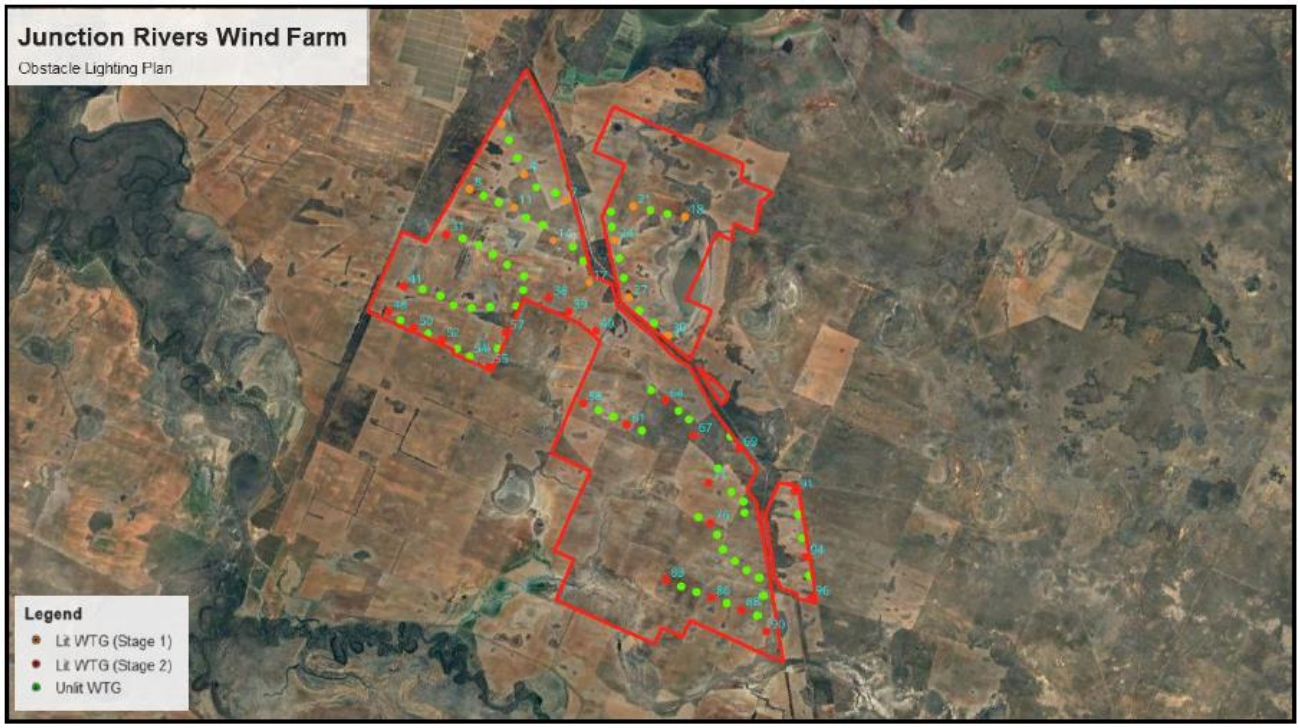


Plate 8 Proposed obstacle lighting layout

To determine the effect that downward light shielding would have on light visibility, a Geodesic Viewshed operation was run on the turbine locations using ArcGIS Pro, Spatial Analyst. The Geodesic Viewshed determines the visibility of an input location (in this case the turbines) from every point on an analysis surface. For this analysis, the 1 arc second resolution Digital Elevation Model (DEM) provided by Geoscience Australia was used as the input surface. Using a DEM as the input surface allows the tool to consider topographic feature that block line of sight between the input features and surface. The tool also considers the curvature of the Earth's surface to limit the maximum visibility range. Additional parameters were configured to simulate the height of the lights and angle of the shielding. Visibility was limited to areas above 5 degrees below the horizontal plane from the specified height the lights will be mounted. Where multiple lights are visible from a single location on the analysis surface, the result is provided as a count showing the number of turbine lights that can been seen from that location, providing an indication of lighting 'hotspots'. Lighting is assumed to have less impact, the further from the source and observation location is. A 5 kilometre outer radius limit has been used to negate the influence of lights from turbines beyond this distance.

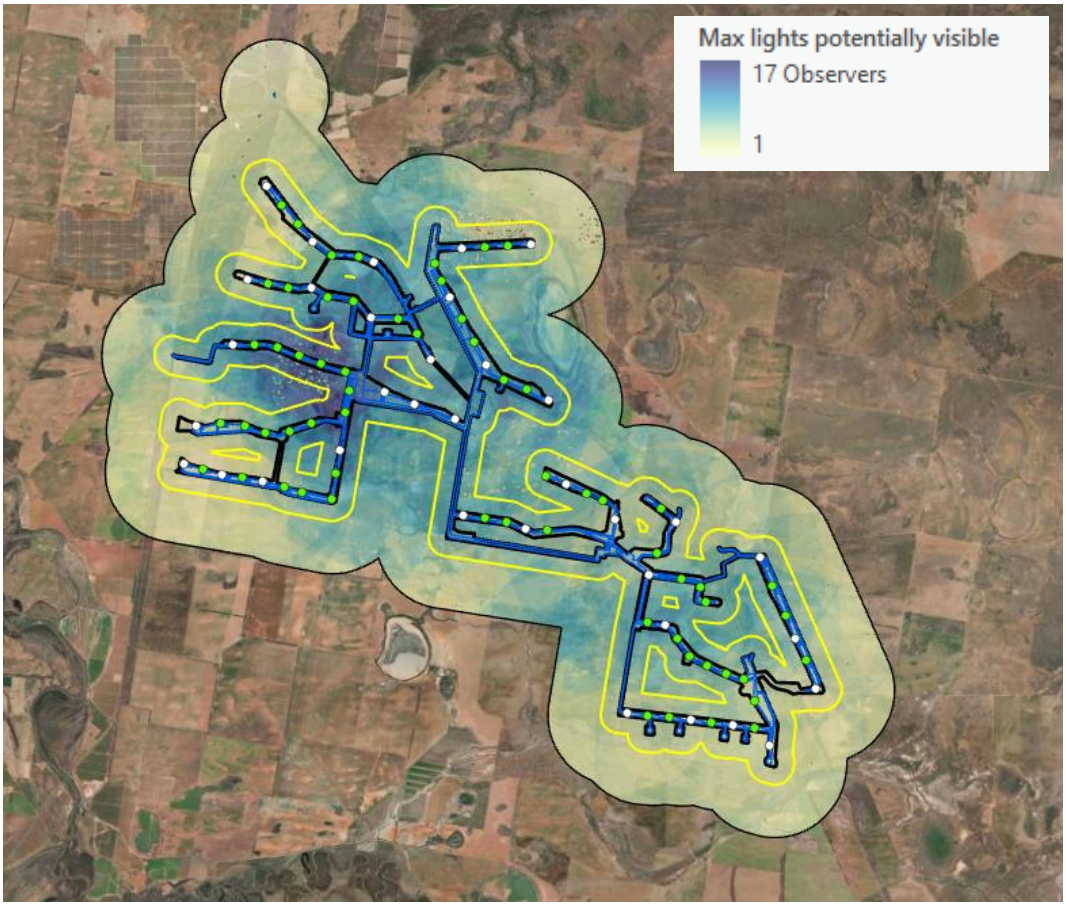


Plate 9 Geodesic Viewshed analysis of proposed aviation lighting within project assessment area

Darker red areas illustrated on Plate 9 and Plate 10 represent the locations where the highest number of lights are visible, with a maximum of 17 lights visible at a distance of ≤5 kilometres, with fewer lights visible in lighter orange and yellow areas (within a minimum value of one visible light). The above analysis does not considered shading from vegetation or other objects.

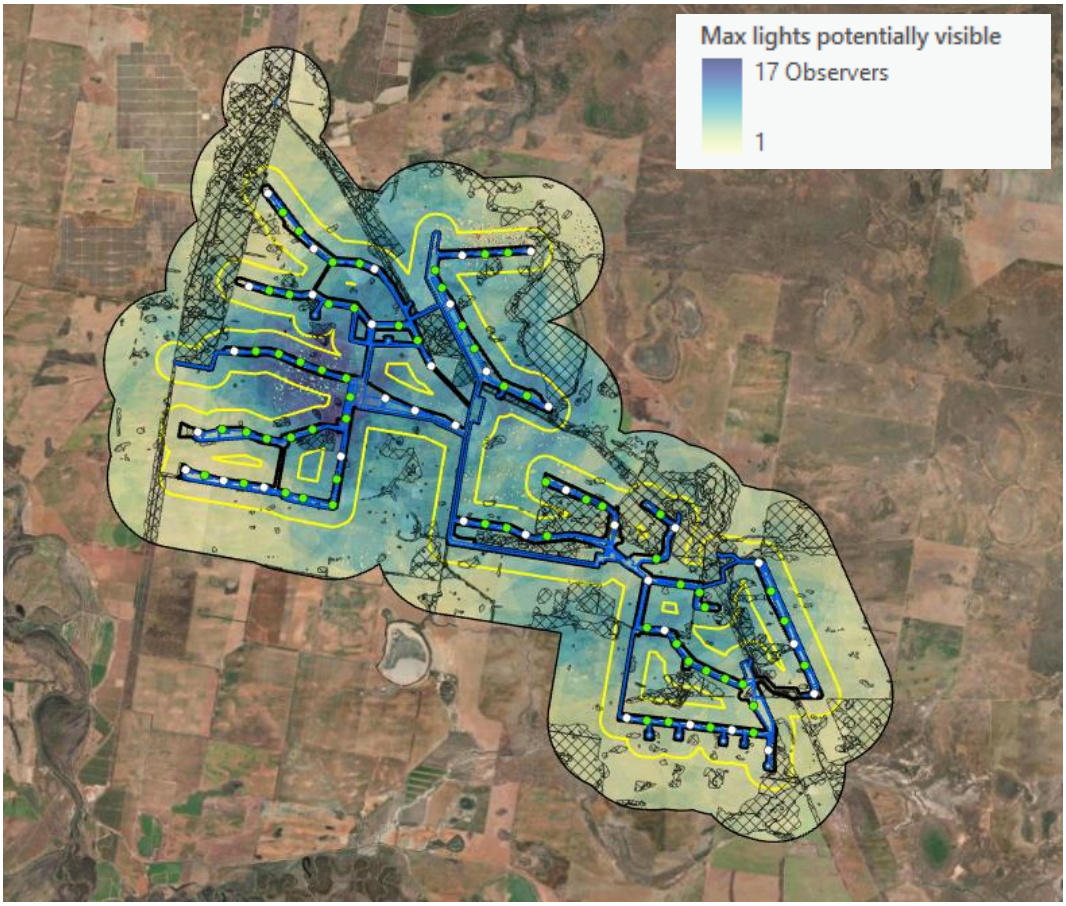


Plate 10 **Geodesic Viewshed analysis of proposed aviation lighting with native vegetation overlain within project assessment area**

From this analysis it can be seen that the areas in the north-eastern potion of the subject land are likely to be subject to the highest number of light sources (Plate 9), which generally correlates to cleared agricultural areas. It can also be seen that lower numbers of light sources will be visible from the majority of native vegetation patches across the subject land (Plate 10). However, the analysis does not take into account potential overshading of vegetation / canopies, nor does it consider how far into the vegetation patches the light may travel. It is likely that the light spill will be most substantial on the edges of the habitat patches, and reduce in intensity the further from the edge the habitats and resident fauna occur.

Although red light (wavelengths ~>600 nm) is often promoted for its reduced skyglow, potential ecological effects remain. Red light is generally considered to be less disruptive than white or blue, however it is not ecologically neutral. Some species exhibit attraction, others avoidance, and unintended consequences such as predator traps, or possible attractants towards operational turbine blades exist. Studies suggest different animals are likely to perceive and react to red light in different way (Margetts, Stuart-Fox, & Franklin 2024).

Bats, for example, exhibit varied responses to artificial light at night depending on foraging guild and habitat context. Narrow-space foraging bats (such as Inland Forest Bat and other *Vespadelus* species present within the subject land), have been shown to exhibit reduced activity and delayed emergence near lit edges of urban forests, suggesting that light may act as a barrier to habitat use or foraging efficiency (Haddock et al. 2019, Voigt et al. 2021). It should be noted however, that red light was shown to have the smallest impact, and the intensity of the light spill as a result of the project will be far less than along urban forest edges. In species more tolerant of light, such as open-space foragers (such as White-striped free-tailed bat and *Ozimops* species present within the subject land), the attraction to insect aggregations near lights may create ecological traps by increasing exposure to predators, or encouraging energetically inefficient behaviours (Haddock et al. 2019,

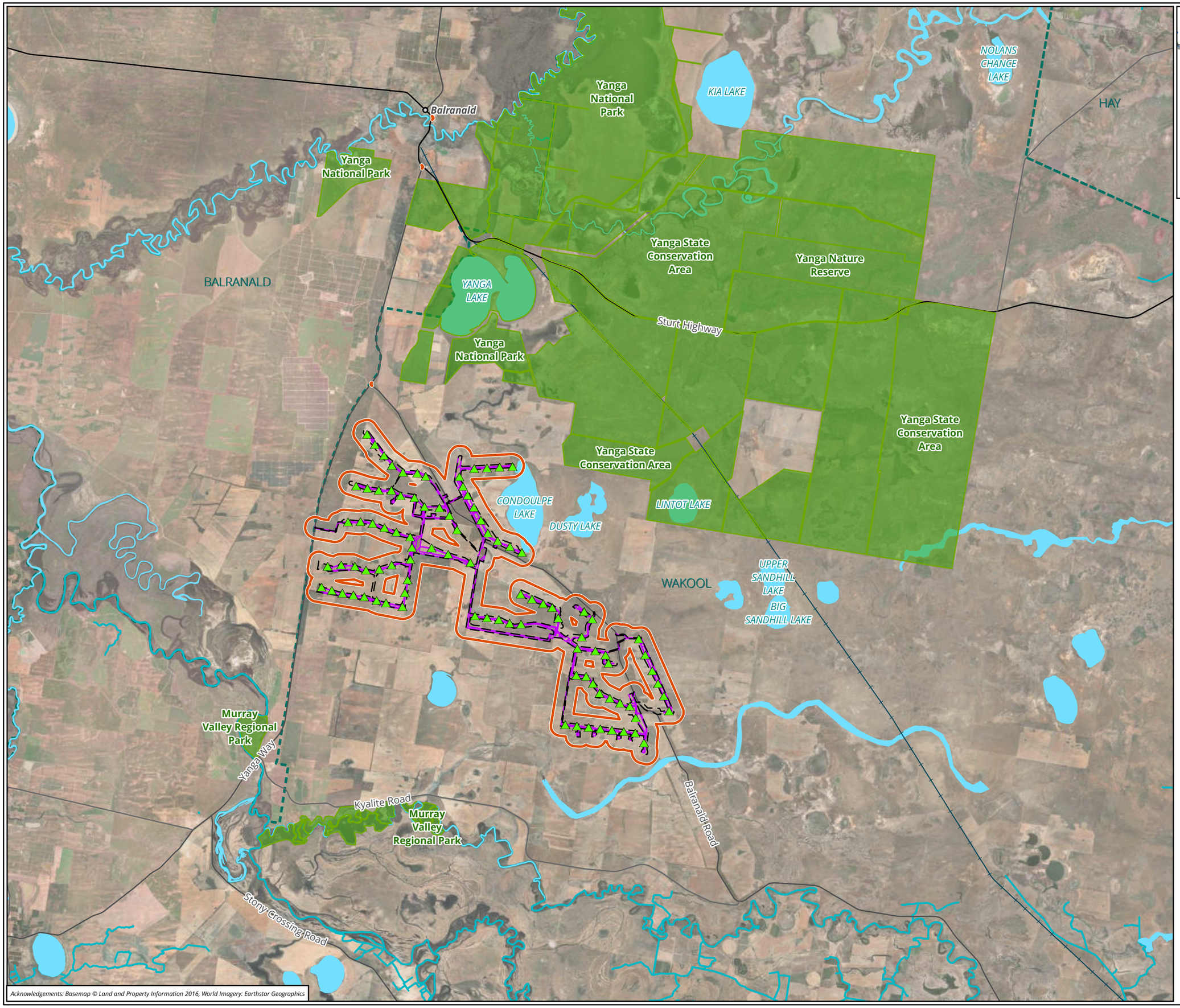
Voigt et al. 2021). This behaviour could extend to being attracted to lights installed on turbines, however the intensity of the light (and thus the attraction) would again be far less than that in more urbanised situations. This is due to the distance the bats would be from the aviation lights, as a result of the height of the lights on the turbines (at least 140 metres above the ground) and the shielding that prevents any light being observable when the animal is at an angle of >10% below horizonal from the light source.

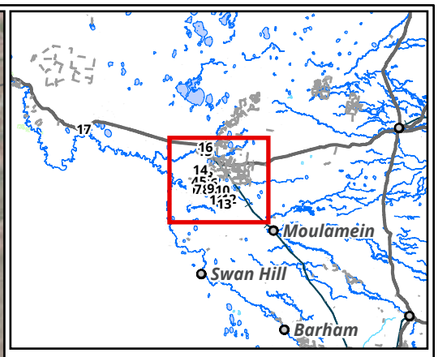
Nocturnally migrating birds are known to face significant challenges from artificial light at night, with global analyses having found that light pollution is most intense within key migratory passage areas, increasing the risk of disorientation and altering flight behaviour. These disruptions may lead to elevated mortality through collisions or energy mismanagement, especially during the already demanding migration phase (Cabrera-Cruz, Smolinsky, & Buler 2018). However, these studies are again focussed on far more intense light sources than would result from the proposed aviation lighting within the subject land. There is some potential for disruption to nocturnally migrating birds from the proposed aviation lighting, however numerous locations along the species' flight paths would produce artificial light at far greater levels than the project, so cumulatively any increased impacts are unlikely to be substantial.

In temperate songbirds, red-spectrum lighting has been shown to shift the timing of dawn and dusk singing earlier in the season, potentially disrupting synchronization with food availability and breeding cues (Silva, Valcu, & Kempenaers 2015). There is some potential for this type of impact to affect Pink Cockatoos within the subject land, however as the species diet consists of seeds of native shrubs and trees, and sometimes roots bulbs and insect larvae and seeds of crops and weeds (Cth DCCEEW 2024), food resources are not limited, or tied to, dawn/dusk activity.

Insect populations, are threatened by artificial light at night with estimates that one third of insects attracted to stationary artificial light sources die either through exhaustion or predation (Owens et al. 2019). However monochromatic red light has repeatedly proven minimally attractive to light-attracted insects, most of which lack red photoreceptors (Owens et al 2024). Light pollution may interfere with insect movement, foraging, reproduction, and predator-prey interactions. Reducing insect biodiversity can destabilize food webs and reduce prey availability for insectivorous species such as bats and birds (Owens et al. 2019). As such interactions between insects and the proposed aviation lighting could impact microbats through a reduction in insect prey availability, or through predator-prey interactions resulting in microbats being drawn into RSA height whilst hunting insects drawn to the lights.

Artificial light at night resulting from proposed aviation lighting has the potential to impact upon resident and migratory fauna as a result of the project. However potential impacts have primarily been minimised through the reduced intensity of the lights (200 cd down from a possible 2000 cd), the proposed shielding which reduces the intensity of the lights at close range, and the positioning of the lights as far from retained habitat patches as possible. Impacts associated with altered fauna behaviours as a result of proposed aviation lighting are not considered likely to be substantial to threatened species affected by the project. The potential increased microbat activity within RSA height as a result of feeding on insects attracted to the lights is also not expected to be substantial, however it is more of an unknown and as such will be assessed through ongoing monitoring of collisions with lit turbines during the implementation of the project's BBAMP.





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

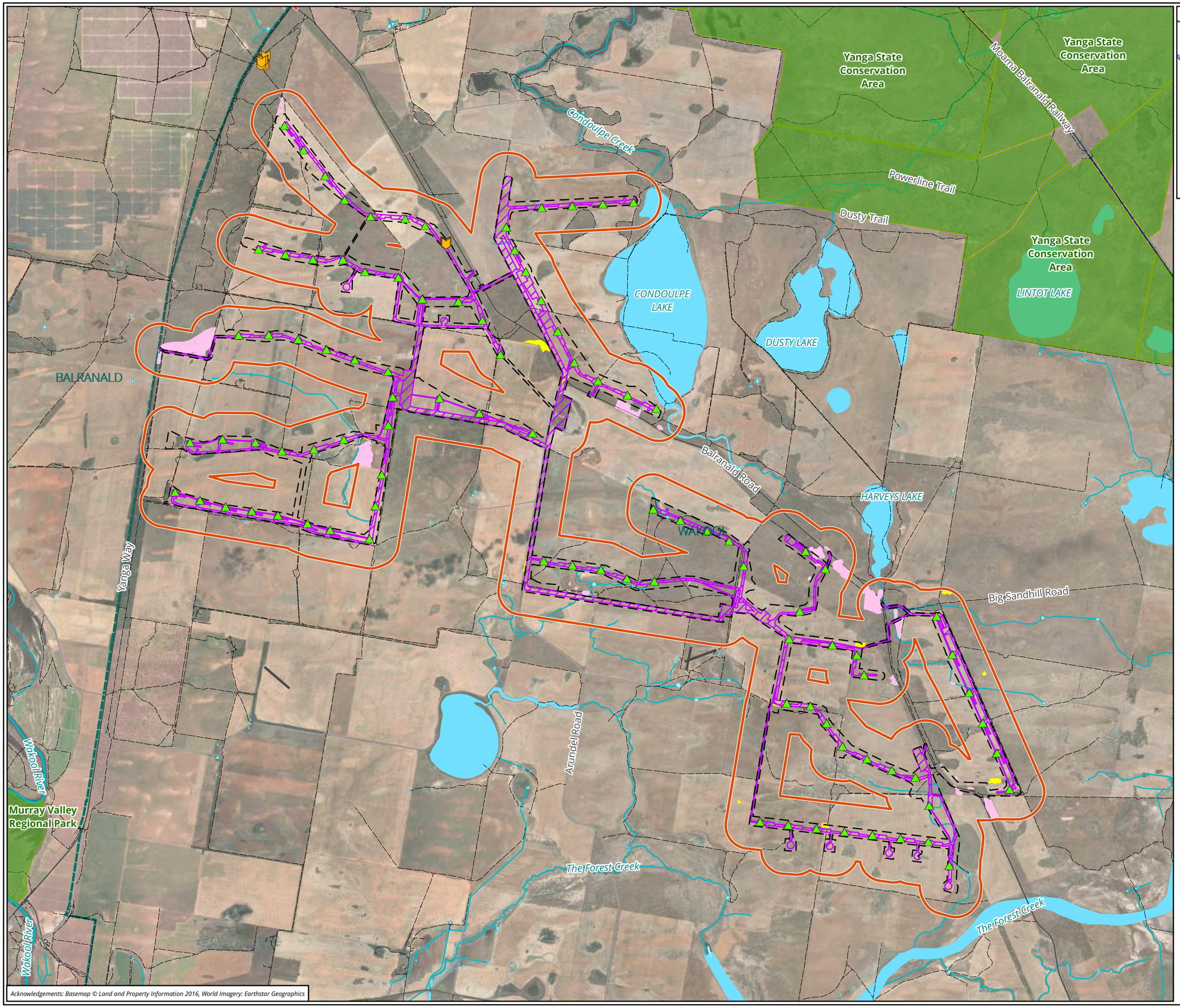
Scale: 1:180,000 @ A3

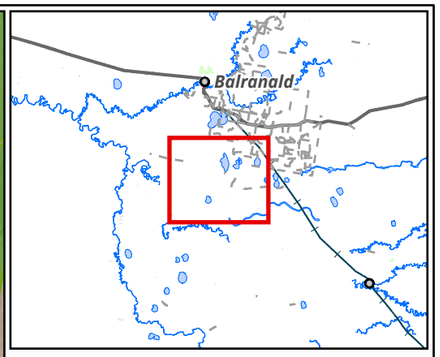
Coordinate System:
GDA2020 MGA Zone 54

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

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_F18.2_IndirectImpacts

8.3. Prescribed impacts

Identification and assessment of prescribed biodiversity impacts are outlined and addressed in Table 65, and the section below, and shown in Figure 19.

Table 65 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: • Dams. • Windmills. • Fences. • Farm tracks. • Formed public roads. • Water troughs. • 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. 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. 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). 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. Landscape scale habitat connectivity also exists for aerial species over the wind farm between water bodies present in the surrounding landscape. Waterbird species are likely to move between large watercourses and permanent (or near-permanent) water sources such as wetlands in the Nimmie Caira, Yanga National Park and the greater Lowbidgee area, to the north, and the Edward River, Wakool River and Murray River, to the south.	All threatened fauna, flora and TECs within the landscape.	Connectivity corridors have a high biodiversity importance. Waterbird movements have the potential to be impacted by the project resulting in barriers to flyways, further addressed in Section 8.3.5.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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
	Condoulpe Creek, along the north-eastern boundary of the subject land provides connectivity to the Yanga NP, Yanga SCA and Yanga RP.		
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. 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. 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. The majority of riparian areas have been avoided through detailed design. Some impacts to mapped, undefined watercourses degraded through historical agricultural use are proposed.
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.	A range of non-threatened threatened species are potentially susceptible to vehicle strike, threatened species most at risk include: • Pink Cockatoo • Regent Parrot.	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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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 (National Parks and Wildlife Services 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 (National Parks and Wildlife Services NSW 2003).

Around 14% of the Lowbidgee Floodplain DoI occurs within the bounds of the Yanga National Park, Yanga State Conservation Area and Yanga Regional Park. This area is known to host one of the largest waterbird breeding colonies in Australia (NSW DCCEEW 2024b). The aquatic habitat within the seasonal watercourse Condoulpe Creek and dryland lake, Condoulpe Lake, within the subject land are receive water seasonally from the Murrumbidgee River via Yanga Lake and Yanga Creek.

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.

A buffer distance of at least 2.5 kilometres between any WTGs and the Yanga SCA and/or Yanga NP has occurred within the current project design. WTG 18 is the nearest turbine to Yanga SCA. It is currently placed around 2.7 kilometres west of Yanga SCA. WTG 1 is the nearest turbine to the Yanga NP, placed around three kilometres south-west. The project is committed to ensuring connectivity, especially from Condoulpe Lake and Creek remains within the subject land. This includes A 400-metre buffer around wind turbines from watercourses and wetlands to prevent collisions, and ensure key riparian corridors from the subject land to the Lowbidgee Floodplain remain intact.

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 14).

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.

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 2025). 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 2025). 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 66 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 66 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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. Note this is considered a High level consequence for this Endangered (BC Act and EPBC Act) listed species	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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% 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

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 during flood years.				
Black Falcon	No	Turbine strike	• <50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision 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 Kite	No	Turbine strike	• >50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Black Swan	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (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

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 during flood years.				
Black-shouldered Kite	No	Turbine strike	• >50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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
Brown Falcon	No	Turbine strike	• >50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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
Caspian Tern	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude.	Likely – further addressed below	Addressed below	Addressed below
Curlew Sandpiper	Yes – Important Mapped Areas only	Turbine strike	• <5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years. Note this is considered a High level consequence for this Critically Endangered (BC Act and EPBC Act) listed species	Likely – further addressed below	Addressed below	Addressed below
Fork-tailed Swift	No	Turbine strike	• 50% likelihood of a strike occurring in a given year • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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

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
Great Cormorant	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude.	Likely – further addressed below	Addressed below	Addressed below
Inland Forest Bat	No	Turbine strike	• <50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision more likely during spring and summer	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

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
Little Black Cormorant	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Little Pied Cormorant	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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
Maned Duck (Australian Wood Duck)	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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
Nankeen Kestrel, including Nankeen Kestrel (Australian)	No	Turbine strike	• >50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Pacific Black Duck	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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
Peregrine Falcon	No	Turbine strike	• >50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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 Cockatoo, including Pink Cockatoo (eastern)	No	Turbine strike	• 50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Pink-eared Duck	No	Turbine strike	• 5% likelihood of a strike occurring in a given year.	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

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
			• Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.				
Regent Parrot (eastern subspecies)	No	Turbine strike	• <50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Southern Free-tailed Bat	No	Turbine strike	• 50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Spotted Harrier	No	Turbine strike	• <50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines).	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	Likely – further addressed below	Addressed below	N/A – Not a migratory species

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.	unlikely to significantly impact even the local population.			
Wedge-tailed Eagle	No	Turbine strike	• >95% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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
Whiskered Tern	No	Turbine strike	• 5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years.	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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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-bellied Sea-Eagle	No	Turbine strike	• 50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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
White-striped Freetail-bat	No	Turbine strike	• >50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision more likely to occur over spring and summer	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

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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 66 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 66 above:

- There is 1 bird species considered very probable that the risk even could occur in any year (>95 %).
- There are 8 at-risk bird and bat species considered more probable than not that a strike event could occur in any year (>50%).
- There are 5 at-risk bird and bat species it is considered equally probable that a strike event could or could not occur in any year (50%).
- There are 7 at-risk bird and bat species it is considered less probable than not that a strike event could occur in any year (< 50%).
- For 17 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:

- Occasional mortalities could occur but appear unlikely to be high in frequency or magnitude.
- 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Table 67 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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years. • Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years.	As outlined in Section 6.1.2 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: • 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. • 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. • 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. • 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. 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. 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. 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. • Highest strike likelihood: 7 probable, 38 possible strike	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
	turbines (approx. 47% of turbines). • Collision 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.	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. 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. 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. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years. • 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): • 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. • Fledglings have the potential of entering the proposed wind farm airspace when dispersing from Yanga Lake. • A 400-metre buffer around wind turbines from watercourses and wetlands is considered large enough to prevent collisions. 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. 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Protected / threatened species	Rate, timing & consequence	Significance of potential impacts
Curlew Sandpiper	• <5% likelihood of a strike occurring in a given year. • Highest strike likelihood: 1 probable, 1 possible strike turbine (approx. 2% of turbines). • Collisions more likely to occur between spring and autumn during flood years. • Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years.	The potential occurrence of Curlew Sandpiper within the subject land is considered low. Habitat for the species, in the vicinity of the subject land, is only likely to be present during flood years in areas such as Condouple Lake, which is only likely to occur very infrequently, and was only observed holding water from 5 % of aerial photography and satellite images assessed from between 1986 and 2024 (WRM 2024). The species has only been recorded a handful of times within 60 km of the subject land, within the Nimmie-Caira portion of the Lowbidgee Floodplain and at Yanga Lake, however more records occur just outside this buffer, such in irrigation areas near Tullakool, south-east of the subject land. Based on the presence of ephemeral wetland habitats surrounding the subject land including the Nimmie Caira, Yanga National Park and the greater Lowbidgee area, to the north, and the Edward River, Wakool River and Murray River, to the south, there is some potential for the species to fly through the subject land, and therefore potentially interact with operational turbines. As outlined by Nature Advisory (2024e) 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 within RSA height within the subject land. Furthermore, on the basis of the species' local records, and known habits, Curlew Sandpiper are unlikely to use habitat within the subject land due to a lack of suitable habitat, for the vast majority of the time. It is more likely that individuals or flocks could very occasionally fly through the airspace of the subject land 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 subject land, it is expected that this would occur rarely if at all during the lifespan of the wind farm (Nature Advisory 2024e), and if as expected, this occurred during a long-range flight, it is most likely the species would be well above RSA height and unlikely to collide with turbine. However, due to the species Critically Endangered (BC Act and EPBC Act) status, if one or more birds was to collide with turbines, this would be considered an undesirable event, and potentially substantial impact to the species. As such, the species is considered 'at-risk' and will be considered in operational monitoring events and adaptive management strategies.
Fork-tailed Swift	• 50% likelihood of a strike occurring in a given year • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision more likely to occur between spring and early autumn	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). 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. 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

Protected / threatened species	Rate, timing & consequence	Significance of potential impacts
	• Repeated loss of small number of individuals but no reduction in population viability.	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.
Inland Forest Bat	• <50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision more likely during spring and summer. • Moderate loss in numbers of individuals, leading to minor reduction in population viability for between one and five years.	Inland Forest Bat was not identified by Nature Advisory (2021 data), nor by Biosis when analysing data collected by Nature Advisory (2022), however the species was identified in the data collected by Biosis in 2024. The species was identified by calls considered 'Almost certain' to be the species at ground level, however calls at height were less definitive, with the species only positively recorded on the basis of a 'Possible' call. Nonetheless the species has been conservatively assessed as likely to occur within RSA height, and therefore subject to collision risk. The species is considered a 'edge forager', and a manoeuvrable and agile species, that generally forages below canopy. The species is widely distributed in arid and semi-arid Australia, and flies with rapid wing beats and forage over a wide area (Churchill 2008). Based on the known flight characteristics of the species it is not considered likely that a high number of collisions will occur, however given the threatened nature of the species (Vulnerable, BC Act), any collisions will be considered undesirable, and additional mitigation may be warranted to prevent further impacts to the species, and the local population.
Little Eagle	• <50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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.	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). 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. 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. 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Protected / threatened species	Rate, timing & consequence	Significance of potential impacts
Pink Cockatoo, including Pink Cockatoo (eastern)	• 50% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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.	As outlined in the previous section of this BDAR, Pink 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. 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. 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. 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. 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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.	As outlined in Section 6.1.3, 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). 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). 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

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Protected / threatened species	Rate, timing & consequence	Significance of potential impacts
		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 (< 20 m approx.) still remains adjacent to WTG 48, however the proponent is committed to micro-siting this turbine outside the recommended setback. 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. 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	• >95% likelihood of a strike occurring in a given year. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • 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.	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. 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. 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'). 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

Protected / threatened species	Rate, timing & consequence	Significance of potential impacts
		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. • 6 relevant high-risk turbines (approx.6% of turbines) • 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.	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 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. 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). 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). 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. 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision more likely to occur over spring and summer.	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. 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

Protected / threatened species	Rate, timing & consequence	Significance of potential impacts
	• Repeated loss of small number of individuals but no reduction in population viability.	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. 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 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). 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. • Highest strike likelihood: 7 probable, 38 possible strike turbines (approx. 47% of turbines). • Collision more likely to occur over spring and summer • 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. 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. 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. 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 66 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 66 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.

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 by Nature Advisory (Nature Advisory 2023e, Nature Advisory 2023a), 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:

- Australasian Bittern *Botaurus poiciloptilus*.
- Australasian Darter *Anhinga novaehollandiae*.
- Australasian Shoveler *Spatula rhynchotis.*
- Australian Pelican *Pelecanus conspicillatus*.
- Black Falcon *Falco berigora*.
- Black Swan *Cygnus atratus*.
- Caspian Tern *Hydroprogne caspia*.
- Fork-tailed Swift *Apus pacificus.*
- 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 Biosis and 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 by Nature Advisory (2023f). However, reassessment by Biosis has increased potential barrier effect risk for five species to Low, those being; Australasian Bittern (macro scale), Black Kite (meso scale), Curlew Sandpiper (macro scale), Wedge-tailed Eagle (meso scale), and Whistling Kite (meso scale).

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 11 illustrates these differences in scales.

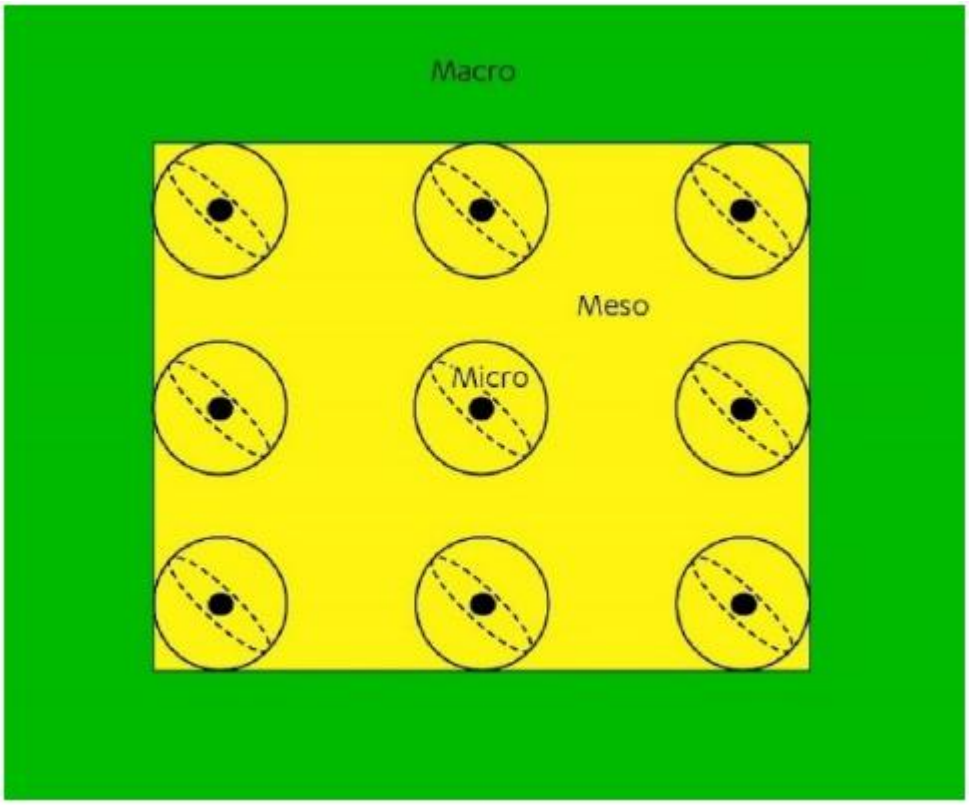


Plate 11 **Schematic illustrating the spatial scales over which micro-avoidance, meso- and macro-responses operate. Dots refer to turbine tower locations, circles are rotor-swept areas and ellipses (dotted) to a hypothetical rotor position (not to scale, from (Cook et al. 2014)).**

As outlined in Section 7.1 (refer Figure 14 and Table 54), 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. 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. 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 14).

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).

As outlined above, the qualitative risk assessments presented in Section 6.1 and Appendix 4.2 have concluded that all species except Australasian Bittern, Black Kite, Curlew Sandpiper, Wedge-tailed Eagle and Whistling Kite are likely to be subject to no more than negligible risk from barrier effect. This is due to

common raptors (Black Kite, Wedge-tailed Eagle and Whistling Kite) being considered likely to be required to undertake avoidance behaviour at the meso (and occasionally macro) scales, due to the frequency with which the species would fly at RSA height during long and high soaring forage flights. The lower frequency (but high potential consequence) macro-scale avoidance behaviour from Australasian Bittern and Curlew Sandpiper, potentially required in future migratory/nomadic flightpaths, may also result in greater negative impacts to the species.

Other species, considered at a 'negligible' level of risk based on the outcomes of the qualitative risk assessments presented above, yet potentially subject to some level of barrier effect include: Black Falcon (meso-scale), Black-shouldered Kite (meso-scale), Fork-tailed Swift (macro-scale), Nankeen Kestrel (meso-scale), Pink Cockatoo (meso-scale), Spotted Harrier (meso-scale), Regent Parrot (macro-scale), Yellow-bellied Sheathtail-bat (macro-scale), and a range of waterbirds at both the macro and meso scales.

Plate 12 below provide landscape scale context of higher quality habitats present in the landscape between which species undertaking migratory or nomadic flights, may have to engage in macro-avoidance behaviour to avoid the operational wind farm. Higher quality habitat include NPWS areas (green polygons) and larger wetlands mapped Wetlands of NSW dataset (blue hatching) or DoIW wetlands (pink hatching), including areas of the Nimmie Caira, Yanga National Park and the greater Lowbidgee area, to the north, and the Edward River, Wakool River and Murray River, to the south.

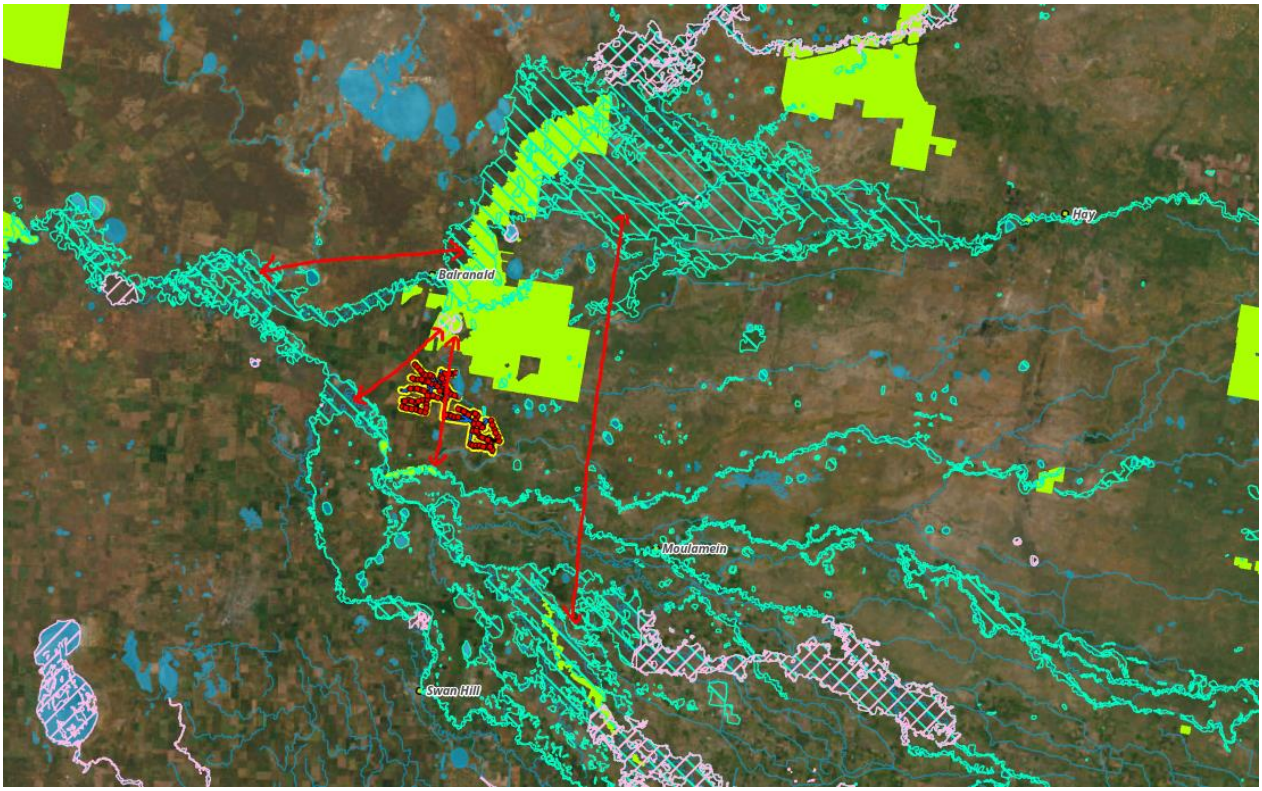


Plate 12 Landscape scale habitat features surrounding the subject land and potential direct flightpaths between habitats

It can be seen from Plate 12 above that in general the shortest paths between habitats, along which landscape scale movements are likely to be undertaken, avoid the subject land. However, there is potential for species to fly directly over (or through) the wind farm, or be required to undertaken macro-scale avoidance around the wind farm, when travelling directly south from Yanga Lake toward wetlands along the Edward River, including those within the Murray Valley Regional Park.

It is acknowledged that the Yanga Group of reserves supports very high conservation value wetland habitats including 14 % of the Lowbidgee Floodplain, with areas in its northern extent listed on the Directory of Important Wetlands in Australia, and NSW NPWS Agency comments note the wetlands contain one of the largest waterbird breeding colonies in Australia. Furthermore, it is possible that from time to time, some of the species supported by these high quality and important habitats may be required to fly through, over, or around the operational wind farm during nomadic or migratory movements. Whilst it is acknowledged that BUS was completed in October 2022, which occurred at the start of period of significant rainfall leading to increased waterbird habitat in the environment (noting September 2022 was also well above, and August above, the average rainfall totals), the data collected does not suggest waterbirds are common within the subject land. These findings are backed up by the findings of Nature Advisory's (2023e) Regional Review of Waterbirds in the Riverina, which concluded the majority at waterbird species are not at substantial or significant risk from collision or barrier effect. The in-depth analysis undertaken by Biosis and Nature Advisory, and presented in Sections 5, 6, 7, and 8 above, as well as Appendix 4.2, Appendix 5, and Appendix 9 of this BDAR, conclude that substantial or significant impacts to the species utilising the Yanga Group of reserves, and other higher quality habitats within the landscape are unlikely to occur.

Nonetheless, a detailed strategy for operational monitoring intended to capture any unexpected impacts is also presented in Section 9 below, and will be finalised prior to commissioning of any turbines in finalisation of the project's BBAMP. This will further reduce the potential for substantial or significant impacts, and should they unexpectedly occur, they will be realised early and adaptive management will be initiated to prevent such events from reoccurring.

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.

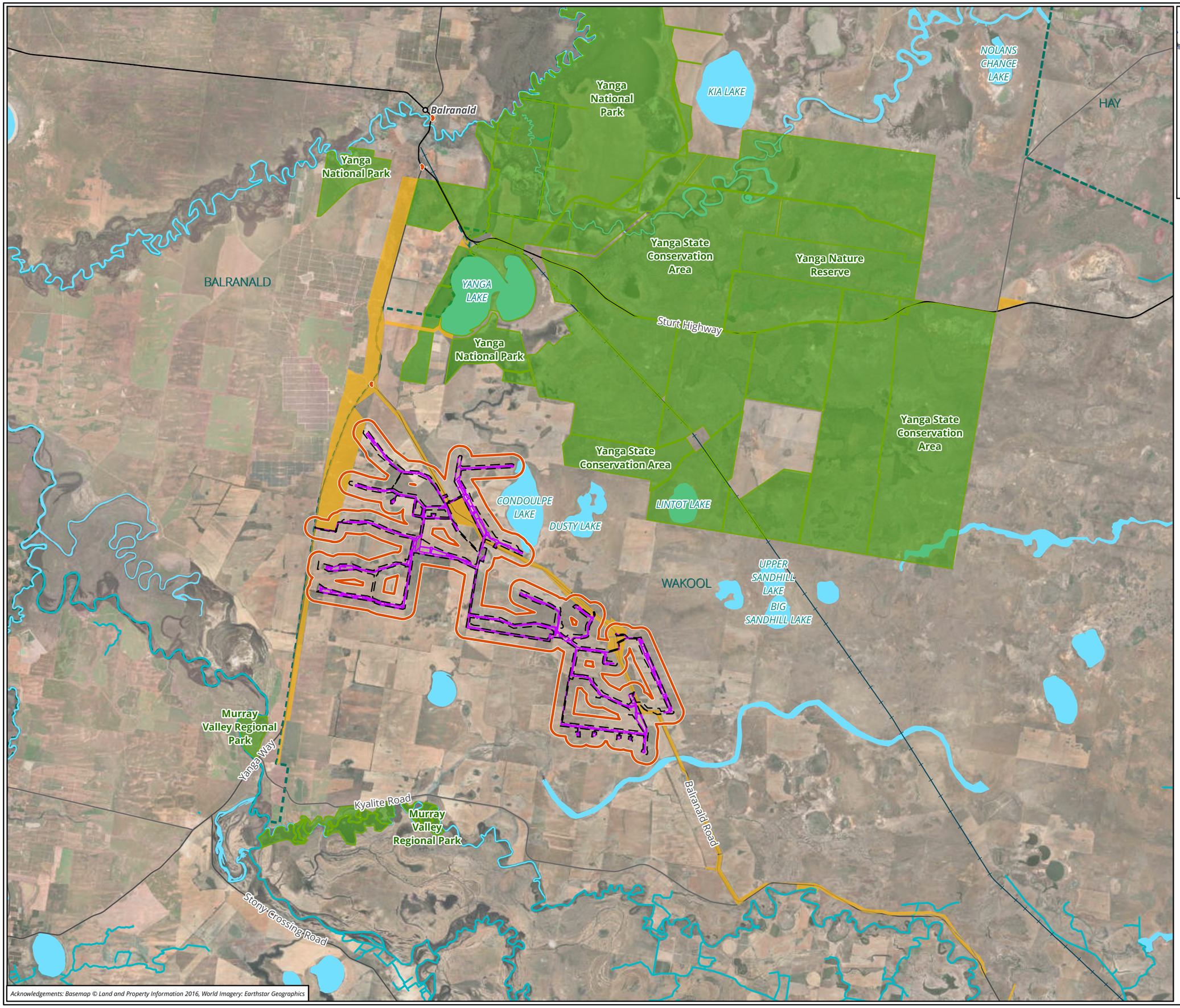
Consequences

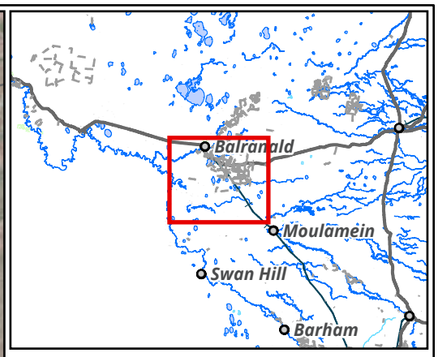
It can reasonably be expected that the potential for vehicle strikes can be effectively managed though:

- 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

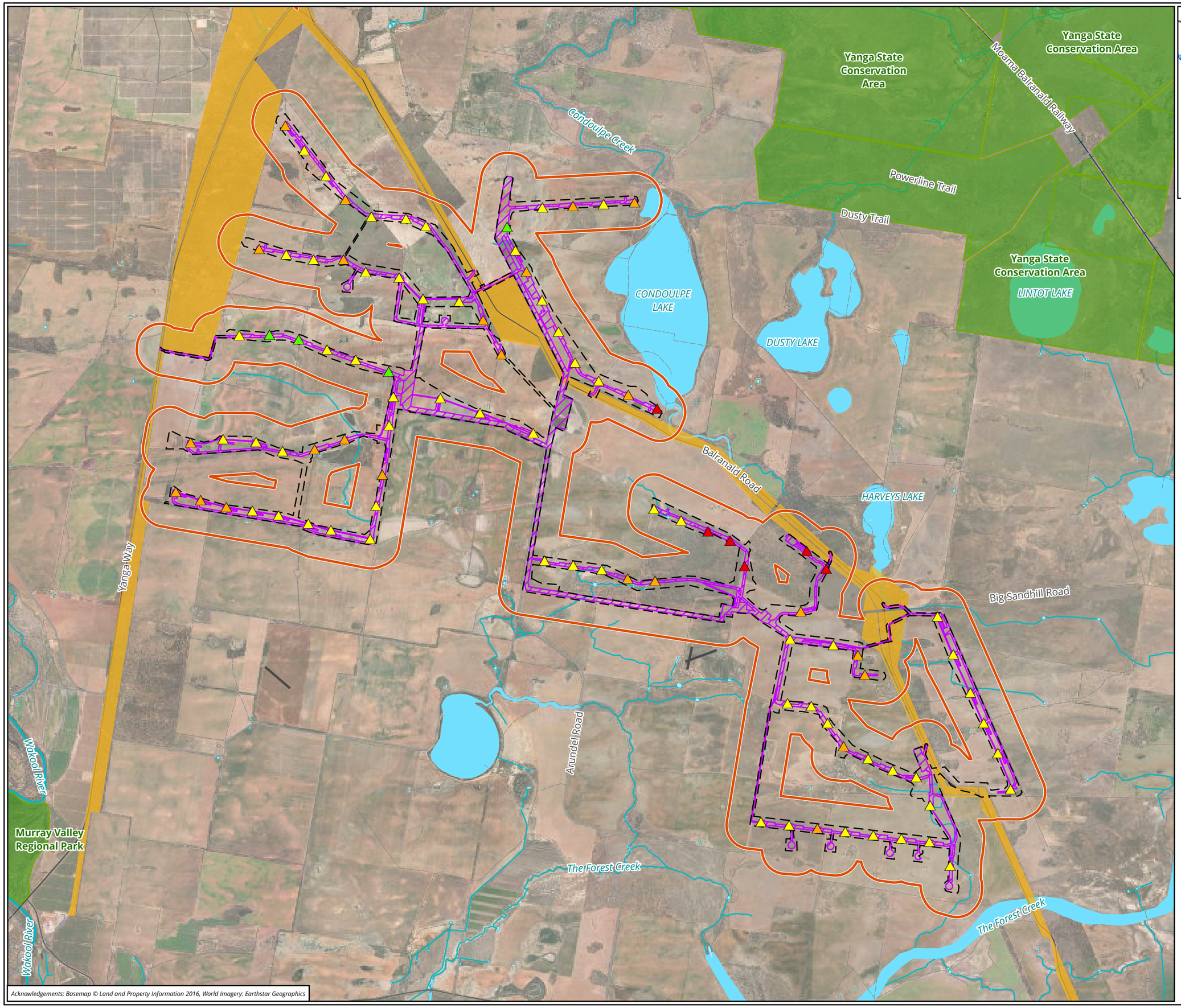
Scale: 1:180,000 @ A3

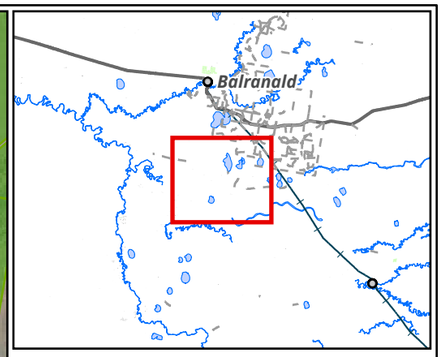
Coordinate System: GDA2020 MGA Zone 54

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

- Very high
- 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

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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 68 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 1,615.20 ha of native vegetation 232.16 ha of TECs, including 101 ha of Weeping Myall Loss of habitat of 74 ecosystem species 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	30 km east	Includes construction and operation of 1 GW wind farm, including approximately	Potential impacts to 17 PCTs including Natural grassland TECs

Project	Distance	Overview	Potential biodiversity impacts
(Prepare EIS)		162 WTGs across approximately 42,000 ha.	Potential impacts to 3 threatened 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 69 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Table 69 Measures to mitigate and manage impacts

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
Direct and indirect impacts				
Removal of native vegetation and TECs	B01	• 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. • CEMP and BMP sub-plan will include prescriptions for mitigation of potential impacts of construction activities on retained native vegetation and habitat . The plan will include measures to address all items listed outlined below: – Minimise vegetation clearance and disturbance, including impacts to standing dead trees and riparian zones. – Where possible, limit clearing to trimming rather than the removal of whole plants. – Micro-siting of all construction related access roads, stockpiles, vehicle parking and site compounds (and other ancillary items that can practicably be micro-sited) will occur and where possible these should be located in areas that do not contain native vegetation and/or fauna habitat. – Include detailed maps illustrating the extents of native vegetation and TECs (including any non-woody components) within the development corridor, and clearly illustrate clearing limits and No-Go zones. Ensure TSRs and other sensitive areas (such as those supporting threatened species populations) surrounding the development corridor are included in maps. – Physically delineate vegetation to be cleared and/or protected on site and install appropriate signage prior to works commencing. – 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 must be checked as part of the pre-clearing survey, and clearing will not begin before successful installation. – Undertake pre-clearance inspections by a licenced ecologist of vegetation to ensure all no-go areas are appropriately fenced. – Protect trees in accordance with the requirements of Australian Standard 4970-2009 for the Protection of Trees on Development Sites, where possible.	• Prior to construction • During detailed design • Ongoing through construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		– Retain dead tree trunks 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 should be lifted and placed into adjacent vegetation, not pushed. – If any threatened species (flora or fauna) are discovered during the works, stop any work that have the potential to impact upon that threatened species (or any directly associated and unrecorded threatened species) immediately and notify the onsite Manager. Work will only recommence once the impact on the species has been assessed and appropriate control measures provided. – 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. – The CEMP and BMP will include measurable targets, auditable mitigation/management measures and an adaptive management strategy. • A Biosecurity Management Plan prepared as part of the project's CEMP and will include best practice measures to prevent the spread of weeds and pathogens, and other biosecurity items into or out of the impact area upon implementation. • Secure biodiversity offsets in accordance with the NSW BOS.		
Removal of fauna and flora habitat	B02	• Wherever possible the project will look to avoid removal of hollow-bearing trees and trees supporting nests during detailed design. • The CEMP will include a plan for pre-clearance surveys. Pre-clearance surveys will include (at a minimum): – Fauna general: ○ Survey of all areas to be cleared prior to construction to identify and mark all fauna habitat features to be impacted including hollow-bearing trees (HBTs). ○ All HBTs to be removed will follow a two-stage removal process (as detailed in B03 below), including knocking of the tree to be removed prior to removal. ○ All fauna habitat features to be removed will be surveyed by a suitably qualified ecologist, prior, during and immediately after removal. ○ Active nests will be avoided by clearing (where possible).	• Prior to construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		○ If native fauna is likely to be present, a licenced ecologist should inspect the removal and undertake fauna relocation. – Flora general: ○ All vegetation to be removed is to be clearly marked for removal. ○ 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. • 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.		
Removal of threatened fauna habitat	B03	**Pink Cockatoo** • Once final development footprint is determined undertake a HBT survey to create an inventory of potential Pink 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. • Installation of hollow exclusion measures may be utilised once a hollow had been confirmed as not being used for breeding by any native 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 process, under ecologist supervision is required for the removal of all potential Pink Cockatoo nest trees. This would include a method such as: – Remove all non-habitat vegetation (e.g., non-habitat trees) prior to the removal of habitat trees (e.g., hollow-bearing tree). – Leave habitat trees standing for at least one night after other clearing to allow any fauna the opportunity to remove themselves after site disturbance. – Actively shake habitat trees immediately prior to removal. – Non-habitat branches are removed before the habitat branches, – Ecologist inspects habitat trees before and after felling to rescue any trapped / injured fauna. – Wildlife carers (or vets) are available to treat any injured fauna.	• Prior to construction • During construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
	B03	**Regent Parrot** • 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 (as detailed in B03 above) under ecologist supervision is required for the removal of all potential Regent Parrot high use areas.		
	B04	**Threatened raptor species (incl. non-threatened at-risk species)** • All potential raptor nests within 200 m of the finalised development footprint are to be mapped at least one month prior to vegetation removal. • 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). • Clearing of raptor nests with juveniles present will not be undertaken. • 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. • Clearing of vegetation within 200 m of raptor nests with juveniles present will be avoided wherever possible • Two-staged tree removal (as detailed in B03 above) under ecologist supervision is required for the removal of all raptor nests.		
	B05	**Other threatened species** • Pre-clearance surveys will be undertaken when vegetation removal is proposed during the breeding season of threatened species know to occur within the subject land, as outlined in this BDAR (for example between July – October for Southern Whiteface). • 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	B06	**Bitter Quandong - *Santalum murrayanum*** • Extent of Bitter Quandong population is to be confirmed and mapped during pre-clearance surveys. • 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).	• Prior to construction • During construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		• Ensure No-Go Zones are established early and maintained throughout the life of the construction phase of the project. • 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 mitigation and management. • To the fullest extent feasible no grazing is to occur within the patch of vegetation supporting the population.		
	B07	***Austrostipa metatoris*** • 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 population, no-go zones and ongoing monitoring will be established as per the recommendations associated with Bitter Quandong (B06) above.	• Any future works associated with the project	Proponent / Principal contractor
Indirect impacts on retained native vegetation, habitat and native species	B08	• Project operational and construction fencing will be designed so as not to create barriers to fauna movement, nor to funnel fauna species into dead ends or towards roads. Egress points will be provided for fauna that do enter the project site (during both construction and operational phases). • 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. • Develop and implement specific erosion and sediment controls described in a CEMP, such as: – Minimising the area and duration of soil disturbance. – Progressively rehabilitate disturbed areas. – 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. – Specific Erosion and Sediment Control Plans for waterway crossings. – Ensure native vegetation in adjacent TSRs is protected from sediment-laden runoff during construction. • All material stockpiles, vehicle parking and machinery storage, and other ancillary works are to be located within areas considered within the approved development footprint and not be located within retained vegetation outside the development footprint. • As Waste Management Plan will be developed to ensure rubbish and construction waste are properly managed, and include strategies to manage pest species.	• Prior to construction • During construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		• Cleared native vegetation, proposed to be mulched or stored for re-use on site, must be: – Stockpiled separately from topsoil in a manner which facilitates respreading or salvaging, avoids damage to adjacent live vegetation and does not impede wildlife. – If reused for landscaping and site rehabilitation, spread <10 cm deep to aid in retention of native seed bank and allow for germination from seed-drop. • Undertake ongoing pest animal control. – Where possible in conjunction with a local/regional pest control program (or providing a monetary contribution towards) to ensure a strategic approach can be achieved.		
Reduced viability of adjacent habitat due to edge effects	B09	• 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. • Re-use felled vegetation (logs and tree-hollows) and other habitat features to increase the habitat values of any retained and adjacent vegetation. • 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 • During construction	Proponent / Principal contractor
Reduced viability of adjacent habitat due to noise, dust or light spill	B10	• The CEMP will include a plan to ensure: – Minimisation of the amount of time that noise, light and vibration impacts are occurring. – Regularly train workers and contractors to use equipment in ways to minimise noise. – Site managers periodically check the site and nearby residences for noise problems so that solutions can be quickly applied. – All plant and equipment will be turned off when not in use. – Breeding habitat such as tree hollows and nests adjacent to works areas must be mapped by an ecologist and considered in noise management strategies. • The CEMP will include dust suppression to be undertaken as required using water sprays, water carts or other media on: – Unpaved work areas subject to traffic or wind. – Sand, spoil and aggregate stockpiles. – During the loading and unloading of dust generating materials. – During any other activities deemed to generate high levels of dust.	• Prior to construction • During construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		• 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. • Lighting will be designed so as not to shine onto adjacent retained vegetation and habitats as much as is possible. • Ongoing measure to reduce the impacts of aviation obstacle lighting will be investigated during detailed design. • Turbines will be subject to regular maintenance that includes activities that minimise noise generation.		
Transport of weeds and pathogens to/from the site to/from adjacent vegetation	B11	• A Biosecurity Management Plan prepared as part of the project's CEMP will include measures to prevent the spread of weeds and pathogens, and other biosecurity items into, out of, and within the site upon implementation. – The plan will include prescriptions for regular monitoring and control of weeds and include measurable targets, auditable mitigation/management measures and an adaptive management strategy.	• Prior to construction • During construction • Operation	Proponent / Principal contractor
Adaptive management strategies proposed to monitor and respond to impacts on biodiversity values that are uncertain	B12	• All construction and operational management plans will be progressively reviewed and updated through the life of the operations. • All adaptive management strategy plans, including the BMP and BBAMP, will form part of an overarching Environmental Management Strategy (EMS).	• Prior to construction • During construction • Operation	Proponent / Principal contractor
	B13	• Preparation of a BMP will ensure mitigation strategies are properly implemented during construction and operation of the project. – The BMP will be prepared by a qualified ecologist or consulting company in consultation with NSW DCCEEW (CPHR) and Cth DCCEEW. – The BMP will be implemented for all stages of the project (pre-construction, construction, operation and decommissioning). – Mitigation strategies included in the plan will include (but are not limited to): ○ Permit system for the clearing of native vegetation. ○ Installation of no-go zones and delineation of vegetation to be removed/retained. ○ Pre-clearance procedures for vegetation and habitats to be removed.	• Prior to construction • During construction • Operation	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		○ 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. ○ Details of protection procedures for directly impacts threatened flora. ○ 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. ○ Fencing requirements for No-Go Zones. ○ Management requirements for stockpiles, vehicle parking, machinery storage, other ancillary works. ○ Pest management requirements. ○ An adaptive management strategy and timing of regular review/updates. ○ All relevant mitigation measures included in this BDAR. ○ Further detail as provided in Section 9.1.1 below. • 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 increases to biodiversity impacts as a result of micro-siting during detailed design.		
	B14	• 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 CPHR and Cth DCCEEW for reducing bird and bat collision risk. – All relevant mitigation measures included in this BDAR. – Identify additional mitigation measures, further detailed in Section 9.1.2 below.	• Prior to construction • During construction • Operation	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
	B15	• Preparation of a Groundwater and Soil and Water Management Plan (or similar) that will: – 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. – Include detailed maps and management measures focussing on the extents of native vegetation and TECs (including any non-woody components). Ensure TSRs and other sensitive areas (such as those supporting threatened species populations) surrounding the development corridor are included in the plan (as required). – Describe how water will be managed to achieve compliance with consent and EPL licence conditions. – Establish responsibilities and reporting requirements. – Establish surface water quantity and quality monitoring requirements. – Establish trigger action response plans to enable progressive improvement.	• Prior to construction • During construction • Operation.	Proponent / Principal contractor
Proximity to National Parks and State Conservation Areas	B16	• No WTGs will be placed within 2.5 km of the Yanga SCA or Yanga NP. • WTG 18 is currently placed around 2.7 km from Yanga SCA, micro siting of this Turbine will ensure it is not placed within 2.5 km of the Yanga SCA.	• Prior to construction • During detailed design	Proponent / Principal contractor
Prescribed impacts				
Turbine strike and barriers to movements	B17	• A minimum 400 m buffer between the blade tip of operational turbines and suitable wetland habitats determined to provide habitat for at-risk species will be maintained. – 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. – 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. – Rainfall triggers will be developed in the finalisation of the BBAMP to determine when additional monitoring of wetland habitat will commence. – Start and end of curtailment would be determined via field survey confirmation that birdlife and habitat value was present (start) had reduced significantly enough back to pre-flood	• Operation	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		conditions (end) for operation of the turbines to not increase collision risk for at-risk species. Further information is provided in Section 9.1.2. • 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 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. • Investigation of feasibility and suitability of automated bird and bat 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. – Installation and implementation of an automated bird and bat detection system, deemed feasible and suitable, if BBAMP triggers requirements. • Where blade strike impacts are found to occur implement adaptive management strategies as outlined in Section 9.1.2 (Table 73) below.		
Vehicle strikes	B18	• Speed limit for construction vehicles within and surrounding the site will be reduced to minimise increased risk of vehicle strike on fauna (ensuring relevant road safety laws are followed). • Speed limits within the subject land must be enforced for the life of the project. • 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. • A vehicle strike protocol, including details of local WIRES contacts will be created and made available to all staff. • Suitable speed limit reductions will be determined during preparation of the BMP.	• Prior to construction • During construction • Operation	Proponent / Principal contractor
Construction in waterways & removal of dams	B19	• Construction within waterbodies will be preferentially undertaken when dry. • During the micro siting process, where possible, construction in wet areas including dams, drainage lines and creek lines will be avoided. • Where avoidance, or undertaking works when waterbodies are dry is not possible, all areas containing standing water, e.g., dams, must be surveyed as part of the pre-clearance and clearing survey outlined in the CEMP including: • Engaging a qualified and licensed ecologist to be present during dewatering of dams (and other relevant waterbodies), to undertake fauna relocation (e.g., turtles, frogs, etc.) into an appropriate nearby habitat.	• Prior to construction • During construction	Proponent / Principal contractor

Measures to mitigate and manage impacts	No.	Action	Timing	Responsibility
		• 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.		
Fragmentation of movement corridors	B20	• Establish local Biodiversity Stewardship Sites to ensure local habitats outside the development corridor are improved and conserved in perpetuity. • Ensure indirect impacts to TSRs are prevented through implementation of the BMP and other relevant management plans. • The following opportunities will be fully explored as a part of the detailed design: – Opportunities to further minimise the disturbance footprint and clearing within important movement corridors for fauna. – Opportunities for post-works restoration of habitat connectivity within important movement corridors for fauna. – Areas subject to temporary disturbance will be rehabilitated using a native species planting schedule as much as practical considering any operational and safety constraints. – 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	• Prior to construction • During construction • Operation	Proponent / Principal contractor

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 Pink Cockatoo and Regent Parrot (refer Table 69 above).
- Fauna monitoring and management protocol including identification and reporting of fauna mortalities to the relevant CPHR 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

- 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 69.

- 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 working 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 DPHI, NSW CPHR, Cth DCCEEW, and NSW NPWS 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.

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 70) are considered a trigger-level alert, and if realised would warrant an increased focus on areas of concern to determine whether furth action is required. Mitigation measures relevant to each alert level are described in Table 73.

Trigger alerts presented herein are based on the entire project being operational (i.e. all 96 turbines). If the project becomes operational in two stages alerts levels will be revised. Final alerts and mitigation measures will be developed when BBAMP is finalised following project approval as required by any Conditions of Consent.

Table 70 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 (up to twice the blade length) a wind turbine during any single mortality search or incidentally by wind farm personnel.	Tier 1 mitigation instigated
	Non threatened 'at-risk' species	• Where two 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 (up to twice the blade length) a wind turbine during any single mortality search or incidentally by wind farm personnel.	
	Other protected species	• Where six 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 (up to twice the blade length) 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 71) are considered an unacceptable impact and require action be taken. A detailed investigation and stringent temporary or permanent mitigation would be required should they occur. 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 further below.

Table 71 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: – Any impact that is likely to reduce the total species' population by more than 1% for at least a two-year period; or • Where population numbers are not known: – Where four 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 (up to twice the blade length) a wind turbine within a two month cycle** or during incidental searches. • 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: – Any impact that is likely to reduce the total species' population by more than 1% for at least a five-year period; or • Where population numbers are not known: – Where two 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 (up to twice the blade length) a wind turbine within a two-month cycle** or during incidental searches. • 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 CPHR 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 operational 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 'twice-blade length' radius, and a repeated 'single blade length' 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 CPHR on request.

It is proposed carcass searches be undertaken in accordance with the schedule in Table 72, pending adaptive management, triggers and introduction or amendments to mitigation measures.

Table 72 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: – Search area of twice the blade length around relevant turbines, with a follow up single blade length pulse search from October to March (6 in total). – Search area of twice the blade length around relevant turbines, with no pulse searches required from April to September (6 in total). • Following two years following commissioning of relevant turbines, a review of sampling frequency will be undertaken to inform adaptive management.
High and Very 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: – Search area of twice the blade length around relevant turbines, with follow up single blade length pulse searches throughout. • From three years following commissioning of relevant turbines, sampling frequency thereafter will be informed by a series of scavenger surveys and adaptive management.
All turbines with aviation obstacle lighting installed	• 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: – Search area of twice the blade length around relevant turbines, with follow up single blade length pulse searches throughout. • From three 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 CPHR will be sought with regard to design and implementation of any such investigations and of an ultimate mitigation strategy, if required. CPHR 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 73 below.

Table 73 Consideration of likely required mitigation measures

Type	Mitigation considerations and response
General	• Ongoing reassessment of species risk levels and thus relevant trigger-levels during periodic updates to the BBAMP. • Periodic review of the turbine mitigation strategy and monitoring program every two years as part of BBAMP updates. • Incorporate any operational mitigation measures developed during the preparation and implementation of the BMP relating to active nests / nest trees. • Undertake flight path surveys and mapping of at-risk species to feed in to ongoing reassessment of turbine collision risk. Duration would align with carcass monitoring survey requirements. • Minimising availability of raptor perches on infrastructure within close proximity to turbines and overhead powerlines. • Prompt animal carcass removal within the 200 m of a turbine (within 24 hrs of discovery) to minimise raptor scavenging opportunities and reviewed annually. • Participation in 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. • Investigation of feasibility and suitability of deterrents or evolving technologies to be implemented if triggered by Tier 2 or Tier 3 impacts, such as: – Ultrasonic technologies, such as the SMART (Song Meter with Analysis and Remote Transfer) system by Wildlife Acoustics (see further detail below). – Radar (or optical sensor) or live camera technologies for automatic, reactive and temporary curtailment of turbines at Very High and High risk turbines (see further detail below). – Novel deterrent techniques related to blade visibility.

Type	Mitigation considerations and response
	– 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)). • Develop nocturnal low-wind speed 'smart curtailment' strategies to be employed should unacceptable impact triggers to microbats be realised. This is particularly relevant to turbines with aviation obstacle lighting installed. • Increased mitigation of turbines presenting increased risk to at-risk waterbirds when increased suitable wetland habitats occur within / surrounding the BBAMP area during flood years (further detailed below). • 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 wetland species. – Ongoing assessment of the suitability of the nominated 400m buffer to ensure bird (and bat) impact minimisation is prioritised, however potential energy loss is also maintained as low as possible. – Develop details of catchment-scale flood event monitoring requirements that trigger additional monitoring of habitats in proximity to the operational wind farm (i.e., Condoulpe Lake). – Develop threshold triggers for further investigation and implementation of seasonal event-based mitigation strategies to maintain the minimum 400 metre setbacks. Mitigation strategies further discussed below. • 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. – 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: • 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. • Increased frequency of carcass removal, or increased use of other methods of deterrence (where relevant). • 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. • 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. • Temporarily cease operation of a turbine(s) relevant to the impact trigger event during the rapid investigation, if deemed necessary to prevent reoccurrence of trigger. • 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.

Type	Mitigation considerations and response
	• Installation 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 2 and Tier 3 trigger, if deemed necessary to prevent reoccurrence of trigger . • The assessment is to determine possible causes of the impact and identify **the additional mitigation measures to be implemented** to minimise recurrence of the impact (as far as is practicable). 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 CPHR; • Implementation, increase, or re-location of collision risk reduction technologies such as SMART curtailment for microbats, or avian detection systems (examples of which include the IdentiFlight Avian Detection System and Wildlife Imaging Systems thermal camera and remote power system designs). – The suitability and feasibility of which system would be implemented if required in accordance with final BBAMP triggers will be determined prior to turbine commissioning. • Implementation of low-wind speed, nocturnal 'smart curtailments' to reduce the potential for microbat collision during periods of highest activity. • Temporary turbine shut down during periods of low visibility (i.e., fog), if suspected as the cause of collision(s). • Implementation of novel deterrent techniques related to blade visibility. • Regular 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). • 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 nesting within 200m of a turbine, the nesting event will be allowed to occur, with increased monitoring and/or temporary curtailment. • Reassessment of the nominated 400m turbine curtailment buffer from suitable wetland habitat, and implementation of any newly determined buffer width. • Short-term shutdowns where there is a delay in getting the necessary personnel to site to undertake increased turbine monitoring and relevant assessments. • 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. If following implementation of the above, or any other relevant, mitigation strategy there is a reoccurrence of the Tier 2 and Tier 3 impact (to the same species, or a sufficiently similar species), further investigation and mitigation muse be implemented to further minimise recurrence of the impact (as far as is practicable).

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 Wind Farm 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 13 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 13 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 14).

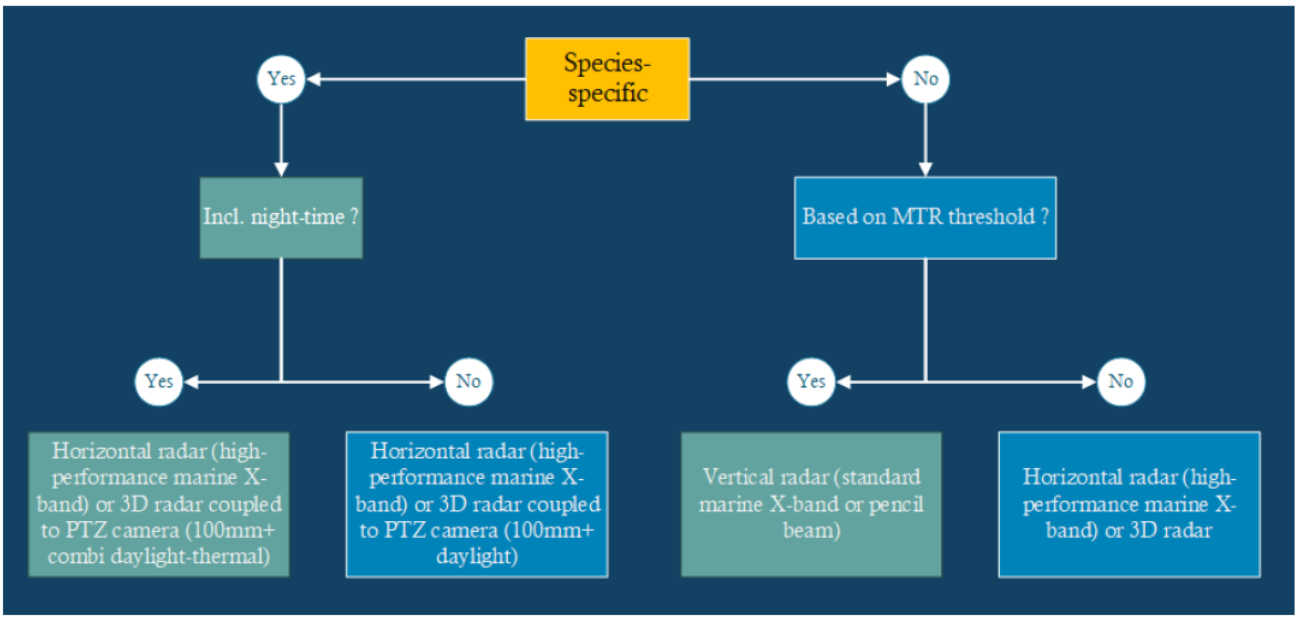


Plate 14 Recommended solution for turbine shutdowns (MTR is migration traffic rate, and relates to birds flying per hour, per kilometre).

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, Blue-billed Duck and Curlew Sandpiper 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.

Whilst there is limited published literature available, anecdotal evidence from a wide range of ornithological experts suggest waterbirds, and wading shorebirds in particular, fly at steep angles into and out of wetland habitats when making longer range (and particularly migratory) flights. Furthermore, when making short distance flights, between wetlands, many of the at-risk species are known to fly low, close to the water. Based on these accepted flight behaviours a set-back of 400 metres from wetland habitat is considered suitable for mitigating the potential for at-risk waterbird species to fly close to turbine blades when flying though RSA height, during steep accents/descents. The suitability of this nominated buffer will be further investigated during preparation and implementation of the project's BBAMP.

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 15 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.

This frequency of inundation is supported by Water Resource Management's (WRM) frequency of inundation analysis for Condouple Lake as part of the project's Flood Impact Risk Assessment. WRM reviewed aerial

photography and satellite imagery from between 1986 and 2024, and found from the total 416 observations collected, only 20 (5 %) detected water in the lake (WRM 2024). When dry, this lake is subject to cropping.

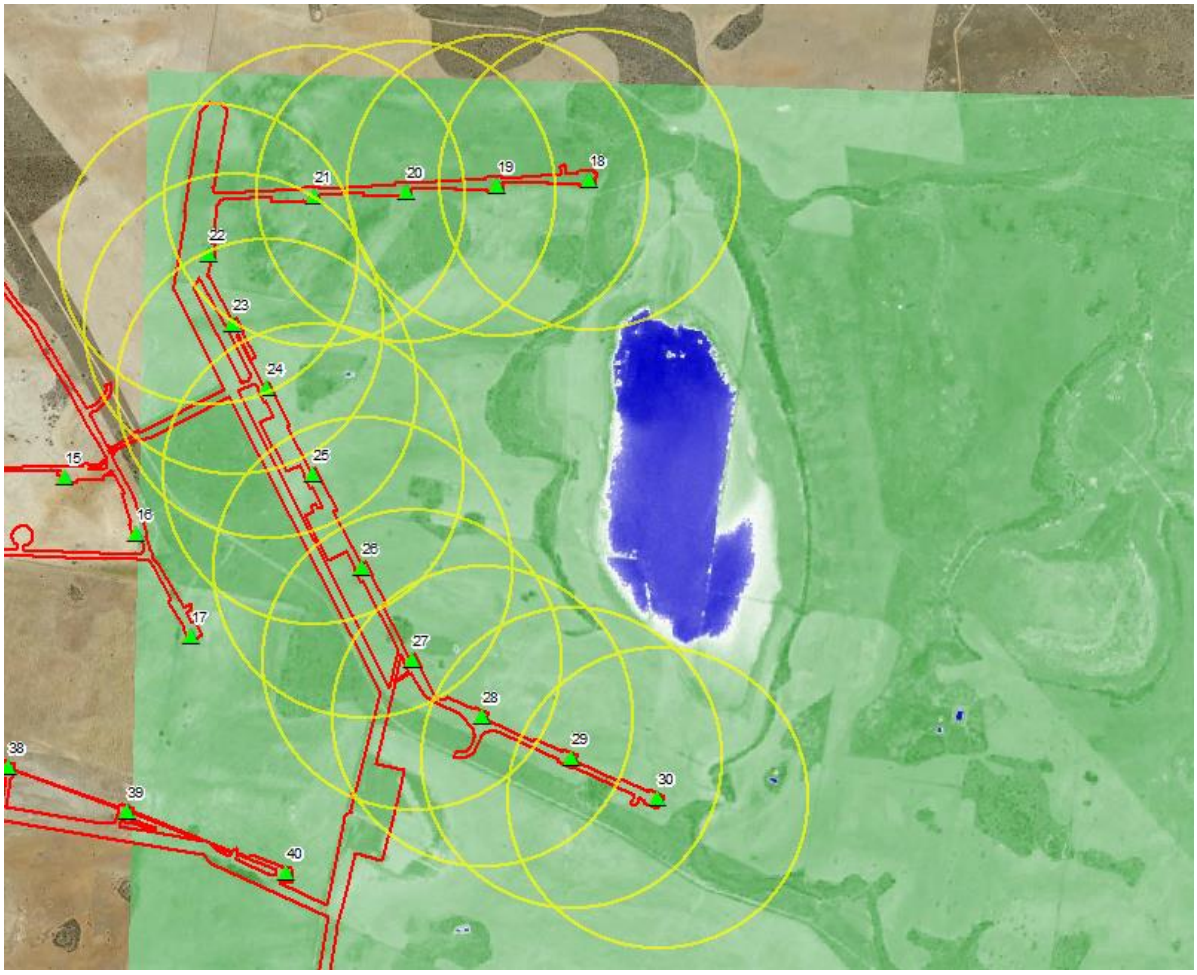


Plate 15 **NDWI imagery of Condoulpe Lake from January 2023 illustrating wetland habitat during flooding (blue colour) remains approximately 1 km from operational turbine blades.**

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 and low-windspeed nocturnal curtailment strategies

'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. This will be particularly relevant if bat fatalities occur that are attributed to aviation obstacle lighting.

If bat fatalities are occurring at levels where mitigation triggers are being realised, and technologies such as the SMART system are not implemented, it is likely that alternative strategies to curtail turbines and mitigate

blade strike for microbats will be required. Developing a strategy to prevent microbat strikes requires an understanding of the effects of weather parameters, especially wind speed on flight activity (Bennett et al. 2022), and will consider factors such as:

- Wind speed (m/s)
- Time after sunset
- Month of the year
- Temperature (ºC)
- Precipitation (mm/hr). (NatureScot 2021)

It is likely that any such strategy would implement low-windspeed nocturnal curtailment of specific turbines, when temperatures are warmer, and other environmental factors are conducive to increased microbat activity. Any such strategy would look to minimise the amount of energy generation lost in combination with reducing microbat fatalities below final trigger levels.

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 CPHR. 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.

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 one threatened flora and two threatened fauna species credit species – Atriplex *Atriplex inferequens*, Crowned Gecko, and Painted Burrowing Frog.
- Known foraging and assumed breeding habitat for one fauna species credit species – Pink 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.

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 74 provides a summary of the ecosystem credit offsets required for impacts from proposed development at the subject land.

Table 74 Offsets required (ecosystem credits)

Vegetation zone	Impact (ha)	VI score	TEC	HBTs	Credit requirement
16_Moderate	3.80	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	91.0	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**

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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 75 provides a summary of the species credit offsets required for impacts from proposed development at the subject land.

Table 75 Offsets required (species credits)

Vegetation zone	Species	Habitat condition (vegetation integrity score) loss	Area (ha)	Credit requirement
23_Moderate	*Atriplex infrequens*	62.7	2.03	64
163_Moderate		59.5	3.58	107
170_Moderate		59.5	4.67	139
170_Low		29.7	0.56	8
170_DNG		15.0	3.50	26
Subtotal				**344**
170_Moderate	Crowned Gecko *Lucasium stenodactylum*	59.5	4.67	139
170_Low		29.7	0.56	8
170_DNG		15.0	3.50	26
Subtotal				**173**
16_Moderate	Painted Burrowing Frog *Neobatrachus pictus*	53.4	3.04	81
16_Low		28.6	0.34	5
16_DNG		14.7	1.70	13
16_Paddock Trees		10.7	0.21	1
58_High		91.0	0.42	19
58_Moderate		74.8	5.46	171
58_DNG		17.7	3.38	30
58_Paddock Trees		46.6	0.01	1
163_Moderate		59.5	2.91	87
170_Moderate		59.5	0..62	18
170_Low		29.7	0.01	1
170_DNG		15.0	0.73	5
Subtotal				**432**

Vegetation zone	Species	Habitat condition (vegetation integrity score) loss	Area (ha)	Credit requirement
16_Moderate	Pink 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	127
170_Low		29.7	0.48	7
170_DNG		15.0	2.1	15
Subtotal				**840**
Grand total				**1789**

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 76 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

Class	Contains hollows	Number of trees	Ecosystem credits
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**

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 77 below.

Table 77 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

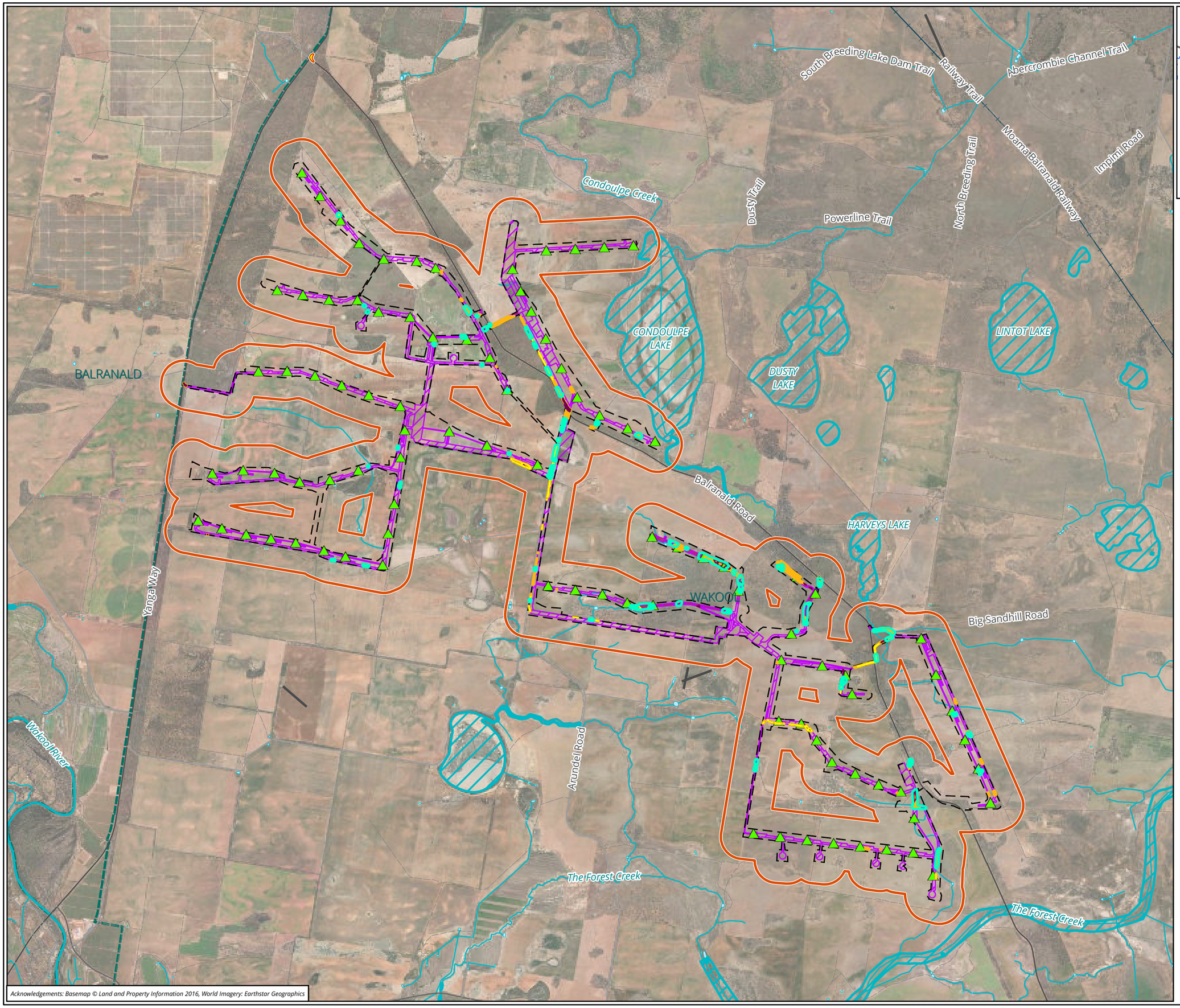
10.3.3. Impacts not requiring assessment

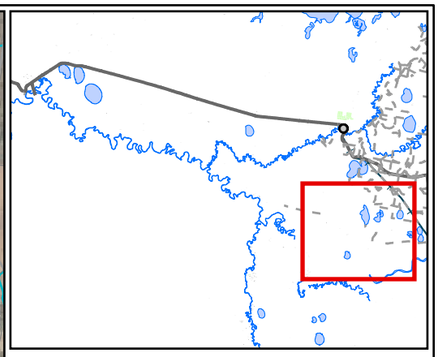
As outlined in Section 9.3 of the BAM, areas within the subject land that do not contain native vegetation do not need to be assessed for ecosystem credits. Areas of land mapped as Category 1 Exempt land under the LLS Act also do not require assessment under the BAM.

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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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

Impacts

- Not requiring assessment
- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (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

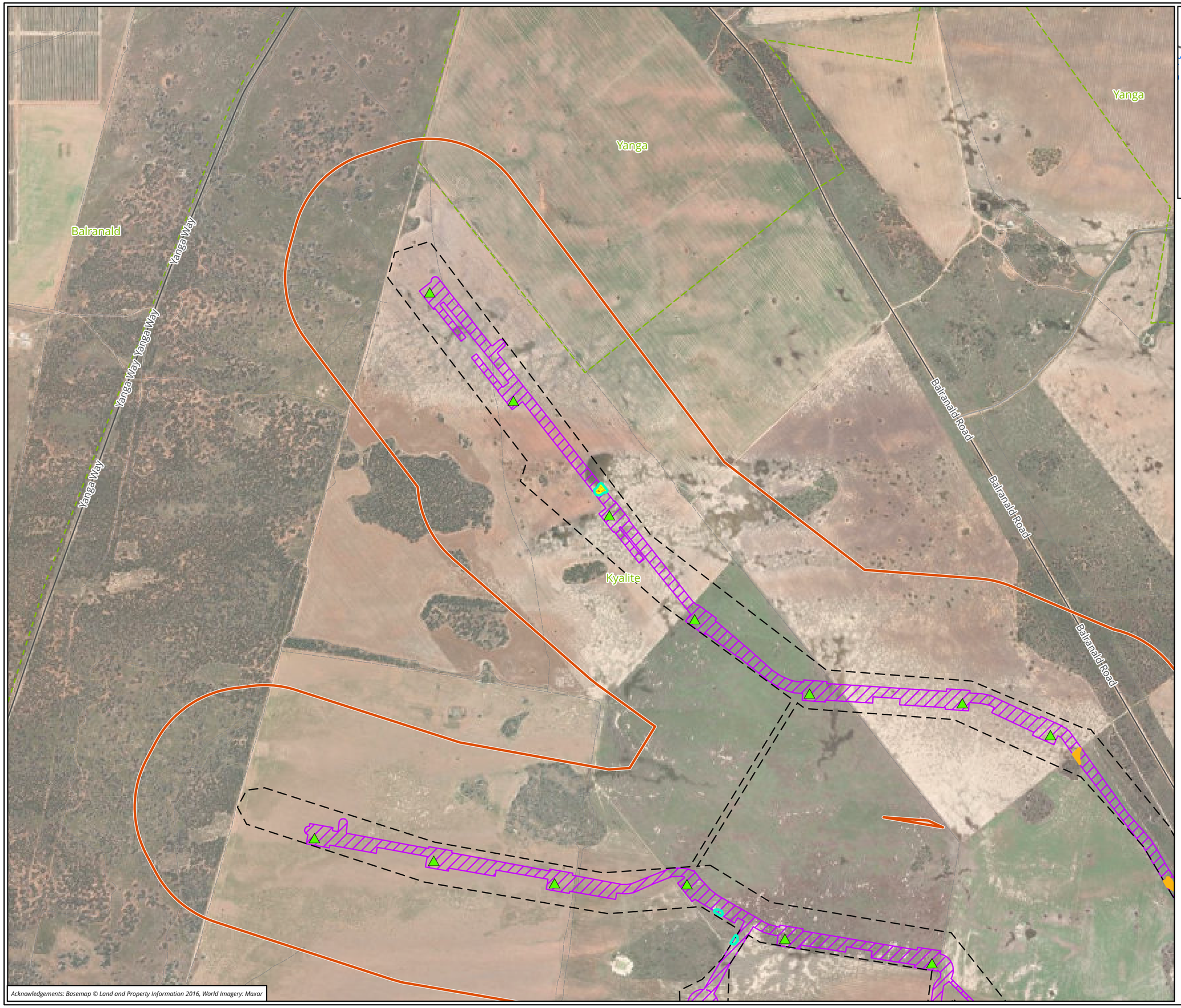
Scale: 1:79,000 @ A3

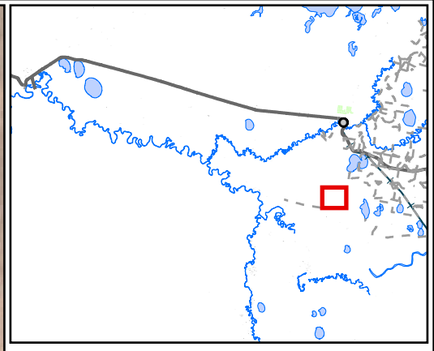
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets





Legend

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

Impacts

- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.2 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

Scale: 1:17,000 @ A3

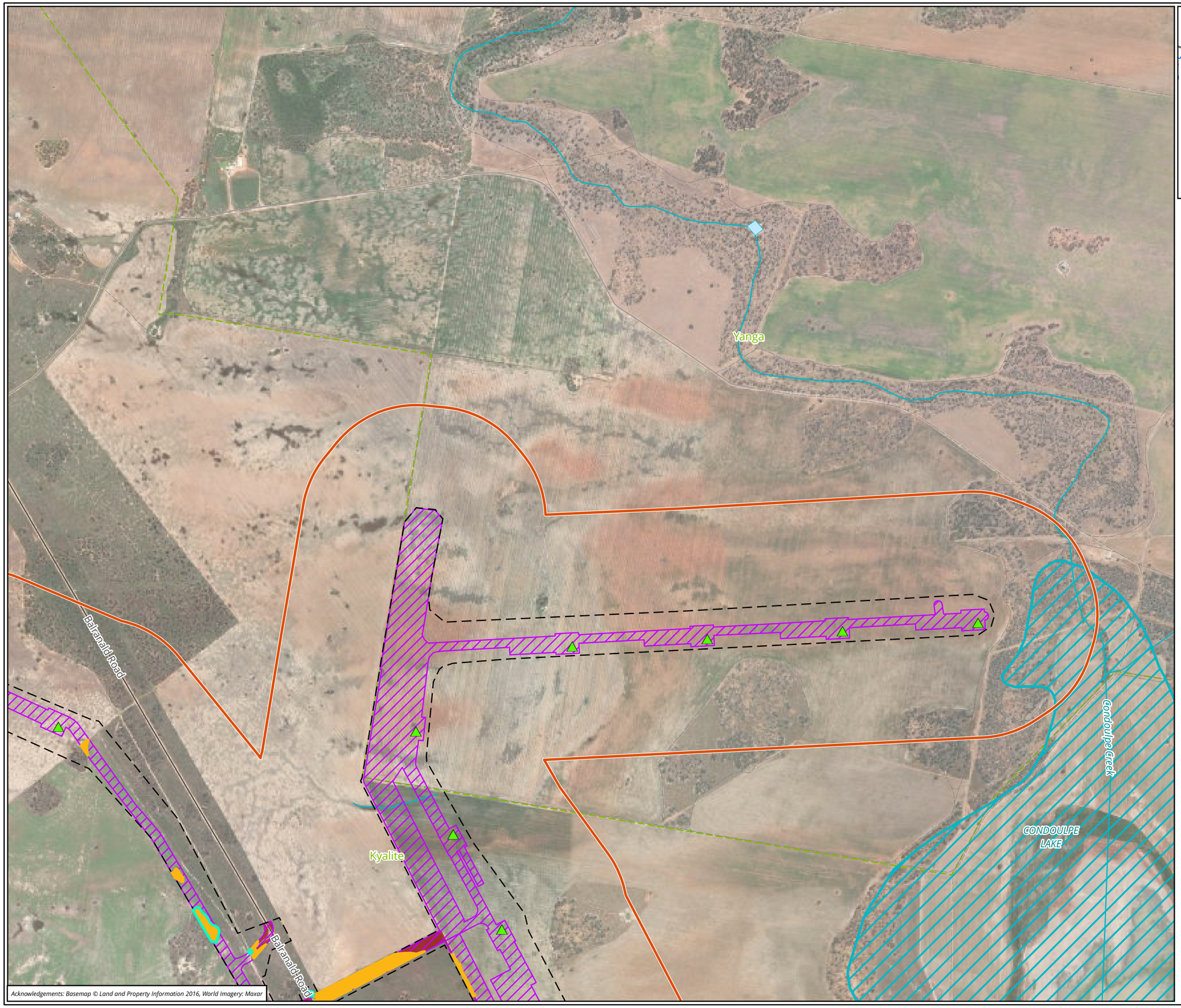
Coordinate System: GDA2020 MGA Zone 54

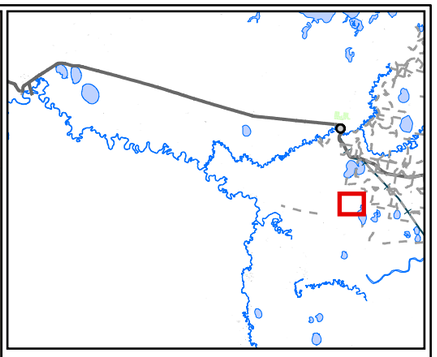
N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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

Impacts

- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.3 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800 N

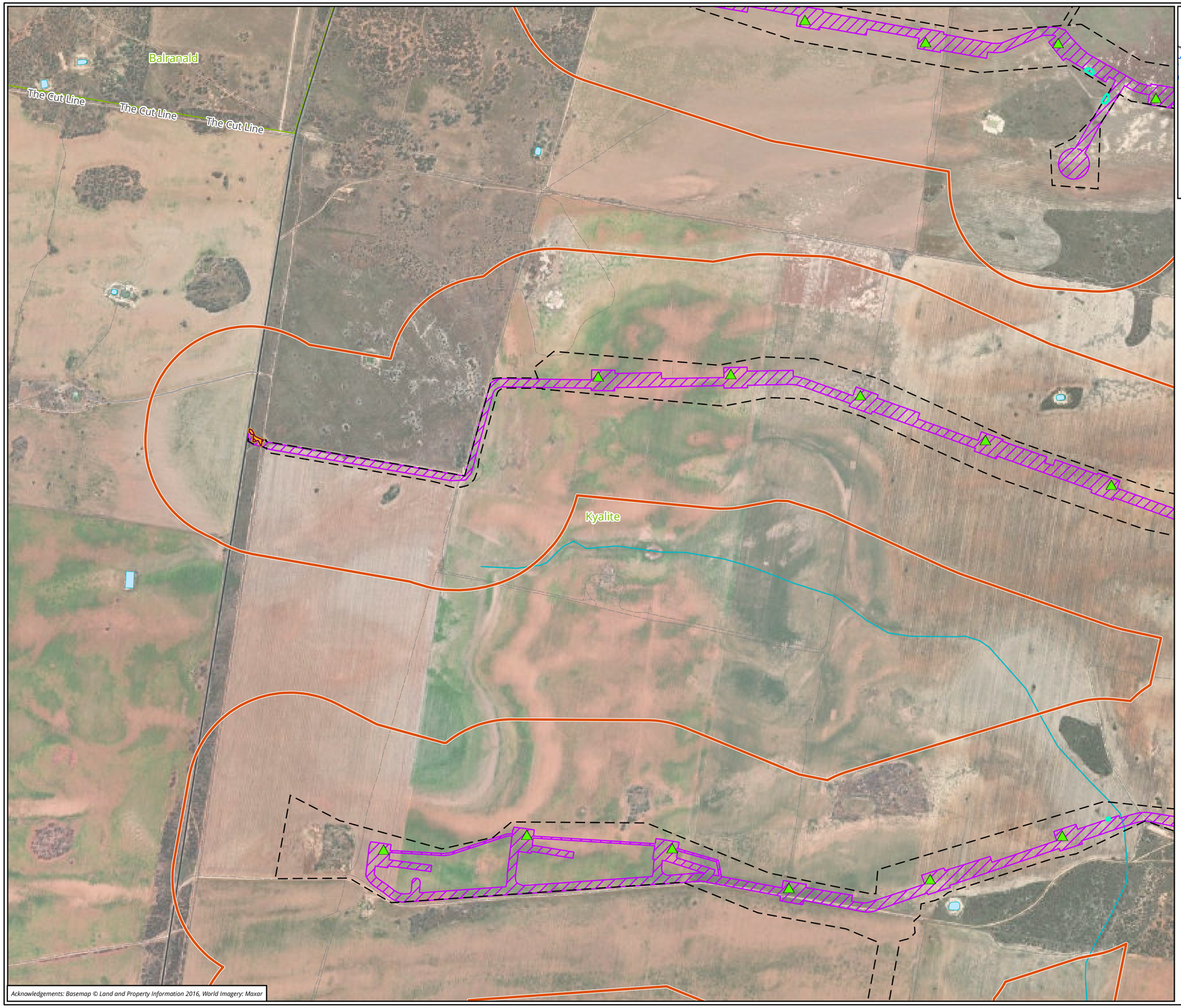
Meters

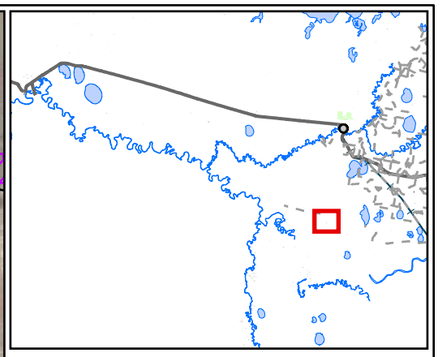
Scale: 1:17,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets





Legend

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

Impacts

- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.4 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

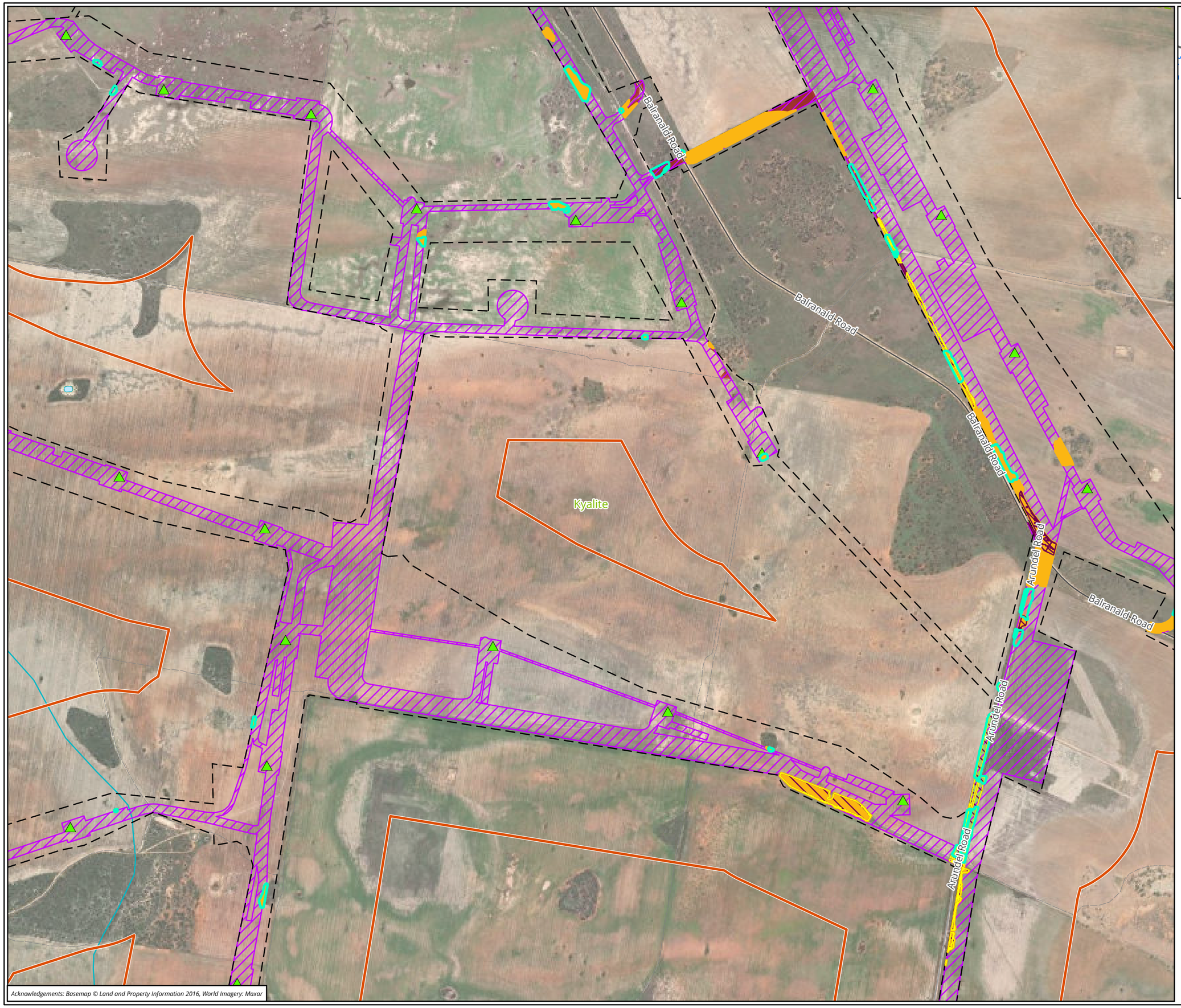
Scale: 1:17,000 @ A3

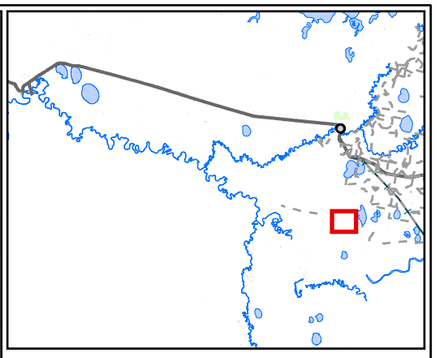
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets





Legend

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

Impacts

- Not requiring assessment
- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.5 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

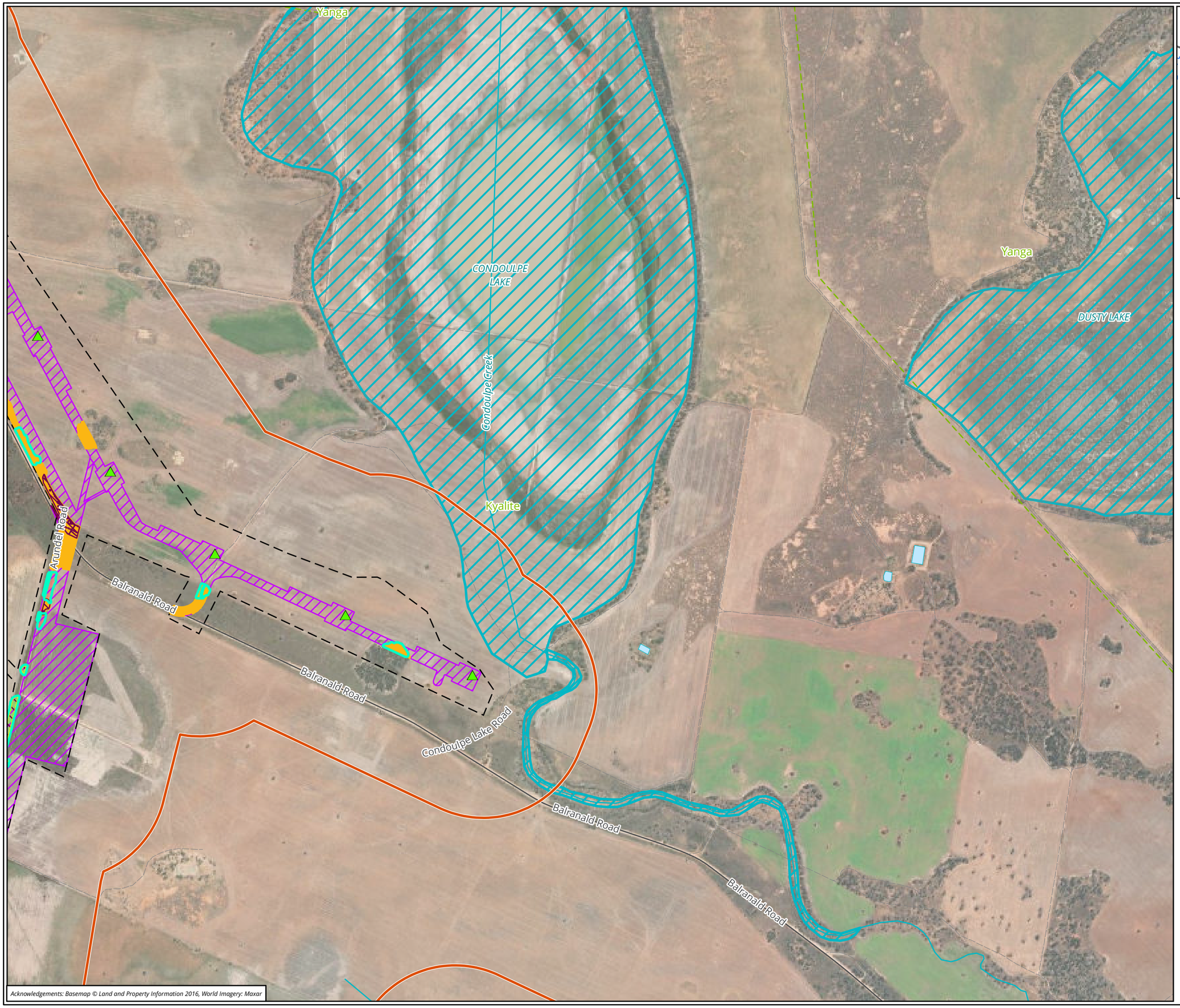
Scale: 1:17,000 @ A3

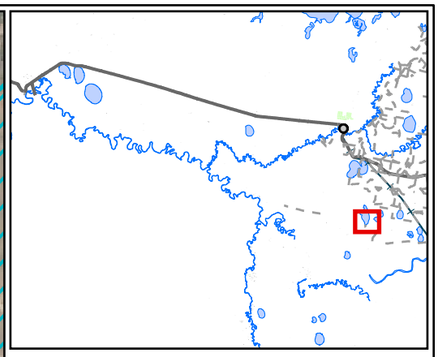
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets





Legend

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

Impacts

- Not requiring assessment
- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.6 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

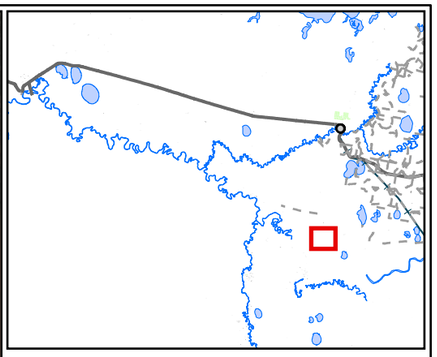
Meters

Scale: 1:17,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets



Legend

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

Impacts

- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.7 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800 N

Meters

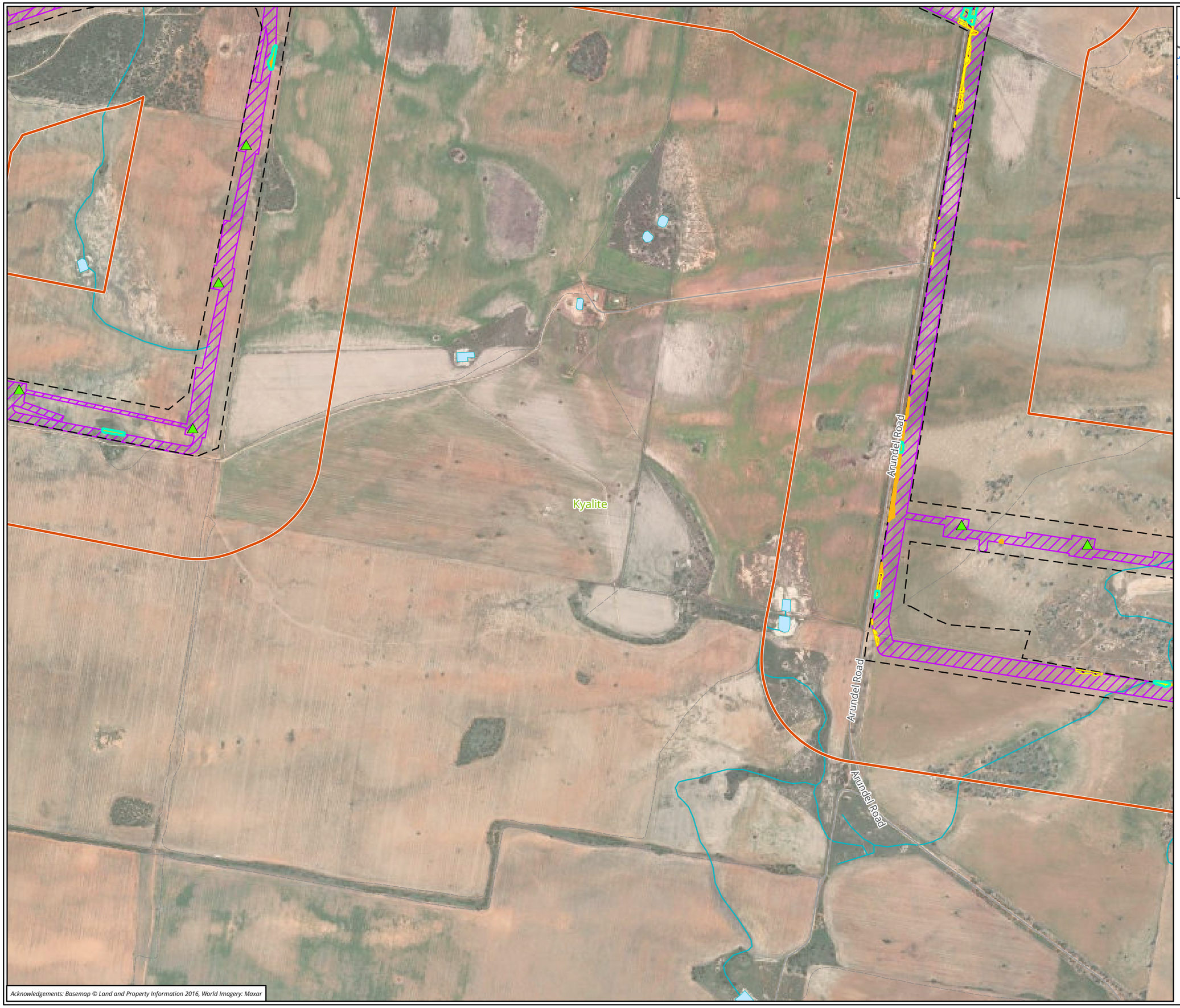
Scale: 1:17,000 @ A3

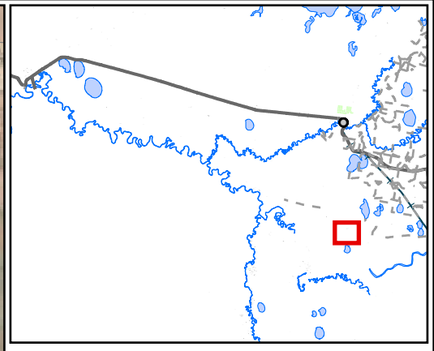
Coordinate System: GDA2020 MGA Zone 54

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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

Impacts

- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.8 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

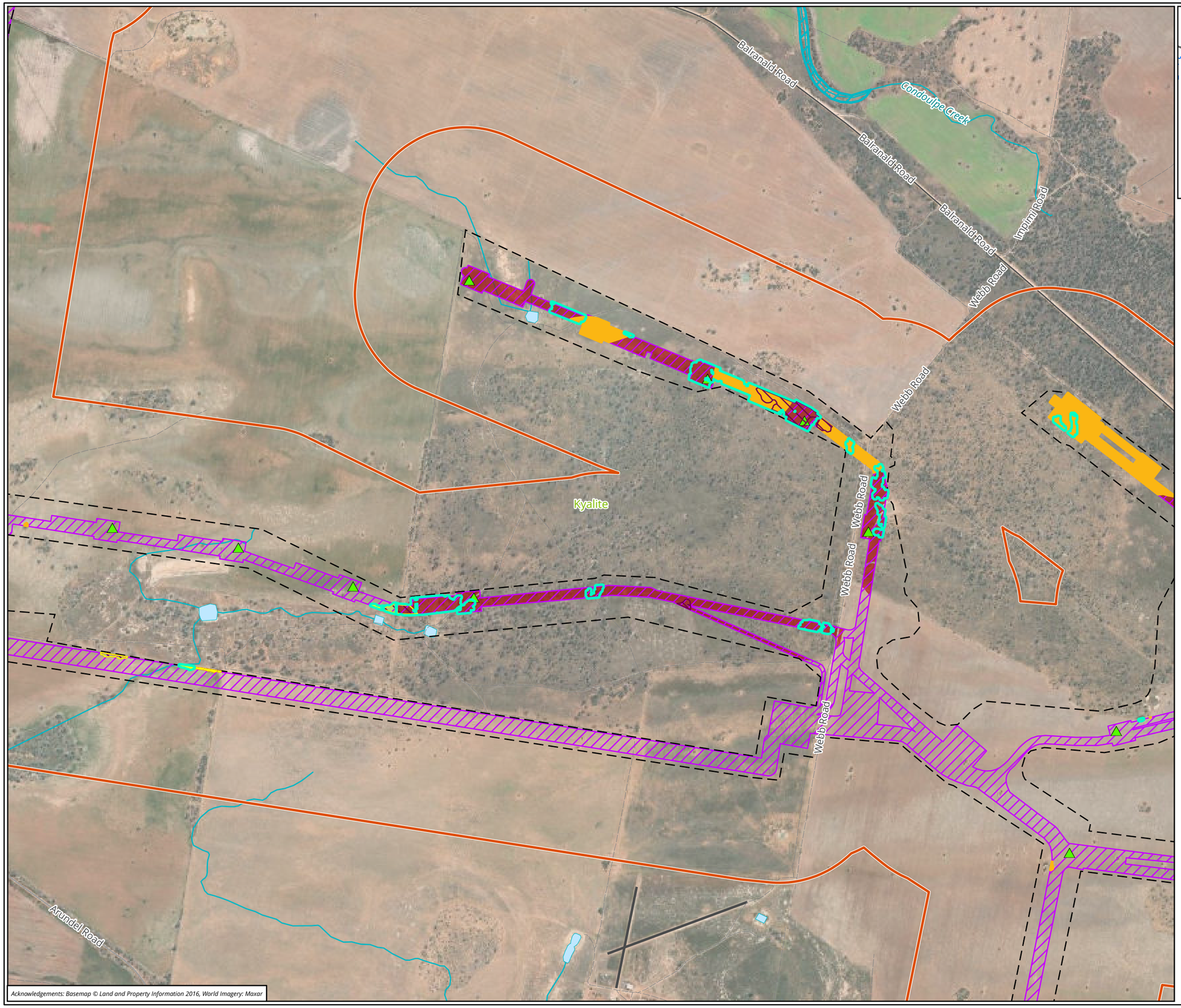
Scale: 1:17,000 @ A3

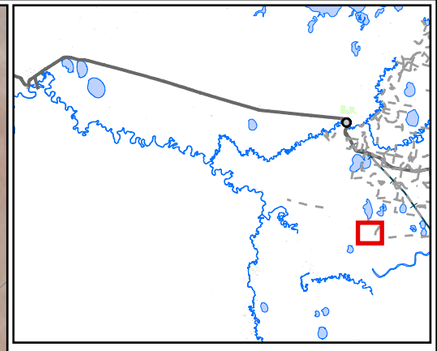
Coordinate System: GDA2020 MGA Zone 54

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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

Impacts

- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.9 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

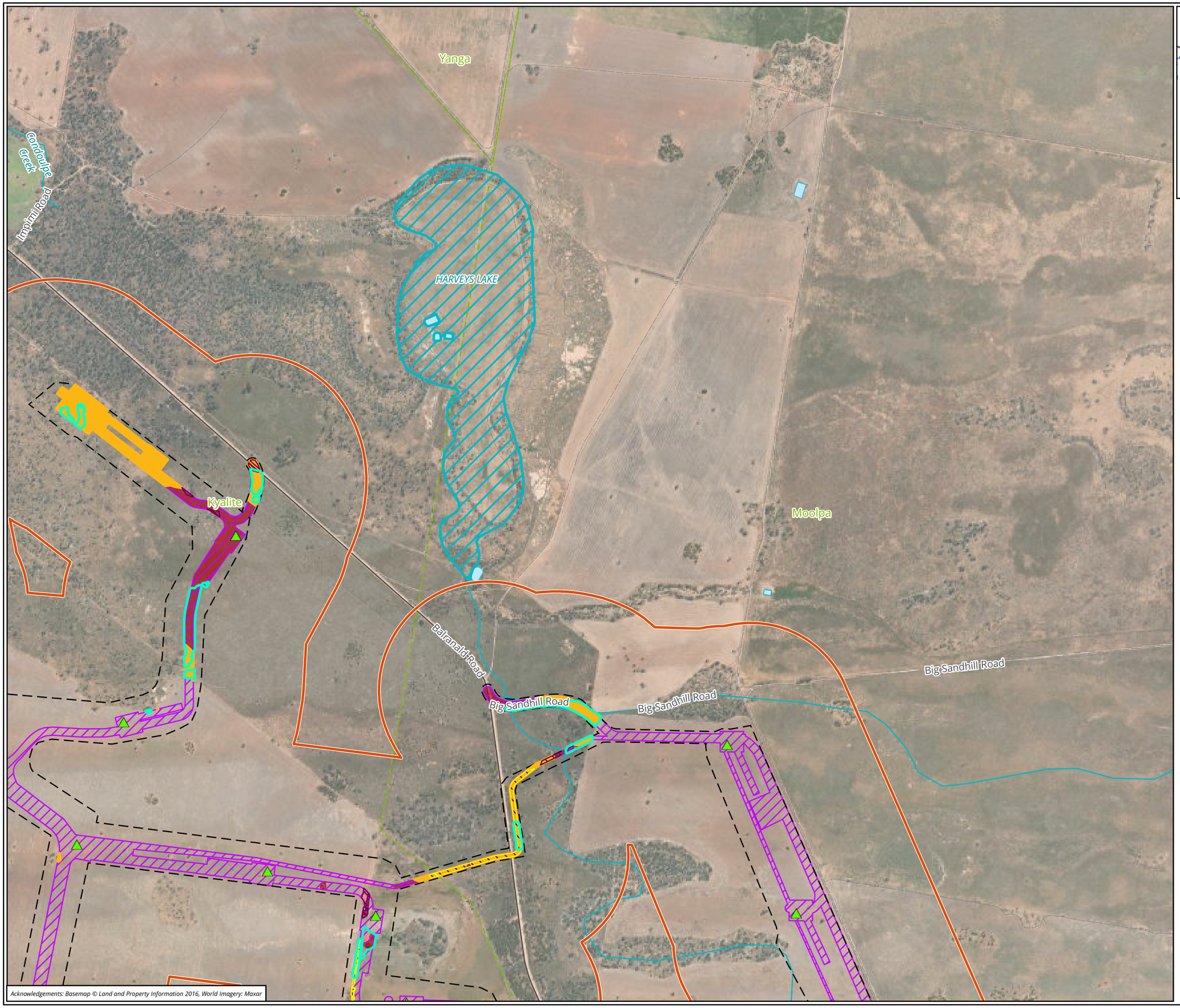
Scale: 1:17,000 @ A3

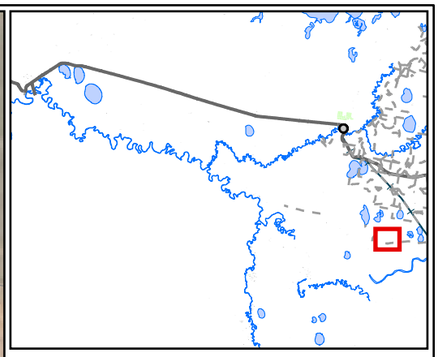
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets





Legend

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

Impacts

- Not requiring assessment
- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.10 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

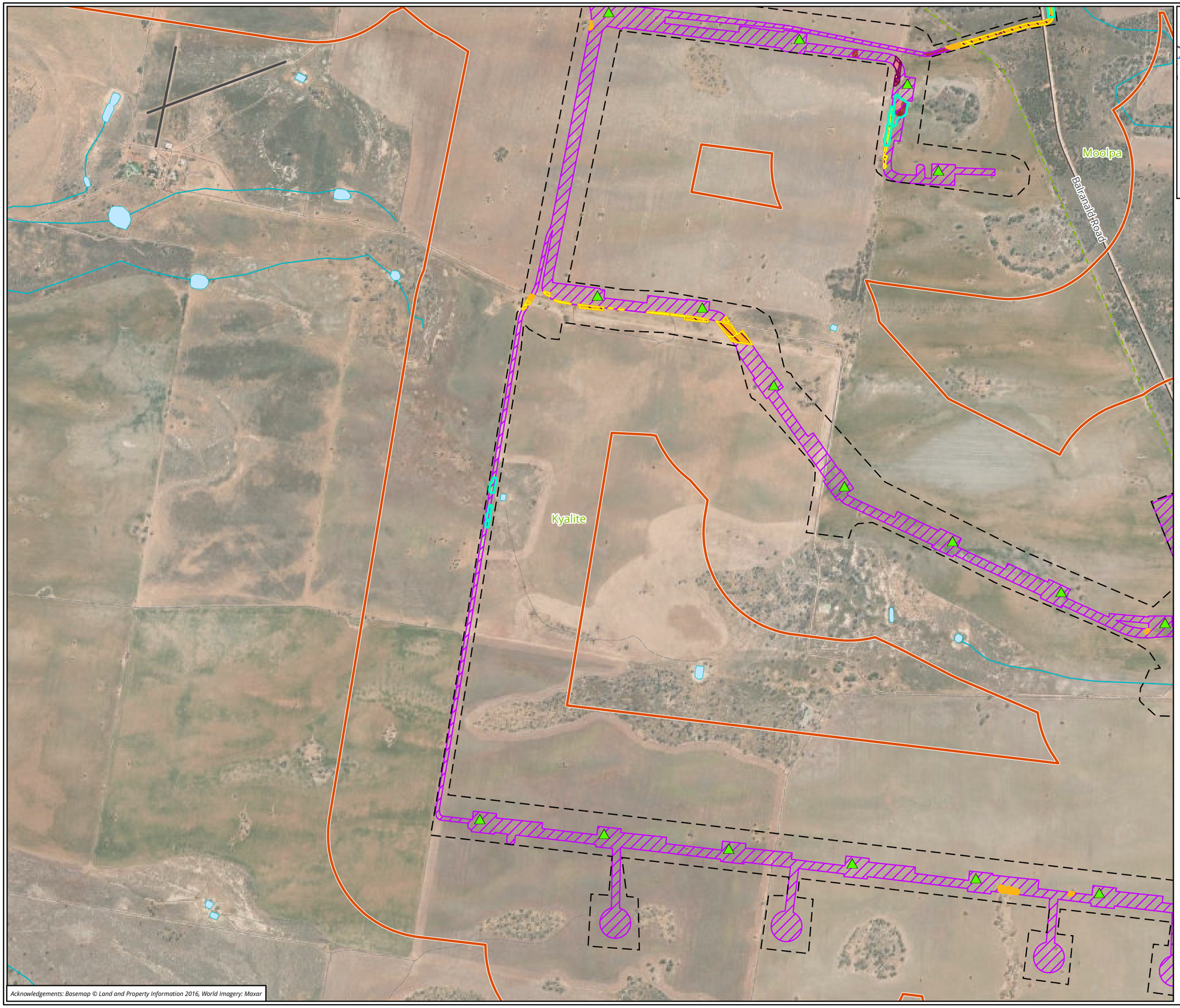
Scale: 1:17,000 @ A3

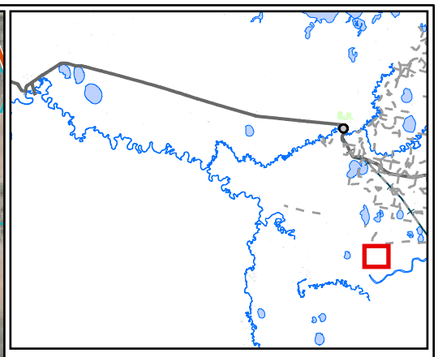
Coordinate System: GDA2020 MGA Zone 54

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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

Impacts

- Not requiring assessment
- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (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

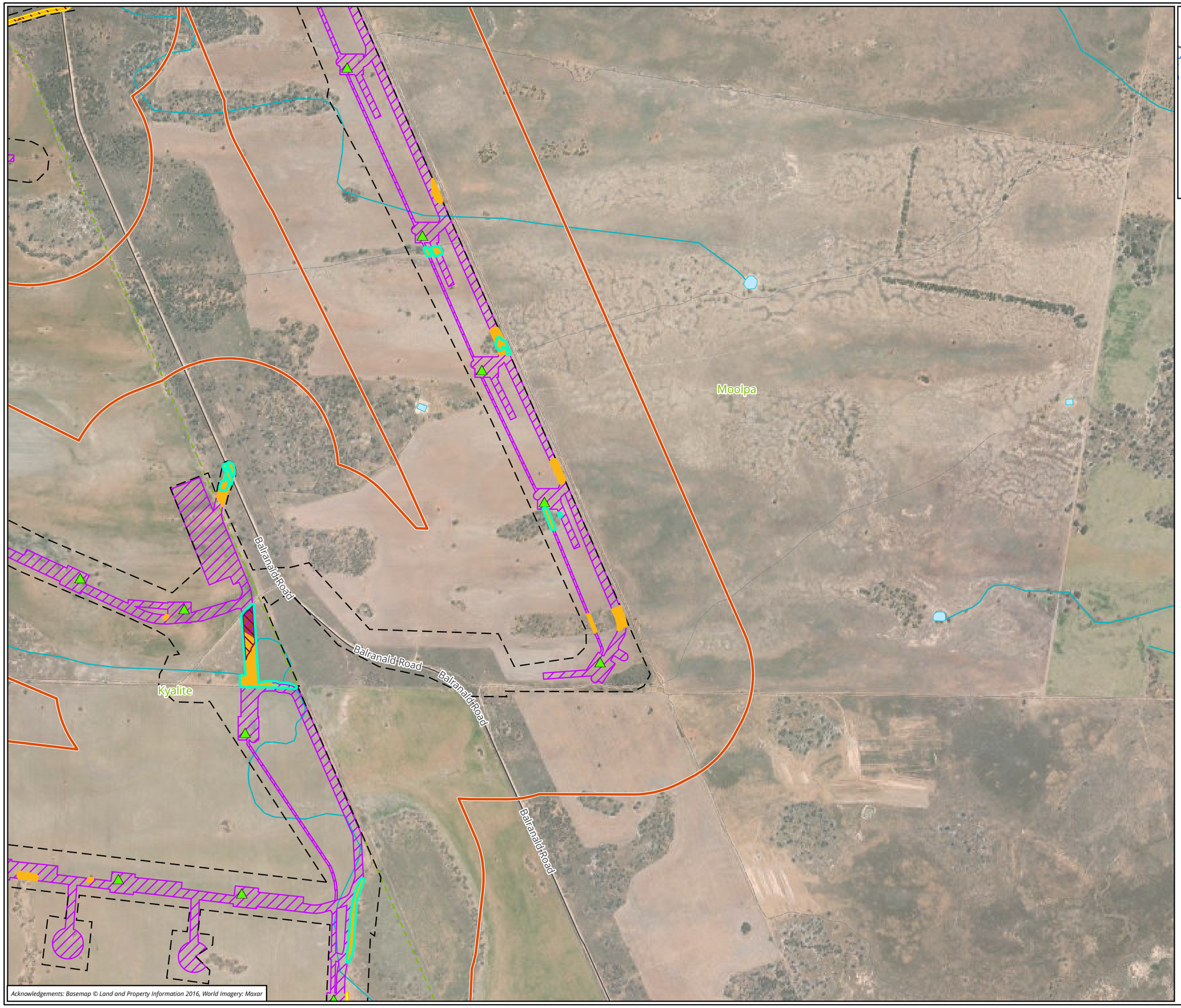
Coordinate System: GDA2020 MGA Zone 54

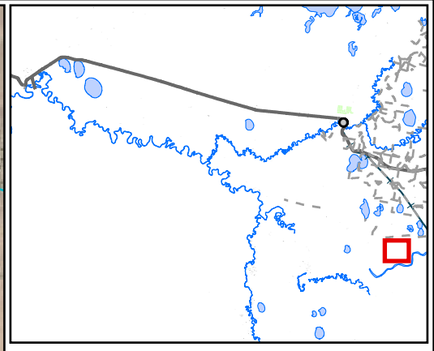
N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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

Impacts

- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.12 Impacts requiring offsets, not requiring offset, not requiring assessment

0 200 400 600 800

Meters

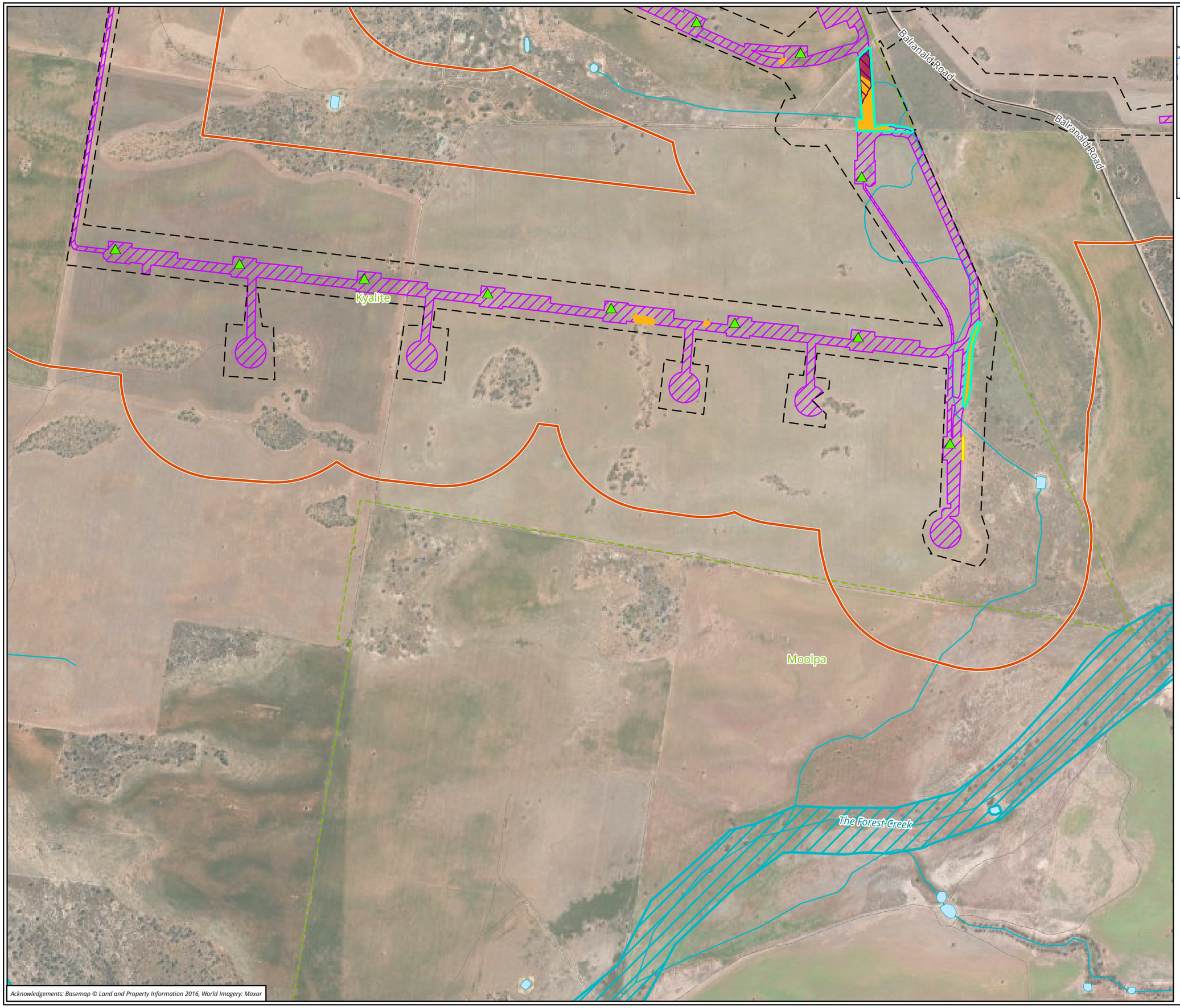
Scale: 1:17,000 @ A3

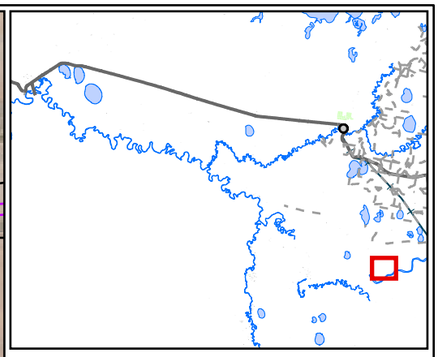
Coordinate System:
GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets





Legend

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

Impacts

- Not requiring offset
- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (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

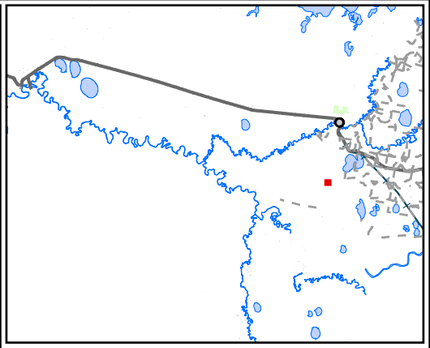
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.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

Impacts

- Requiring offset

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.14 Impacts requiring offsets, not requiring offset, not requiring assessment

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

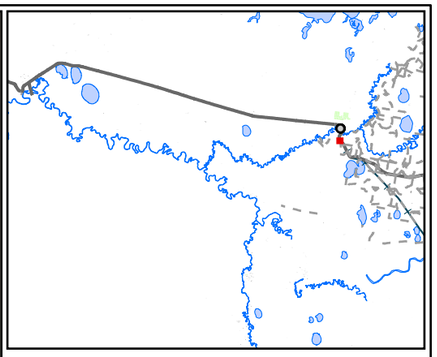
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets

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

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.15 Impacts requiring offsets, not requiring offset, not requiring assessment

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

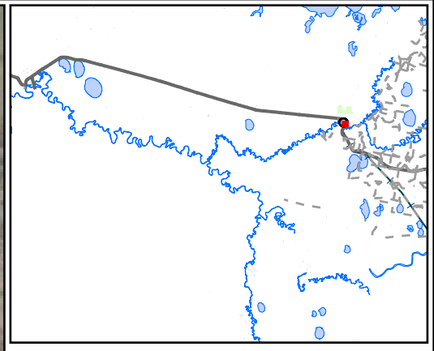
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets

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

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

Figure 20.16 Impacts requiring offsets, not requiring offset, not requiring assessment

0 20 40 60 80

Meters

Scale: 1:2,000 @ A3

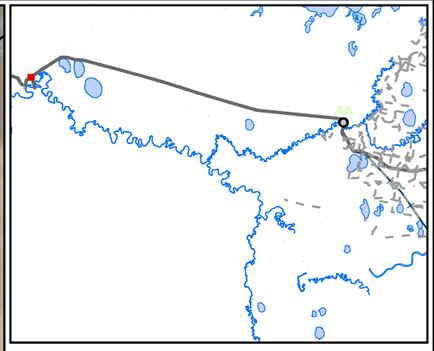
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets

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

Threatened species requiring offset

- Artiplex infrequens
- Crowned Gecko
- Painted Burrowing Frog
- Pink Cockatoo (Major Mitchell's Cockatoo)

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

biosis

Matter: 37502, Date: 23 May 2025
GIS: JET, Checked by: CW, Last edited by: jbeckius
Location: P:\37500s\37502\Mapping\37502_BDAR 10 + MAY2025.aprx
Layout: 37502_F20_Offsets

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

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)

BAM Credit Summary Report

Proposal Details

Assessment Id
00034462/BAAS18138/22/00034463

Proposal Name
Burrawong WF - BDAR RtS

BAM data last updated *
05/08/2025

Assessor Name
Callan Wharfe

Report Created
11/08/2025

BAM Data version *
Current classification (live - default) (82)

Assessor Number
BAAS18138

BAM Case Status
Finalised

Date Finalised
11/08/2025

Assessment Revision
13

BOS entry trigger

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

Atriplex infrequens / A saltbush (Flora)									
23_Moderate	62.7	62.7	2	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	64
163_Moderate	59.5	59.5	3.6	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	107
170_Moderate	59.5	59.5	4.7	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	139
170_Low	29.7	29.7	0.56	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	8
170_DNG	15.0	15.0	3.5	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	26
								Subtotal	**344**

Lophochroa leadbeateri / Pink Cockatoo (Fauna)									
16_Moderate	53.4	53.4	2.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	60
16_Low	28.6	28.6	0.36	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	5
16_DNG	14.7	14.7	2.6	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	19
16_Paddock_trees	10.7	10.7	0.21	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	1
21_Moderate	64.6	64.6	0.85	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	27
23_Moderate	62.7	62.7	1.7	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	52
57_Moderate	61.1	61.1	0.19	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	6

58_High	91.0	91.0	0.85	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	39
58_Moderate	74.8	74.8	9.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	340
58_DNG	17.7	17.7	11	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	97
58_Paddock_trees	46.6	46.6	0.07	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	2
163_Moderate	59.5	59.5	1.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	43
170_Moderate	59.5	59.5	4.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	127
170_Low	29.7	29.7	0.48	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	7

170_DNG	15.0	15.0	2.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	15
								Subtotal	**840**
Lucasium stenodactylum / Crowned Gecko (Fauna)									
170_Moderate	59.5	59.5	4.7	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	139
170_Low	29.7	29.7	0.56	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	8
170_DNG	15.0	15.0	3.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	26
								Subtotal	**173**
Neobatrachus pictus / Painted Burrowing Frog (Fauna)									
16_Moderate	53.4	53.4	3	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	81

16_Low	28.6	28.6	0.34	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	5
16_DNG	14.7	14.7	1.7	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	13
16_Paddock_trees	10.7	10.7	0.21	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1
58_High	91.0	91.0	0.42	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	19
58_Moderate	74.8	74.8	4.6	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	171
58_DNG	17.7	17.7	3.4	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	30
58_Paddock_trees	46.6	46.6	0.01	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1

163_Moderate	59.5	59.5	2.9	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	87
170_Moderate	59.5	59.5	0.62	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	18
170_Low	29.7	29.7	0.01	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1
170_DNG	15.0	15.0	0.73	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	5
								Subtotal	**432**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00044469/BAAS18138/23/00044470	Burrawong WF - Scattered trees - RtS	05/08/2025
Assessor Name	**Report Created**	**BAM Data version ***
Callan Wharfe	11/08/2025	Current classification (live - default) (82)
Assessor Number	**BAM Case Status**	**Date Finalised**
BAAS18138	Finalised	11/08/2025
Assessment Revision	**BOS entry trigger**	**Assessment Type**
3	Major Project	Scattered Trees

* 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 on 19 December 2023.

The Junction Rivers Wind Farm EIS exhibition ended on 12 August 2024. Table 78 below summarises the MNES related requirements and where they have been addressed within this assessment.

Table 78 Response to Submissions EPBC Bilateral Assessment Information

Biodiversity requirements	Relevant section where addressed
Biodiversity	
12.1 Provide evidence to support exclusion of PCT 170 in the development corridor from the Plains Mallee Box Woodland TEC. This must include assessment against the EPBC Act approved conservation advice	Evidence to support exclusion of Plains Mallee Box Woodland added within Section 3.2.4. This included assessment against the EPBC Act approved conservation advice.
19.1. Revise Table 62 to accurately report the Pink Cockatoo credit liability for the 'PCT170 Moderate' vegetation zone.	Table 74 within the BDAR has been updated to fix the Pink Cockatoo credit liability for the 'PCT170 Moderate' vegetation zone**.**
21.1. Amend Table 65 to match the text in section 12.1.1. Amend Table 67 of the BDAR to include further justification to support excluding MNES species from further assessment.	Text within Table 65 (now Table 79) has been aligned. Further justification has been added to Table 67 (now Table 81) for determination that further assessment (including SIC) is not required for relevant MNES.
21.2. Revise the BDAR to specifically address prescribed impacts to MNES.	The BDAR was revised to incorporate additional avoid and minimise, survey effort and mitigation measures relevant to the prescribed impacts. MNES related prescribed impacts are considered within Section 8.3, Table 65, Table 66 and Appendix 5.
21.3. Amend section 12 of the BDAR and specifically address each of the bilateral assessment requirements as detailed in Attachment C to this response.	Section 12 of the BDAR has been amended to specifically address the each of the bilateral assessment requirements that are relevant to the BDAR, outlined in Attachment C of the response. Actions taken are summarised below.

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 80 and Table 81).

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 79 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:

- Pink 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.
- Pink 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 79 and Table 80, 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 81).

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 79 below.

Table 79 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: • Pink Cockatoo. • Regent Parrot. The Controlled Action decision identified the following species as being at risk of impact: • Plains Wanderer. • Australian Painted Snipe. • South-eastern Hooded Robin. • Grey Snake. • Australasian Bittern. • Grey Falcon. • Blue-winged Parrot. • Painted Honeyeater. • Malleefowl. The following additional EPBC Act listed species were identified as part of this assessment: • Australasian Bittern. • Corben's Long-eared Bat. • Southern Whiteface. • Mossgiel Daisy. • Winged Peppercress. • Menindee Nightshade. • *Austrostipa metatoris.*	The following species were determined to be at risk of significant impact, and require assessment under the EPBC Act, refer to Table 80 and Table 81: • Corben's Long-eared Bat. • Regent Parrot. • Pink Cockatoo. • Australasian Bittern. • Grey Falcon.

Matter of NES	Project specifics	Potential for significant impact
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: • Shar-tailed Sandpiper. The following additional EPBC Act listed species were identified as part of this assessment: • Fork-tailed Swift. • Caspian Tern. • Gull-billed Tern. • Common Greenshank.	The following species were determined to be at risk of significant impact, and require assessment under the EPBC Act, refer to Table 80 and Table 81: • Sharp-tailed Sandpiper. • Common Greenshank. • Caspian Tern. • 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.	-
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 80 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
Pink 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. All HBTs identified as potential nest trees (refer to Figure 10). All areas of native vegetation within the subject land are foraging habitat for this species. 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 Pink cockatoo consist of: • Arid and semi-arid woodlands dominated by Mulga, mallee and box eucalypts, Slender Cypress Pine or Belah. • Known habitat containing suitable attributes, including potential habitat for the subspecies, especially where there are large mature trees with suitable hollows. • Surrounding matrix of these areas for the role of providing movement corridors for dispersal across the landscape. 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. 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. 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 (Commonwealth of Australia 2013).	Habitat critical to the survival of the species refers to areas that are necessary: • For activities such as foraging, breeding, roosting, or dispersal. • 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). • To maintain genetic diversity and long-term evolutionary development. • For the re-introduction of populations or recovery of the species. (TSSC 2024a). 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.
Curlew Sandpiper *Calidris ferruginea*	Critically Endangered, Migratory	Mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996). 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 is considered likely to use the habitat present within the subject land only on a very rare basis. 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 (Commonwealth of Australia 2013).	Habitat critical to the survival of the species refers to areas that are necessary: • For activities such as foraging, breeding, roosting, or dispersal. • 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). • To maintain genetic diversity and long-term evolutionary development. • For the re-introduction of populations or recovery of the species. (TSSC 2024a). The assessment completed by Nature Advisory (Nature Advisory 2023e) noted this species is unlikely 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.

MNES species	EPBC listing status	Habitat description	Potential habitat within the subject land	Important populations	Critical habitat
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: • Any regions where the species is likely to occur, and • Any newly discovered locations that extend the likely range of the species. 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 samphire; often with scattered clumps of lignum or canegrass.	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'. 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. Any location outside the above area that may be periodically occupied by Australian Painted Snipe when wetland conditions are favourable. (Cth DCCEEW 2022a). 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
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: • For activities such as foraging, breeding, roosting, or dispersal • 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) • To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. 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
Grey Snake ***Hemiaspis damelii***	Endangered	In the Lowbidgee floodplain region of NSW (approx. 40 km north-east of 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).	No suitable habitat that would support this species was identified within the subject land. 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.	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: • For activities such as foraging, breeding, roosting, or dispersal • 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) • To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. 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).	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	As an Endangered listed species, all populations are considered 'Important Populations'. This species was not recorded within the subject land. An assessment completed by Nature Advisory	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

MNES species	EPBC listing status	Habitat description	Potential habitat within the subject land	Important populations	Critical habitat
		The dams within the subject land are small and disturbed, they are not considered likely to support breeding habitat or foraging habitat for this species.	could occasionally support habitat for the species. in the study area. 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. 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.	(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.	2022c). The habitat present within the 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 ***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 (TSSC 2020)	PCTs 16, 21, 23, 57, 58, 163 and 170. Potential breeding habitat would occur in the form of eucalyptus woodland. Potential roosting habitat would occur in the form of eucalyptus woodland. 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: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. 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: • For activities such as foraging, breeding, roosting, or dispersal • 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
					• To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. 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. 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. 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 (DCCEEW 2023) 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. Wetlands both near the coast and in semi-arid zones used for foraging and staging. Eucalypt forests and woodlands within the breeding range in Tasmania, coastal southeastern South Australia and southern Victoria. Live and dead trees and stumps with suitable hollows within the breeding range. (DCCEEW 2023)

MNES species	EPBC listing status	Habitat description	Potential habitat within the subject land	Important populations	Critical habitat
					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.
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: • 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. • 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). 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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. 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: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. 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). 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. 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: • For activities such as foraging, breeding, roosting, or dispersal • 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) • 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. This includes a mosaic of feeding and roosting habitat where the species frequents, including freshwater, marine and artificial wetland (TSSC 2024b). 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. 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: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. No 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: • For activities such as foraging, breeding, roosting, or dispersal • 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 • For the reintroduction of populations or recovery of the species or ecological community. 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 than 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. Fork-tailed Swift was not recorded within the subject land during 24 months of BBUS completed by Nature Advisory. 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. 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 2024)..	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. 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 2024). 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. 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 coastal 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 2023d).	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: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. 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: • Relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both. • Habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat • Living and dead trees with hollows and crevices which are essential for roosting and nesting. (Cth DCCEEW 2023d). 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: • 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 • Populations that are near the limit of the species range. 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 • 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) • To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. 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. 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'. 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: • For activities such as foraging, breeding, roosting, or dispersal • 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, 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) • To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. 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 soil, red sands, red-brown earths and loamy soils. The vegetation associated with this species includes Saltbush and Bluebush plains and Mallee associations	PCT 16. 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: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. 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: • For activities such as foraging, breeding, roosting, or dispersal • 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 • For the reintroduction of populations or recovery of the species or ecological community. 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: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. The 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: • For activities such as foraging, breeding, roosting, or dispersal • 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) • 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. Critical habitat for this species has not been defined. The habitat where this species was identified is not considered critical habitat.
Atriplex infrequens	Vulnerable	The species known habitat is associated with broad drainage tracts, clay flats and possibly occasionally inundated habitats. Very little ecological information is available for this species, so it's critical habitat components can only be speculated as relatively undisturbed and ungrazed drainage lines and flats (DECC, 2008	The species is associated with PCTs 23, 163 and 170 and would be more likely to occur in areas that are subject to lower levels of disturbance from vegetation clearing and grazing and are subject to periodic inundation.	Important populations have not been defined for *Atriplex infrequens*. Therefore important population would be those that are considered: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. The 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: • For activities such as foraging, breeding, roosting, or dispersal • 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) • To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community.

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.
- Microbat survey (Bat Utilisation Survey):
  - Six seasonal microbat survey effort covering autumn, winter, spring (two seasons), summer (two seasons).

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*
- Pink 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 59 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.

- 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.
- Pink Cockatoo:
  - Of the 252 hollow-bearing trees mapped during Pink 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 Pink 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 (Commonwealth of Australia 2013):

- Pink 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 81 below provides a summary of impact assessments undertaken for all MNES potentially impacted by the project.

Table 81 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						
Pink Cockatoo ***Lophochroa leadbeateri***	Recorded	• Direct removal of breeding habitat. • Direct removal of foraging habitat. • Potential indirect impact to retained vegetation.	• Removal of at least 17 suitable HBTs supporting potential breeding habitat. • 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. **Significant impacted considered likely.**
Regent Parrot ***Polytelis anthopeplus monarchoides***	Recorded	• Direct removal of foraging habitat. • Potential indirect impact to retained vegetation.	• Up to 72 ha of forage habitat considered critical to the survival of the species. • Impacts comprise 8.74 ha of PCT 170 providing secondary forage habitat, and 63.37 ha of habitat providing 'other forage	• Temporary and permanent • 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. 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. 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 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. • Species not recorded during 24 months BBUS.	• No areas of breeding or foraging habitat proposed for impact. • Potential impacts to individuals.	• Temporary and permanent. • 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. • Impacts not considered likely for this species.	• No areas of breeding or foraging habitat proposed for impact.	• Temporary and permanent. • Ongoing from construction and for the life of the project (up to 30 years.	. A detailed desktop assessment was completed assessing location of BioNet records, Mapped Important habitat and habitat within the subject land. Although there is grassland habitat within the subject land, in the form of derived grasslands from woodland mallee communities this species is not considered to occur where, the subject land contains no remnant or natural grasslands that would typically support this species occur. No nearby records are	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
					present, and no nearby populations are known. Species is not considered likely to occur within the subject land	
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. • Impacts not considered likely for this species.	• No areas of breeding, and highly limited foraging habitat proposed for impact.	• Temporary and permanent. • Ongoing from construction and for the life of the project (up to 30 years.	The detailed habitat assessment of all aquatic habitat within the subject land, including its use as temporary or stop over habitat determined this species not considered likely to use the habitat present within the subject land. Additional to this, this species was not detected during 2 years of BBUS survey effort. 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. Detailed assessment completed by Nature Advisory and Biosis on the movements and potential impacts to waterbird within the locality was completed. 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. 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. Any potential impact mitigated through project design. Detailed assessment completed within Sections 6, 7, 8.3.5 and 9, further assessment is not considered required.
South-eastern Hooded Robin ***Melanodryas cucullata cucullata***	Low	• Species unlikely to occur and was not detected during BBUS or targeted survey efforts. • Impacts not considered likely for this species.	• Up to 34.5 ha of potential breeding and foraging woodland habitat.	• Temporary and permanent. • Ongoing from construction and for the life of the project (up to 30 years.	A detailed assessment was completed of records under the NSW BioNet atlas for this species. One record of this species occurs around 11 km from the subject land. This species is considered sedentary with some local seasonal movement. A population of this species is not considered to occur within the subject land. This conclusion was supported through the survey effort completed, where the species was	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
					not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within the subject land. Species is not considered likely to occur. all areas of potential habitat within the development footprint that could support this species will be offset through BC Act bilateral agreement as an ecosystem species.	
Grey Snake ***Hemiaspis damelii***	Low	• Habitat in the subject land is unlikely to support this species. • Impacts not considered likely for this species.	• No areas of breeding or foraging habitat proposed for impact.	• Not applicable.	A detailed assessment was completed of records under the NSW BioNet atlas for this species. A population of this species is known to occur north-east of Balranald – Maude in an area of known suitable habitat, that contains wetland inundation, black soils, cracking soils etc. The habitat assessment completed within the subject land did not find suitable habitat for this species.. 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 habitat within proximity of the subject land. • Species not recorded during 24 months BBUS.	• No areas of breeding or foraging habitat proposed for impact. • Potential impacts to individuals.	• Temporary and permanent. • 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. 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.	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.
Grey Falcon ***Falco hypoleucos***	Low	• Species may very occasionally occur within the subject land, was not	• Up to 75.68 ha of potential forage habitat,	• Temporary and permanent.	Species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys	SIC undertaken – refer to Appendix 5.

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
		detected during BBUS or targeted survey efforts. • Possible turbine collision risk.	and limited potential breeding habitat.	• Ongoing from construction and for the life of the project (up to 30 years.	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.	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. • Impacts not considered likely for this species.	• Up to 75.68 ha of habitat assessed as unlikely to support the species.	• Temporary and permanent. • Ongoing from construction and for the life of the project (up to 30 years.	This species occurs throughout most of NSW in a scattered formation of records within the NSW BioNet Atlas. The nearest record of this species occurs around 30 km from the subject land. A population of this species, or regular movements of this species has been determined not to occur within the subject land through during 2 years of BBUS survey effort, and targeted woodland bird surveys within 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.
Painted Honeyeater *Grantiella picta*	Low	• Species unlikely to occur and was not detected during BBUS or targeted survey efforts. • Impacts not considered likely for this species.	• Up to 75.68 ha of habitat assessed as unlikely to support the species.	• Temporary and permanent • Ongoing from construction and for the life	This species moves in relation to food preference, mistletoe. An abundance of mistletoe was not observed within the subject land. The habitat within the subject land is not considered to be preferred by this species, but could still be used. Regular movements or occurrence of this species within the	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
				of the project (up to 30 years	subject land is not considered likely to occur. Within a 50 km radius, only 2 records of this species are present, both are over 30km from the subject land. This conclusion is supported by the survey effort, where the species was not detected during 2 years of BBUS survey effort, or targeted woodland bird surveys within 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.	
Malleefowl ***Leipoa ocellata***	Low	• Species unlikely to occur and was not detected during BBUS or targeted survey efforts. • Impacts not considered likely for this species.	• Up to 5.23 ha assessed as unlikely to support the species.	• Temporary and permanent • 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. This species is considered conspicuous, and would have been detected, or, breeding mounds/evidence of past use would have been detected within the subject land during the extensive survey effort to date. 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).	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
					Potential habitat to be impacted has been offset through the bilateral agreement where this species is listed as an ecosystem credit species.	
Common Greenshank ***Tringa nebularia***	Low	• Possible turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land. • Species not recorded during 24 months BBUS.	• No areas of breeding or foraging habitat proposed for impact.	• Temporary and permanent. • 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.
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. • Potential indirect impact to retained vegetation.	• Up to 30.37 ha of potential foraging and breeding habitat.	• Temporary and permanent. • 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. Refer to further information in Sections 6, 7, 8.3.5 and	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

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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
					9.	the project.
Fork-tailed Swift ***Apus pacificus***	Low	• Species unlikely to occur and was not detected during BBUS or targeted survey efforts. • Impacts not considered likely for this species. • Low potential for 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. • 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. 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. 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.	SIC not undertaken, species is not considered likely to be present. Potential significant impact is unlikely. Significant impacts 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. • Species not recorded during 24 months BBUS.	• No areas of breeding or foraging habitat proposed for impact.	• Temporary and permanent. • 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) 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.

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
Gull-billed Tern *Gelochelidon nilotica*	Low	• Possible turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land. • Species not recorded during 24 months BBUS.	• No areas of breeding or foraging habitat proposed for impact.	• Temporary and permanent. • 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) 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.
Southern Whiteface *Aphelocephala leucopsis*	Recorded	• Recorded within subject land • Unlikely to fly at RSA height. • Direct impact to potential breeding and foraging habitat.	• Up to 32.44 hectares of potential breeding and foraging habitat.	• Temporary and permanent. • 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. 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.
Curlew Sandpiper *Calidris ferruginea*	Low	• Low possibility of turbine collision risk during periods of high rainfall producing wetland habitat within proximity of the subject land. • Species not recorded during 24 months BBUS.	• No areas of breeding or foraging habitat proposed for impact.	• Temporary and permanent. • Ongoing from construction and for the life of the project	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 Assessment not required due to very low likelihood of occurrence and impact. Species will be considered in ongoing monitoring and

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
				(up to 30 years.		mitigation associated with BBAMP, however significant impact is highly unlikely to occur.
Mossgiel Daisy *Brachyscome papillosa*	Low. Not recorded during targeted surveys.	• Species confirmed absent during targeted surveys	• Nil	• N/a	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. The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. Where populations of this species occur, is it considered 'common', with large numbers of individuals present. This is visible within the NSW BioNet Atlas within recently surveyed areas for Keri Keri Wind Farm, PEC and Baldon Wind Farm. Although it is noted that isolated records and small populations occur. Due to the area of the subject land surveyed, it is considered unlikely a population of this species is present. If a population was present, we considered that at least some individuals would have been recorded in the areas surveyed by the subject land.	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
Winged Peppercress *Lepidium monoplocoides*	Low. Not recorded during targeted surveys.	• Species confirmed absent during targeted surveys	• Nil	• N/a	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. The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. This species is noted as not being tolerant of grazing, much of the subject land has been subject to grazing reducing the potential of this species occurring. Due to the area of the subject land surveyed, it is considered unlikely a population of this species is present. If a population was present, we considered that at least some individuals would have been recorded in the areas surveyed within the subject land.	SIC not undertaken, species is not considered likely to be present. No potential significant impact.
Menindee Nightshade *Solanum karsense*	Low. Not recorded during targeted surveys.	• Species confirmed absent during targeted surveys	• Nil	• N/a	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. The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. Records of this species are isolated and fragmented outside the key population area in Menindee. No records are present south of Balranald. This species is noted as being	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
					common to locally abundant where populations occur as it is a clonal species. Due to the area of the subject land surveyed, it is considered unlikely a population of this species is present. If a population was present, we considered that at least some individuals would have been recorded in the areas surveyed within the subject land.	
A Spear Grass *Austrostipa metatoris*	Confirmed absent from current subject land.	• Species was not identified within the subject land or impact area. • 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. • No direct or indirect impacts expected.	• Temporary and permanent. • 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. The species was not recorded elsewhere within the subject land and is therefore considered unlikely to occur or be subject to impacts. The habitat assessment completed of the remaining areas to be surveyed determined these areas are unlikely to support this species. This species is known to be threatened by grazing and is considered unlikely to occur within the subject land where grazing pressures occur. The TSR was observed as high quality vegetation in most areas with limited evidence of regular grazing, likely leading to the persistence of this species.	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
Atriplex infrequens	Low. Presence assumed as surveys were unable to be completed during required survey period	• Impacts will occur to PCTs associated with the species. • It is only considered a low potential for the species to be present within the subject land. • If the species was to occur it would not be considered an Important Population of this Vulnerable listed species.	• Up to 14.34 ha of assumed presence habitat will be impacted.	• Temporary and permanent. • Ongoing from construction and for the life of the project (up to 30 years.	If the species was present within the subject land it would not be considered an Important Population. The subject land occurs near the southern extent of the species' known / predicted population, which equates t the NSW / VIC boarder, however records occur along a 350 km (approx.) stretch of the border, with the subject land near the centre of these records. As such the subject land is not considered at or near the extent of the species range, nor does it meet any of the other requirements for consideration as an Important Population. Assumed habitat includes lower condition areas and those not subject to regular inundation, and as such is likely to be substantially greater than habitat with actual potential to support the species.	SIC not undertaken. Potentially existing is not considered an Important Population and as such a significant impact is considered highly unlikely to occur.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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 69 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.

Pink Cockatoo

Specific measures for this species include:

- Once final development footprint is determined undertake a HBT survey to create an inventory of potential Pink 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 Pink 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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.

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 82).

Table 82 Residual impacts to MNES

Residual project impact	MNES impacted	Impact to MNES
Removal of native vegetation providing habitat to MNES	Pink Cockatoo	Removal of at least 17 suitable HBTs supporting potential breeding habitat. Up to 39.45 ha of habitat meeting the definition of habitat critical to the survival of the species to be removed/impacted. 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. Impacts to primary movement corridors and primary foraging habitats being avoided. Significant impact considered unlikely.
	Corben's Long-eared Bat	Up to 30.37 ha of potential foraging and breeding habitat to be removed/impacted. 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. 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. Significant impact considered unlikely.
	Malleefowl Painted Honeyeater Blue-winger Parrot South-eastern Hooded Robin Plains-wanderer Grey Snake	Impacts to habitat assessed as unlikely to support these species.
	Sharp-tailed Sandpiper Australasian Bittern	No areas of important breeding or foraging habitat proposed for impact, or to an ecologically important

Residual project impact	MNES impacted	Impact to MNES
	Common Greenshank Gul-billed Tern Caspian Tern Fork-tailed Swift	portion of a population.
	Atriplex infrequens	14.34 ha of vegetation where species has been assumed to occur due to survey limitations to be impacted.
	Austrostipa metatoris	All areas where this species was identified will be avoided by the proposed works. 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 64 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: • Inadvertent impacts on adjacent habitat or vegetation. • Reduced viability of adjacent habitat due to edge effects. • Reduced viability of adjacent habitat due to noise, dust or light spill. • Transport of weeds and pathogens from the site to adjacent vegetation. • Increased risk of starvation, exposure and loss of shade or shelter. • Loss of specialist breeding habitats. • Increase in predators and pest animal populations. • Fragmentation of movement corridors.
	MNES considered to be at-risk of impact from turbine strike, and possible barrier effects: • Sharp-tailed Sandpiper • Australasian Bittern • Common Greenshank • Gul-billed Tern • Caspian Tern • Fork-tailed Swift • Grey Falcon • Curlew Sandpiper	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 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.

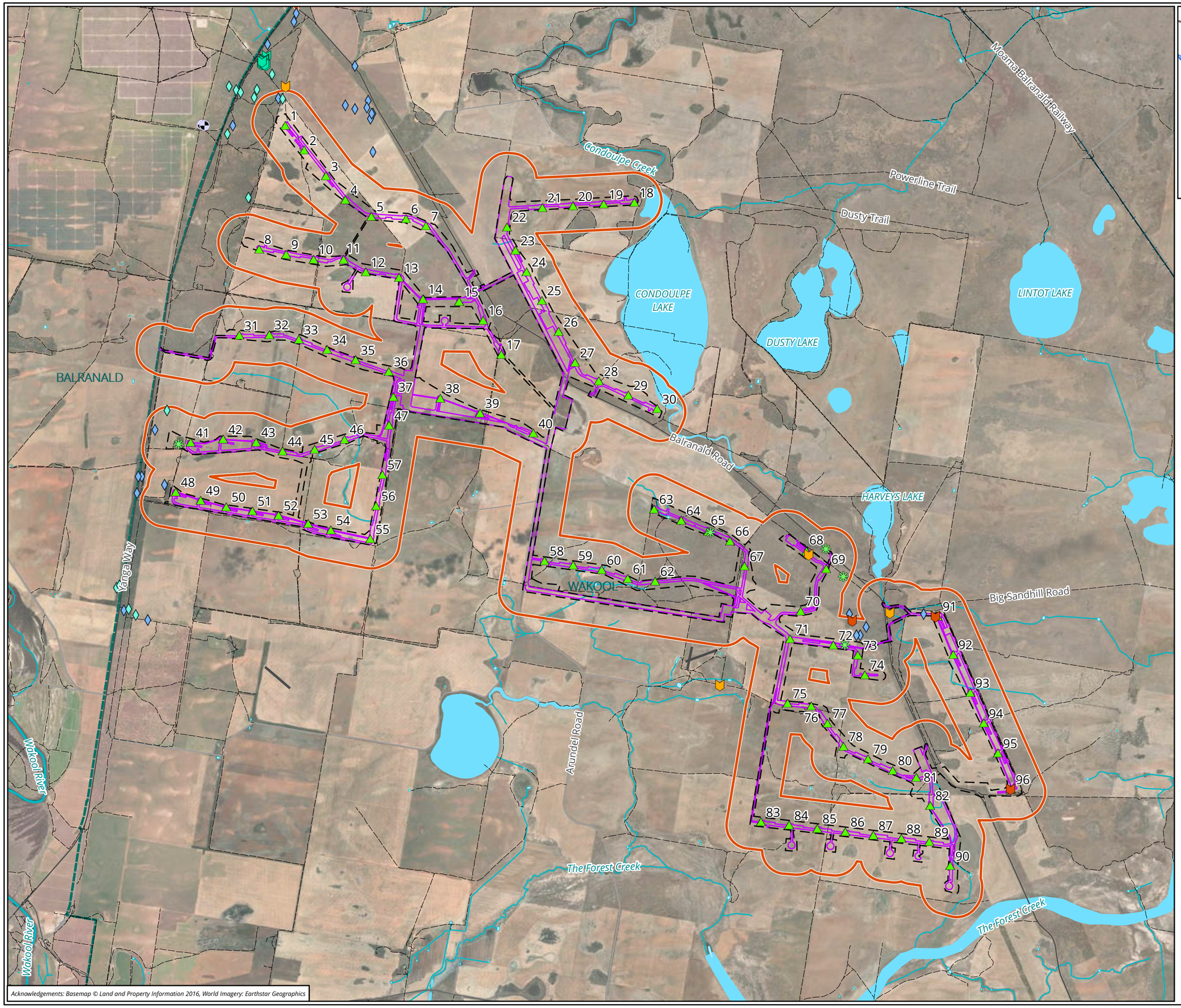
12.1.7. Offsetting of residual impacts to MNES

Impacts to Pink 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 (Commonwealth of Australia 2013) (refer Appendix 5). As such offsetting in accordance with the EPBC Act Environmental Offsets Policy (DSEWPaC 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 (Commonwealth of Australia 2013), and as such offsetting in accordance with the EPBC Act Environmental Offsets Policy (DSEWPaC 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 Pink Cockatoo will ensure the EPBC Act Environmental Offsets Policy (DSEWPaC 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 2025). 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.

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 74, Table 75 and Table 76, and summarised in Table 83 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 83 Summary of project offset requirement

Species / Offset trading group (OTG)	PCT ID	Credits required
Ecosystem credits		
Inland Floodplain Woodlands ≥50% and <70% cleared	PCT 16	100
Sandhill Pine Woodland	PCT 21	52
Acacia melvillei Shrubland	PCT 23	66
Semi-arid Sand Plain Woodlands <50% cleared	PCT 57	4
Semi-arid Sand Plain Woodlands ≥50% and <70% cleared	PCT 58	997
Riverine Chenopod Shrublands <50% cleared	PCT 163	80
Sand Plain Mallee Woodlands <50% cleared	PCT 170	118
Species credits		
Atriplex infrequens	-	344
Crowned Gecko	-	173
Painted Burrowing Frog	-	432

Species / Offset trading group (OTG)	PCT ID	Credits required
Pink 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.

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

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 84 below. Ecological condition was found to range from high to low and areas of derived native grasslands.

Table 84 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 Pink 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 85 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 85 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 85 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 86 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 86 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 Pink 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). Pink 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 Pink 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 (excluding offsets required for scattered trees) are presented in Table 87 and Table 88 respectively. Staged offsets for scattered trees are presented in Table 89 and Table 90.

BAM Calculator Credit Summary Reports for each stage are provided below. It should be noted that there are some minor variations in the numbers of credits required for PCTs and species credit species when split into stages (compared to the full project [refer Section 10.3.1]), due to the BAM Calculator's inbuilt rounding ruleset.

The Proponent will finalise the offset staging plan with DPHI prior to the commencement of construction.

Table 87 Offset staging plan – Stage 1 impacts and credit requirements

PCT / Species	Vegetation zone	Impact (Ha)	Credits required
Stage 1			
PCT 16	16_Moderate	0.59	14
	16_DNG	0.68	0
	16_Paddock Trees	0.21	0
PCT 23	23_Moderate	0.61	19
PCT 58	58_High	0.31	12
	58_Moderate	1.60	52
	58_DNG	6.27	49
	58_Paddock Trees	0.01	1
PCT 163	163_Moderate	0.07	2
PCT 170	170_Moderate	0.13	3
	170_DNG	1.55	0
Totals	-	**12.03**	**152**

PCT / Species	Vegetation zone	Impact (Ha)	Credits required
Atriplex infrequens	23_Moderate	0.61	19
	163_Moderate	0.07	2
	170_Moderate	0.13	4
	170_DNG	1.55	12
Totals	**-**	**2.36**	**37**
Crowned Gecko	170_Moderate	0.13	4
	170_DNG	1.55	12
Totals	**-**	**1.68**	**16**
Painted Burrowing Frog	16_Moderate	0.56	15
	16_DNG	0.14	1
	16_Paddock Trees	0.21	1
	58_High	0.30	14
	58_Moderate	0.27	10
	58_DNG	0.61	5
	58_Paddock Trees	0.01	1
	170_Moderate	0.13	4
	170_DNG	0.33	2
Totals	**-**	**2.56**	**53**
Pink Cockatoo	16_Moderate	0.59	16
	16_DNG	0.68	5
	16_Paddock Trees	0.21	1
	23_Moderate	0.61	19
	58_High	0.31	14
	58_Moderate	1.05	39
	58_DNG	4.24	38
	58_Paddock Trees	0.01	1
	170_Moderate	0.13	4
	170_DNG	0.64	5
Totals	-	**8.47**	**142**

© Biosis 2025 | Leaders in Ecology and Heritage Consulting

Table 88 Offset staging plan – Stage 2 impacts and credit requirements

PCT / Species	Vegetation zone	Impact (Ha)	Credits required
Stage 2			
PCT 16	16_Moderate	3.20	75
	16_Low	0.36	5
	16_DNG	2.10	0
PCT 21	21_Moderate (Sandhill Pine TEC)	1.17	38
PCT 23	23_Moderate (Acacia melvillei Shrubland TEC)	1.42	44
PCT 57	57_Moderate	0.19	4
PCT 58	58_High	0.54	21
	58_Moderate	19.31	632
	58_DNG	24.74	192
	58_Paddock Trees	0.06	1
PCT 163	163_Moderate	3.51	78
PCT 170	170_Moderate	4.54	101
	170_Low	0.56	6
	170_DNG	1.95	0
Totals	-	**63.65**	**1197**
Atriplex infrequens	23_Moderate	1.42	44
	163_Moderate	3.51	104
	170_Moderate	4.54	135
	170_Low	0.56	8
	170_DNG	1.95	15
Totals	-	**11.98**	**306**
Crowned Gecko	170_Moderate	4.54	135
	170_Low	0.56	8
	170_DNG	1.95	15
Totals	-	**7.05**	**158**
Painted Burrowing Frog	16_Moderate	2.48	66
	16_Low	0.34	5
	16_DNG	1.56	11
	58_High	0.12	5
	58_Moderate	4.29	161

PCT / Species	Vegetation zone	Impact (Ha)	Credits required
	58_DNG	2.77	25
	163_Moderate	2.91	87
	170_Moderate	0.49	15
	170_Low	0.01	1
	170_DNG	0.40	3
Totals	**-**	**15.37**	**379**
Pink Cockatoo	16_Moderate	1.67	45
	16_Low	0.36	5
	16_DNG	1.95	14
	21_Moderate	0.85	27
	23_Moderate	1.06	33
	57_Moderate	0.19	6
	58_High	0.54	25
	58_Moderate	8.02	300
	58_DNG	6.75	60
	58_Paddock Trees	0.06	1
	163_Moderate	1.43	43
	170_Moderate	4.14	123
	170_Low	0.48	7
	170_DNG	1.42	11
Totals	-	**28.92**	**700**

Table 89 Scattered trees offset staging plan – Stage 1 impacts and credit requirements

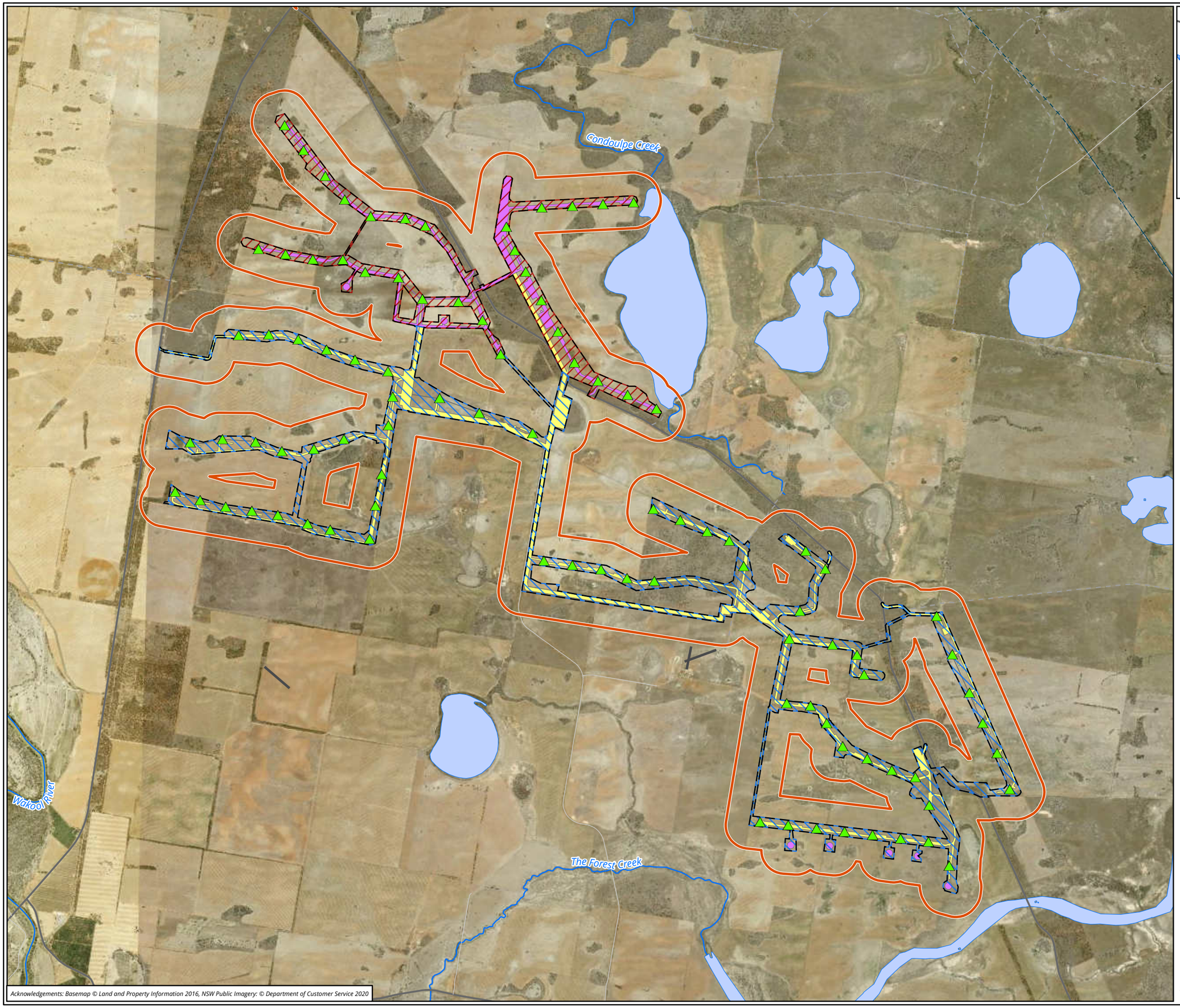
Class	Contains hollows	Number of trees	Ecosystem credits
16-Black Box grassy open woodland wetland			
2	Yes	1	1
Subtotal			**1**
58-Black Oak - Western Rosewood open woodland			
3	Yes	7	7
3	No	5	4
2	Yes	1	1
Subtotal			**12**

Class	Contains hollows	Number of trees	Ecosystem credits
170-Chenopod sandplain mallee			
2	Yes	1	1
2	No	2	2
Subtotal			**3**
21-Slender Cypress Pine - Sugarwood - Western Rosewood open woodland			
3	Yes	1	1
Subtotal			**1**
Grand total			**17**

Table 90 Scattered trees offset staging plan – Stage 2 impacts and credit requirements

Class	Contains hollows	Number of trees	Ecosystem credits
16-Black Box grassy open woodland wetland			
3	Yes	4	4
2	Yes	2	2
Subtotal			**6**
58-Black Oak - Western Rosewood open woodland			
3	Yes	17	17
3	No	7	5
2	Yes	1	1
2	No	1	1
Subtotal			**24**
170-Chenopod sandplain mallee			
3	Yes	3	3
2	Yes	1	1
2	No	1	1
Subtotal			**5**
21-Slender Cypress Pine - Sugarwood - Western Rosewood open woodland			
3	Yes	13	13
Subtotal			**13**
23-Yarran tall open shrubland			
3	Yes	1	1
3	No	1	1
Subtotal			**2**
Grand total			**50**

© Biosis 2025 | Leaders in Ecology and Heritage Consulting



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/BAAS18138/25/00058626

Proposal Name
Burrawong WF - BDAR RtS - Stage 1

BAM data last updated *
05/08/2025

Assessor Name
Callan Wharfe

Report Created
11/08/2025

BAM Data version *
Current classification (live - default) (82)

Assessor Number
BAAS18138

BAM Case Status
Finalised

Date Finalised
11/08/2025

Assessment Revision
1

BOS entry trigger

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	0.59	PCT Cleared - 50%	High Sensitivity to Gain			1.75		14

2	16_DNG	Not a TEC	14.7	14.7	0.68	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												
5	58_High	Not a TEC	91	91.0	0.31	PCT Cleared - 50%	High Sensitivity to Gain			1.75		12
6	58_Moderate	Not a TEC	74.8	74.8	1.6	PCT Cleared - 50%	High Sensitivity to Gain			1.75		52
7	58_DNG	Not a TEC	17.7	17.7	6.3	PCT Cleared - 50%	High Sensitivity to Gain			1.75		49
8	58_Paddock_trees	Not a TEC	46.6	46.6	0.01	PCT Cleared - 50%	High Sensitivity to Gain			1.75		1
											Subtotal	**114**
Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones												
10	170_Moderate	Not a TEC	59.5	59.5	0.13	PCT Cleared - 41%	High Sensitivity to Gain			1.50		3

11	170_DNG	Not a TEC	15	15.0	1.6	PCT Cleared - 41%	High Sensitivity to Gain			1.50		0
											Subtotal	**3**
Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones												
9	163_Moderate	Not a TEC	59.5	59.5	0.07	PCT Cleared - 26%	High Sensitivity to Gain			1.50		2
											Subtotal	**2**
Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones												
4	23_Moderate	Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions	62.7	62.7	0.61	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		19
											Subtotal	**19**
											Total	**152**

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

Atriplex infrequens / A saltbush (Flora)									
23_Moderate	62.7	62.7	0.61	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	19
163_Moderate	59.5	59.5	0.07	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	2
170_Moderate	59.5	59.5	0.13	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	4
170_DNG	15.0	15.0	1.6	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	12
								Subtotal	**37**
Lophochroa leadbeateri / Pink Cockatoo (Fauna)									
16_Moderate	53.4	53.4	0.59	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	16

16_DNG	14.7	14.7	0.68	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	5
16_Paddock_trees	10.7	10.7	0.21	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	1
23_Moderate	62.7	62.7	0.61	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	19
58_High	91.0	91.0	0.31	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	14
58_Moderate	74.8	74.8	1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	39
58_DNG	17.7	17.7	4.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	38
58_Paddock_trees	46.6	46.6	0.01	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	1

170_Moderate	59.5	59.5	0.13	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	4
170_DNG	15.0	15.0	0.64	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	5
								Subtotal	**142**
Lucasium stenodactylum / Crowned Gecko (Fauna)									
170_Moderate	59.5	59.5	0.13	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	4
170_DNG	15.0	15.0	1.6	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	12
								Subtotal	**16**
Neobatrachus pictus / Painted Burrowing Frog (Fauna)									
16_Moderate	53.4	53.4	0.56	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	15

16_DNG	14.7	14.7	0.14	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1
16_Paddock_trees	10.7	10.7	0.21	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1
58_High	91.0	91.0	0.3	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	14
58_Moderate	74.8	74.8	0.27	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	10
58_DNG	17.7	17.7	0.61	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	5
58_Paddock_trees	46.6	46.6	0.01	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1
170_Moderate	59.5	59.5	0.13	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	4

170_DNG	15.0	15.0	0.33	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	2
								Subtotal	**53**

BAM Credit Summary Report

Proposal Details

Assessment Id
00034462/BAAS18138/25/00058627

Proposal Name
Burrawong WF - BDAR RtS - Stage 2

BAM data last updated *
05/08/2025

Assessor Name
Callan Wharfe

Report Created
11/08/2025

BAM Data version *
Current classification (live - default) (82)

Assessor Number
BAAS18138

BAM Case Status
Finalised

Date Finalised
11/08/2025

Assessment Revision
1

BOS entry trigger

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		75
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	2.1	PCT Cleared - 50%	High Sensitivity to Gain			1.75		0
											Subtotal	**80**
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	0.54	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		632

9	58_DNG	Not a TEC	17.7	17.7	24.7	PCT Cleared - 50%	High Sensitivity to Gain			1.75		192
10	58_Paddock_trees	Not a TEC	46.6	46.6	0.06	PCT Cleared - 50%	High Sensitivity to Gain			1.75		1
											Subtotal	**846**
Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones												
12	170_Moderate	Not a TEC	59.5	59.5	4.5	PCT Cleared - 41%	High Sensitivity to Gain			1.50		101
13	170_Low	Not a TEC	29.7	29.7	0.56	PCT Cleared - 41%	High Sensitivity to Gain			1.50		6
14	170_DNG	Not a TEC	15	15.0	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	3.5	PCT Cleared - 26%	High Sensitivity to Gain			1.50		78
											Subtotal	**78**

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	1.4	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		44
											Subtotal	**44**
											Total	**1197**

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

Atriplex infrequens / A saltbush (Flora)									
23_Moderate	62.7	62.7	1.4	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	44
163_Moderate	59.5	59.5	3.5	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	104
170_Moderate	59.5	59.5	4.5	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	135
170_Low	29.7	29.7	0.56	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	8
170_DNG	15.0	15.0	2	Geographic Distribution	Ecology or response to management is poorly known	Vulnerable	Vulnerable	False	15
								Subtotal	**306**

Lophochroa leadbeateri / Pink Cockatoo (Fauna)									
16_Moderate	53.4	53.4	1.7	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	45
16_Low	28.6	28.6	0.36	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	5
16_DNG	14.7	14.7	2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	14
21_Moderate	64.6	64.6	0.85	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	27
23_Moderate	62.7	62.7	1.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	33
57_Moderate	61.1	61.1	0.19	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	6
58_High	91.0	91.0	0.54	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	25

58_Moderate	74.8	74.8	8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	300
58_DNG	17.7	17.7	6.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	60
58_Paddock_trees	46.6	46.6	0.06	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	1
163_Moderate	59.5	59.5	1.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	43
170_Moderate	59.5	59.5	4.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	123
170_Low	29.7	29.7	0.48	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	7
170_DNG	15.0	15.0	1.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Endangered	False	11
								Subtotal	**700**

Lucasium stenodactylum / Crowned Gecko (Fauna)									
170_Moderate	59.5	59.5	4.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	135
170_Low	29.7	29.7	0.56	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	8
170_DNG	15.0	15.0	2	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	15
								Subtotal	**158**
Neobatrachus pictus / Painted Burrowing Frog (Fauna)									
16_Moderate	53.4	53.4	2.5	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	66
16_Low	28.6	28.6	0.34	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	5

16_DNG	14.7	14.7	1.6	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	11
58_High	91.0	91.0	0.12	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	5
58_Moderate	74.8	74.8	4.3	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	161
58_DNG	17.7	17.7	2.8	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	25
163_Moderate	59.5	59.5	2.9	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	87
170_Moderate	59.5	59.5	0.49	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	15
170_Low	29.7	29.7	0.01	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	1

170_DNG	15.0	15.0	0.4	Biodiversity Conservation Act listing status	Ability to colonise improved habitat	Endangered	Not Listed	False	3
								Subtotal	**379**

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00044469/BAAS18138/25/00058633	Burrawong WF - Scattered trees - RtS - Stage 1	05/08/2025
Assessor Name	**Report Created**	**BAM Data version ***
Callan Wharfe	11/08/2025	Current classification (live - default) (82)
Assessor Number	**BAM Case Status**	**Date Finalised**
BAAS18138	Finalised	11/08/2025
Assessment Revision	**BOS entry trigger**	**Assessment Type**
1	Major Project	Scattered Trees

* 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)			
2	True	1.0	1
			1
58-Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion			
3	True	1.0	1
3	False	1.0	1
2	True	1.0	1
3	True	6.0	6
3	False	4.0	3
			12
170-Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones			
2	False	1.0	1
2	True	1.0	1
2	False	1.0	1
			3

BAM Credit Summary Report

21-Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion			
3	True	1.0	1
			1
			17

Species credits for threatened species

Nil

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00044469/BAAS18138/25/00058634	Burrawong WF - Scattered trees - RtS - Stage 2	05/08/2025
Assessor Name	**Report Created**	**BAM Data version ***
Callan Wharfe	11/08/2025	Current classification (live - default) (82)
Assessor Number	**BAM Case Status**	**Date Finalised**
BAAS18138	Finalised	11/08/2025
Assessment Revision	**BOS entry trigger**	**Assessment Type**
1	Major Project	Scattered Trees

* 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	2.0	2
			6
58-Black Oak - Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion			
3	True	13.0	13
3	False	7.0	5
2	False	1.0	1
2	True	1.0	1
3	True	4.0	4
			24
170-Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones			
3	True	3.0	3
2	True	1.0	1
2	False	1.0	1
			5

BAM Credit Summary Report

21-Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion			
3	True	13.0	13
			13
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
			50

Species credits for threatened species

Nil

References

ALA 2025. 'Atlas of Living Australia Spatial Portal', https://spatial.ala.org.au/.

ARC 2022. *Multi-year La Nina events*, *Climate Extremes. ARC Centre of Excellence*, accessed 3 July 2024, https://climateextremes.org.au/multi-year-la-nin%CC%83a-events/.

AusBats 2025. *Australian Bat Society's BatMap viewer*, *Australasian Bat Society*, https://www.ausbats.org.au/batmap.html.

Australian Museum 2020a. *Australian Pelican*, *Australian Museum*, accessed 14 November 2023, https://australian.museum/learn/animals/birds/australian-pelican/#:~:text=Pelicans%20are%20highly%20mobile%2C%20searching,to%20rise%20to%20considerable%20altitudes.

Australian Museum 2020b. *South-eastern Freetail Bat Mormopterus planiceps*, *South-eastern Freetail*, https://australian.museum/learn/animals/bats/south-eastern-freetail-bat/.

Australian Museum 2022. *Brown Songlark*, *Australian Museum*, accessed 8 March 2024, https://australian.museum/learn/animals/birds/brown-songlark/.

Australian Museum 2023a. *White-browed Woodswallow*, *White-Browed Woodswallow*, https://australian.museum/learn/animals/birds/white-browed-woodswallow/.

Australian Museum 2023b. *White-necked Heron*, *White -neck Heron*, https://australian.museum/learn/animals/birds/white-necked-heron/.

Australian National Botanic Gardens & Australian National Herbarium 2007. *Australian Plant Name Index - APNI*, *Botanical Databases*, accessed 8 March 2024, https://www.anbg.gov.au/apni/.

AusWEA 2005. *Wind Farms and Birds: Interim Standards For Risk Assessment*, Report prepared for Australian Wind Energy Association. Brett Lane & Associates Pty Ltd, Carlton North, VIC, https://tethys.pnnl.gov/sites/default/files/publications/BrettLane-2005.pdf.

Baker A & Gynther I (eds.) 2023. *Strahan's Mammals of Australia*, 4th edn, Reed New Holland, Wahroonga, NSW.

Benson JS 1992. 'The natural vegetation of Penrith', *Cunninghamia*, 2, 4: 541–96.

BirdLife Australia 2023a. *Cockatiel*, *Birds in Backyards*, https://www.birdsinbackyards.net/species/Nymphicus-hollandicus.

BirdLife Australia 2023b. *Masked Woodswallow*, *Birds in Backyards*, https://www.birdsinbackyards.net/species/Artamus-personatus.

BirdLife Australia 2023c. *Mistletoebird*, *Birds in Backyards*, accessed 14 November 2023, https://www.birdsinbackyards.net/species/Dicaeum-hirundinaceum.

BirdLife Australia 2023d. *Musk Lorikeet*, *Birds in Backyards*, accessed 14 November 2023, https://www.birdsinbackyards.net/species/Glossopsitta-concinna.

BirdLife Australia 2023e. *Restless Flycatcher*, *Birds in Backyards*, https://www.birdsinbackyards.net/species/Myiagra-inquieta.

BirdLife Australia 2023f. *Rufous Songlark*, *Birds in Backyards*, https://www.birdsinbackyards.net/species/Cincloramphus-mathewsi.

BirdLife Australia 2023g. *Silvereye*, https://www.birdsinbackyards.net/species/Zosterops-lateralis.

BirdLife Australia 2023h. *Straw-necked Ibis*, *Straw-neckked Ibis*, https://www.birdsinbackyards.net/species/Threskiornis-spinicollis.

Birdlife Australia 2024. *Gull-billed Tern*, *Birds in Backyards*, https://www.birdsinbackyards.net/species/Gelochelidon-nilotica.

BirdLife International 2024. *Species factsheet: Caspian Tern* Hydroprogne caspia, *Data Zone*, https://datazone.birdlife.org/species/factsheet/caspian-tern-hydroprogne-caspia.

BOM 2019. *GDE Atlas Home: Water Information: Bureau of Meteorology*, *Bureau of Meteorology: Climate Data Online*, accessed 9 July 2019, http://www.bom.gov.au/water/groundwater/gde/.

Boycott TJ, Mullis SM, Jackson BE, & Swaddle JP 2021. 'Field testing an "acoustic lighthouse": Combined acoustic and visual cues provide a multimodal solution that reduces avian collision risk with tall human-made structures', *PLoS ONE*, 16, 4: e0249826.

Cabrera-Cruz S, Smolinsky J, & Buler J 2018. 'Light pollution is greatest within migration passage areas for nocturnally-migrating birds around the world', *Scienfitic Reports*, 8.

Churchill S 2008. *Australian Bats*, 2nd edn, Allen & Unwin, Sydney, NSW.

Clean Energy Council 2018. *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*,.

Commonwealth of Australia 2013. *Matters of National Environmental Significance Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment, Canberra, ACT, accessed 14 February 2024, https://www.dcceew.gov.au/environment/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance.

Cook ASCP, Humphreys EM, Masden EA, & Burton NHK 2014. *The Avoidance Rates of Collision Between Birds and Offshore Turbines*, Scottish Marine and Freshwater Science.

Copelandi, L & Backhouse G 2022. *Guide to the native orchids of NSW and ACT*, CSIRO, NSW.

Copernicus 2024. *Copernicus Data Space Ecosystem*, *Copernicus*, accessed 3 July 2024, https://dataspace.copernicus.eu/.

Cropper S 1993. *Management of Endangered Plants*, CSIRO Publications Victoria, Melbourne, Victoria.

Cth DCCEEW 2019. *Directory of Important Wetlands in Australia*, *Australian Commonwealth Department of Climate Change, Energy, the Environment and Water*, accessed 26 February 2024, https://www.dcceew.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands.

Cth DCCEEW 2022a. 'National Recovery Plan for the Australian Painted Snipe *Rostratula australis*', Department of Climate Change, Energy, the Environment and Water, Canberra, ACT. https://www.dcceew.gov.au/sites/default/files/documents/national-recovery-plan-australasian-bittern.pdf.

Cth DCCEEW 2022b. 'Conservation Advice for *Hemiaspis damelii* (Grey Snake)', Commonwealth Department of Climate Change, Energy, the Environment and Water, Canberra, ACT. https://www.environment.gov.au/biodiversity/threatened/species/pubs/1179-conservation-advice-05102022.pdf.

Cth DCCEEW 2022c. 'National Recovery Plan for the Australasian Bittern *Botaurus poiciloptilus*', Department of Climate Change, Energy, the Environment and Water, Canberra, ACT. https://www.dcceew.gov.au/sites/default/files/documents/national-recovery-plan-australasian-bittern.pdf.

Cth DCCEEW 2023a. *Directory of Important Wetlands in Australia - Information Sheet. Lowbidgee Floodplain*, https://www.environment.gov.au/cgi-bin/wetlands/report.pl?smode=DOIW;doiw_refcodelist=NSW021.

Cth DCCEEW 2023b. 'Conservation Advice for *Lophochroa leadbeateri leadbeateri* (eastern Major Mitchell's cockatoo)', Commonwealth Department of Climate Change, Energy, the Environment and Water. Canberra, ACT. https://www.environment.gov.au/biodiversity/threatened/species/pubs/82926-conservation-advice-31032023.pdf.

Cth DCCEEW 2023c. 'Onshore Wind Farm Guidance',.

Cth DCCEEW 2023d. 'Conservation Advice for *Aphelocephala leucopsis* (Southern Whiteface)', Australian Commonwealth Government Department of Climate Change, Energy, the Environment, and Water, Canberra, ACT. https://www.environment.gov.au/biodiversity/threatened/species/pubs/529-conservation-advice-31032023.pdf.

Cth DCCEEW 2024. *SPRAT: Polytelis anthopeplus monarchoides — Regent Parrot (eastern)*, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59612.

Cth DCCEEW 2025a. Merops ornatus — *Rainbow Bee-eater in Species Profile and Threats (SPRAT) Database*, *Species Profile and Threats Database. Commonwealth Department of Climate Change, Energy the Environment and Water. Canberra, ACT*, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=670.

Cth DCCEEW 2025b. Nyctophilus corbeni — *Corben's Long-eared Bat, South-eastern Long-eared Bat in Species Profile and Threats (SPRAT) Database*, *Species Profile and Threats Database. Commonwealth Department of Climate Change, Energy the Environment and Water. Canberra, ACT*, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=83395.

Cth DCCEEW 2025c. Tringa nebularia — *Common Greenshank, Greenshank in Species Profile and Threats (SPRAT) Database*, *Species Profile and Threats Database. Commonwealth Department of Climate Change, Energy the Environment and Water. Canberra, ACT*, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=832.

Cwth DCCEEW 2024. *SPRAT: Hydroprogne caspia — Caspian Tern*, https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=808.

DAWE 2021. 'National Recovery Plan for the Painted Honeyeater *Grantiella picta*', Department of Agriculture, Water and the Environment, Canberra, ACT. https://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/painted-honeyeater-2022.

DAWE 2022. 'Onshore Wind Farms - interim guidance on bird and bat management',.

DCCEEW 2023. 'Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot)', Australian Government Department of Climate Change, Energy, the Environment and Water. Canberra, ACT. https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=726.

DEC 2004. *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft*, New South Wales Government Department of Environment and Conservation.

DECC NSW 2002. *NSW ecosystems study: background and methodology. NSW (Mitchell) Landscapes version 2*, Department of Environment and Climate Change NSW. Author: Mitchell P for National Parks and Wildlife Service, Hurtsville, NSW. https://www.environment.nsw.gov.au/resources/conservation/EcosystemsMethodology.pdf.

DEH & Benshemesh J 2007. 'National Recovery Plan for Malleefowl Leipoa ocellata', Department for Environment and Heritage, Adelaide, SA. https://www.dcceew.gov.au/sites/default/files/documents/malleefowl.pdf.

Department of Regional New South Wales 2023. 'NSW 1500k Simplified Surface Geology', https://datasets.seed.nsw.gov.au/dataset/nsw-1500k-simplified-surface-geology.

DEWHA 2010a. *Survey Guidelines for Australia's Threatened Birds: Guidelines for detecting birds listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*, Australian Government Department of the Environment Water Heritage and the Arts. Canberra, Australian Capital Territory.

DEWHA 2010b. *Survey Guidelines for Australia's Threatened Bats: Guidelines for detecting bats listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment Water Heritage and the Arts.

DoE 2010. '2010 NOMINATION - Falco subniger', https://www.dcceew.gov.au/sites/default/files/env/pages/a7465fc2-2fa1-4de4-b562-4eb56012296d/files/nomination-falco-subniger.doc.

DoE 2016. 'National Recovery Plan for the Plains-wanderer (Pedionomus torquatus)', Department of Environment, Australian Commonwealth Government. https://www.dcceew.gov.au/sites/default/files/documents/national-recovery-plan-plains-wanderer.pdf.

DoSEWPC 2012. 'Natural Grasslands of the Murray Valley Plains', https://www.environment.gov.au/biodiversity/threatened/communities/maps/pubs/117-map.pdf.

DPE 2019. 'State Vegetation Type Map: Western Region v1.0 VIS_ID 4492', https://researchdata.edu.au/state-vegetation-type-visid-4492/1385502.

DPE 2021. *Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions - Endangered Ecological Community listing*, *Sandhill Pine Woodland*, https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2008-2010/sandhill-pine-woodland-endangered-ecological-community-listing.

DPE 2022a. 'Biodiversity Values Map NSW', Department of Planning and Environment, Parramatta. https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap.

DPE 2022b. *BAM - Important Areas mapping portal*, https://webmap.environment.nsw.gov.au/Html5Viewer291/index.html?viewer=BAM_ImportantAreas.

DPE 2022c. 'Streamlined assessment module planted native vegetation Biodiversity Assessment Method operational manual', https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/streamlined-assessment-module-planted-native-vegetation-220634.pdf.

DPE 2023a. 'NSW State Vegetation Type Map (SVTM C1.1M1)', Department of Planning and Environment. Sydney, NSW. https://datasets.seed.nsw.gov.au/dataset/nsw-state-vegetation-type-map.

DPE 2023b. *Plant Community - Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion*, *NSW Government*, accessed 21 November 2023, https://vegetation.bionet.nsw.gov.au/DataEntry/PlantCommunity.aspx?M=E&PID=46.

DPE 2023c. 'Draft Wind Energy Guideline: Guidance for state significant wind energy development', Department of Planning and Environment, NSW. https://shared-drupal-s3fs.s3.ap-southeast-2.amazonaws.com/master-test/fapub_pdf/NSW+Planning+Portal+Documents/Draft+Wind+Energy+Guideline+(3).pdf.

DPI 2012. *Risk assessment guidelines for groundwater dependent ecosystems*, New South Wales Government Department of Primary Industries.

DPI 2013. *Policy and Guidelines for Fish Habitat Conservation and Management (2013 Update)*, NSW Department of Primary Industries, https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/634694/Policy-and-guidelines-for-fish-habitat.pdf.

DPI 2025. 'Fisheries NSW Spatial Data Portal', https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal.

DPIE 2016. 'State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469', https://datasets.seed.nsw.gov.au/dataset/riverina-regional-native-vegetation-map-version-v1-0-vis_id-4449.

DPIE 2020a. *Biodiversity Assessment Method (BAM)*, NSW Department of Planning, Industry and the Environment, https://www.environment.nsw.gov.au/research-and-publications/publications-search/biodiversity-assessment-method-2020.

DPIE 2020b. 'Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method', accessed 11 June 2020, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/surveying-threatened-plants-and-habitats-nsw-survey-guide-biodiversity-assessment-method-200146.pdf.

DSE 2011. 'National Recovery Plan for the Regent Parrot (eastern subspecies) Polytelis anthopeplus monarchoides', Authors: Baker-Bagg D, Hurley V, Department of Sustainability and Environment, Melbourne, VIC.

DSEWPaC 2009. *Census of Australian Vertebrates*, Australian Government Department of Sustainability Environment, Water, Population and Communities, Canberra, ACT.

DSEWPaC 2012. 'EPBC Act Environmental Offsets Policy', Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT. https://www.dcceew.gov.au/environment/epbc/publications/epbc-act-environmental-offsets-policy.

Duffy AM, Lumsden LF, Caddle CR, Chick RR, & Newell GR 2000. 'The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in south-eastern Australia', *Acta Chiropterologica*, 2, 2: 127–44.

Ecological Horizons 2025. Junction Rivers Wind Farm Desert Mouse Expert Advice. Report to Biosis Pty Ltd. 2025

GHD 2025. Junction Rivers Wind Farm Desert Mouse habitat assessment. Report to Biosis Pty Ltd. 2025

Haddock J, Threlfall C, Law B, & Hochuli D 2019. 'Light pollution at the urban forest edge negatively impacts insectivorous bats', *Biological Conservation*, 236: 17–28.

Harden GJ (ed.) 1992. *Flora of New South Wales*, NSW University Press, Kensington, NSW.

Harden GJ 1993. *Flora of New South Wales*, NSW University Press, Kensington, NSW.

Harden GJ 2000. *Flora of New South Wales*, Revised Edition, NSW University Press, Kensington, NSW.

Harden GJ 2002. *Flora of New South Wales*, NSW University Press, Kensington, NSW.

Harrington J 2022. *Banded Lapwing*, *Australian Museum*, accessed 14 November 2023, https://australian.museum/learn/animals/birds/banded-lapwing/#:~:text=These%20lapwings%20have%20an%20upright,them%20the%20name%20'lapwing'.

Hayes MA, Hooton LA, Gilland KL, Grandgent C, Smith RL, Lindsay SR, Collins JD, Schumacher SM, Rabie PA, Gruver JC, & Goodrich-Mahoney J 2019. 'A smart curtailment approach for reducing bat fatalities and curtailment time at wind energy facilities', *The Ecological Society of America*, 29, 4.

Lawson M, Jenne D, Thresher R, Wimsatt J, & Straw B 2020. 'An investigation into the potential for wind turbines to cause barotrauma in bats', *PLOS ONE*, 15, 12: e0242485.

Marchant S & Higgins PJ (eds.) 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2, Raptors to Lapwings.*, Oxford University Press, Melbourne, VIC.

Margetts B, Stuart-Fox D, & Franklin A 2024. 'Red vision in animals is broadly associated with lighting environment but not types of visual task', *Ecology and Evolution*, 14, 2.

Masden E & Cook A 2016. 'Avian collision risk models for wind energy impact assessments', *Environmental Impact Assessment Review*, 56: 43–9.

McClure CJW, Rolek BW, Dunn L, McCabe JD, Martinson L, & Katzner TE 2022. 'Confirmation that eagle fatalities can be reduced by automated curtailment of wind turbines', *Ecological Solutions and Evidence*, 3, 3: e12173.

Morcombe M 2002. *Field Guide to Australian Birds*, Steve Parish Publishing.

Murray M 2023. *Black Swan*, *Australian Museum*, accessed 14 November 2023, https://australian.museum/learn/animals/birds/black-swan/.

Murray Wildlife N/A. *Australian Painted Snipe Tracking*, *Australian Painted Snipe Information and Tracking Project*, accessed 3 December 2024, https://paintedsnipe.com.au/.

National Parks and Wildlife Services NSW 2003. *The Bioregions of New South Wales, their biodiversity, conservation and history*, Authors: Roshan Sahukar, Catherine Gallery, Julianne Smart, and Peter Mitchell, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Bioregions/bioregions-of-new-south-wales.pdf.

Natural England 2009. 'Natural England Technical Information Note TIN051: Bats and onshore wind turbines - Interim guidance',.

Nature Advisory 2022a. *Junction Rivers Wind Farm Bat Utilisation Survey*, Report prepared for NGH Consulting. Nature Advisory, Report No. 20195.3(1.0).

Nature Advisory 2022b. *Junction Rivers Wind Farm Bird Utilisation Survey - Year One*, Report prepared for NGH Consulting. Nature Advisory, Report No. 20195.04(1.0).

Nature Advisory 2023a. *Junction Rivers Wind Farm Bird and Bat Baseline Report (Year 2)*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.05(1.1).

Nature Advisory 2023b. *Junction Rivers Wind Farm Bird and Bat Baseline Report (Year 1)*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.05(1.0).

Nature Advisory 2023c. *Junction Rivers Wind Farm Preliminary Literature Review on Habitat Use of the Australiasian Bittern in the Riverina*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.07(1.0).

Nature Advisory 2023d. *Junction Rivers Wind Farm Regent Parrot Targeted Assessment Report*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.06(1.1).

Nature Advisory 2023e. *Junction Rivers Wind Farm Regional Review of Waterbirds in the Riverina*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.07(1.0).

Nature Advisory 2023f. *Junction Rivers Wind Farm Initial Bird and Bat Risk Assessment*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.04(2.1).

NGH Consulting 2022. *Burrawong Wind Farm Spring 2021 Survey Report*, Report prepared for Windlab Pty Ltd. Author: Bambrick, D. NGH Environmental Pty Ltd. Report No. 20-468.

NPWS 2020. 'Yanga National Park, Yanga State Conservation Area and Yanga Nature Reserve Plan of Management', NSW National Parks and Wildlife Service. https://www.environment.nsw.gov.au/research-and-publications/publications-search/yanga-national-park-plan-of-management.

NSW DCCEEW 2010. *Australasian bittern (Botaurus poiciloptilus) - endangered species listing. NSW Scientific Committee - final determination*, *Environment and Heritage*, accessed 30 July 2024, https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2008-2010/australasian-bittern-botaurus-poiciloptilus-endangered-species-listing.

NSW DCCEEW 2023a. 'Suggested BBUS method (Draft)', NSW DCCEEW BCS SW Branch.

NSW DCCEEW 2023b. 'Draft Turbine Risk Assessment and Avoidance Guidance', NSW DCCEEW BCS SW Branch.

NSW DCCEEW 2024a. *NSW BioNet Vegetation Classification database*, *BioNet, New South Wales Department of Climate Change, Energy, the Environment and Water*, accessed 4 March 2024, https://vegetation.bionet.nsw.gov.au/.

NSW DCCEEW 2024b. *BCS Response To Submissions Junction Rivers Wind Farm (SSD-30448824) DOC24/554141*,.

NSW DCCEEW 2024c. *BioNet the website for the Atlas of NSW Wildlife*,.

NSW DCCEEW 2025. *Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions - profile*, *NSW Department of Climate Change, Energy, the Environment and Water*, https://threatenedspecies.bionet.nsw.gov.au/profile?id=20083.

NSW DPE 2025. 'Saving Our Species - Help save the Greenhood Orchid *Pterostylis cobarensis*', NSW Department of Planning and Environment. Wollongong, NSW. https://savingourspecies.environment.nsw.gov.au/project/182.

NSW Scientific Committee 2021. 'Acacia melvillei Shrubland in the Riverina and Murray-Darling Depression bioregions - endangered ecological community listing', NSW Scientific Committee, Sydney, NSW. https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2008-2010/acacia-melvillei-shrubland-riverina-murray-darling-depression--endangered-ecological-community.

NSW Spatial Services 2025. *Historical Imagery*, *NSW Government*, https://portal.spatial.nsw.gov.au/portal/apps/webappviewer/index.html?id=f7c215b873864d44bccddda8075238cb.

OEH 2010. 'NSW Wetlands Map', https://datasets.seed.nsw.gov.au/dataset/nsw-wetlands047c7.

OEH 2014. 'Statement of Management Intent. Murray Valley National Park and Murray Valley Regional Park', https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Parks-reserves-and-protected-areas/Parks-statement-of-management-intent/murray-valley-national-park-regional-park-statement-of-management-intent-140205.pdf.

OEH 2017. *Biodiversity Assessment Method (BAM)*, New South Wales Office of Environment and Heritage, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-170206.pdf.

OEH 2018. *'Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method [SUPERSEDED]*, Office of Environment and Heritage, Office of Environment and Heritage, Sydney NSW 2000, 978-1-92575-453-7.

Operation Migration 2023. *Spotted Harrier: The Ultimate Guide*, https://operationmigration.org/spotted-harrier-the-ultimate-guide/.

Owens A, Cochard P, Durrant J, Farnworth B, perkin E, & Seymoure B 2019. 'Light pollution is a driver of insect declines', *Biological Conservation*, 241.

Pennay M, Law B, & Reinhold L 2004. 'Bat calls of New South Wales', https://www.environment.nsw.gov.au/resources/nature/batcallsofnsw.pdf.

Percival S 2001. 'Assessment of the effects of offshore wind farms on birds.', www.berr.gov.uk/files/file20258.pdf.

Reinhold L, Law B, Ford G, & Pennay M 2001. *Key to the bat calls of south-east Queensland and north-east New South Wales*, Queensland Department of Natural Resources and Mines, State Forests of New South Wales, University of Southern Queensland, and New South Wales National Parks and Wildlife Service, https://www.researchgate.net/publication/303821240_Key_to_the_bat_calls_of_south-east_Queensland_and_north-east_New_South_Wales.

Silva A, Valcu M, & Kempenaers B 2015. 'Light pollution alters the phenology of dawn and dusk singing in common European songbirds', *PubMed*.

Skov H, Brondum R, Baden E, & Ward R 2023. 'Bat and Bird monitoring guidance', https://www.dhigroup.com/upload/publications/2023/bat-and-bird-monitoring-guidance.pdf.

Smales I 2005. *Modelled cumulative impacts on the White-bellied Sea-eagle of wind farms across the species' Australian range*, Prepared for Department of Environment and Heritage. Authors: Smales. I, Biosis Research Pty Ltd, Melbourne, VIC. Project No. 5238.

Smales I 2017. *Wildlife and Wind Farms, Conflicts and Solutions. Onshore: Monitoring and Mitigation.* | *Chapter: Modelling collision risk and populations*, Perrow M (ed.), Pelagic Publishing, Exeter, UK.

Smales I, Muir S, Meredith C, & Baird B 2013. 'A description of the Biosis model to assess risk of bird collisions with wind turbines', *Wildlife Society Bulletin*, 37, 1: 59–65.

Smith, J & Smith, P 2023. *Breeding patterns in an Australian arid-zone landbird community*, Australian Field Ornithology, http://dx.doi.org/10.20938/afo40077087.

Threatened Species Scientific Committee 2015. *Conservation Advice Nyctophilus corbeni South-eastern Long-eared Bat.*, Department of the Environment, Canberra, ACT, https://www.environment.gov.au/biodiversity/threatened/species/pubs/83395-conservation_advice-01102015.pdf.

Threatened Species Scientific Committee 2020. 'Conservation Advice. Falco hypoleucos. Grey Falcon', https://environment.gov.au/biodiversity/threatened/species/pubs/929-conservation-advice-09072020.pdf.

TSSC 2012. 'Commonwealth Listing Advice on Natural Grasslands of the Murray Valley Plains', Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT. http://www.environment.gov.au/biodiversity/threatened/communities/pubs/117-listing-advice.pdf.

TSSC 2019. 'Conservation Advice *Botaurus poiciloptilus* Australasian Bittern', Threatened Species Scientific Committee. Australian Commonwealth Department Environment and Energy, Canberra, ACT. https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1001.

TSSC 2020. 'Conservation Advice Falco hypoleucos Grey Falcon', Threatened Species Scientific Committee. Australia.https://www.environment.gov.au/biodiversity/threatened/species/pubs/929-conservation-advice-09072020.pdf.

TSSC 2024a. 'Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper)', Commonwealth Department of Climate Change, Energy, the Environment, and Water, Canberra, ACT. https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=874.

TSSC 2024b. 'Conservation Advice for *Tringa nebularia* (Common Greenshank)', Commonwealth Department of Climate Change, Energy, the Environment, and Water, Canberra, ACT. https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=832.

Tulp I, Larsen J, Schekkerman H, van der Haterd R, van Horssen P, Dirksen S, & Spaans A 1999. 'Nocturnal flight activity of sea ducks near the windfarm Tuno Knob in the Kattegat', www.buwa.nl/backsite/attachments/att_ 1046958950_98.100% 20rapport%20 eiders.pdf.

Voigt C, Dekker J, Fritze M, & Gazaryan S 2021. 'The Impact of Light Pollution on Bats Varies According to Foraging Guild and Habitat Context', *BioScience*, 71, 10: 1103–9.

Williams NSG, Marshall AJ, & Morgan JW 2015. *Land of sweeping plains. Managing and restoring the native grasslands of south eastern Australia.*, CSIRO Publications Victoria, Melbourne, VIC.

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 2026). 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 2023 and October 2023 and 2024.	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.	Low	Yes	Yes Targeted survey October 2024.	No	Species was not recorded during the targeted survey effort. 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.	Low	Yes	No Presence assumed	No	Assumed present.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 2023 and October 2023 and 2024.	No	Species was not recorded during the targeted survey effort.
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 2023 and October 2023 and 2024.	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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.	Low	Yes	Yes Targeted survey October 2024.	No	Species was not found during the targeted survey effort. BioNet notes 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.	Low	Yes	Yes Targeted survey October 2024.	No	Species was not found during the targeted survey effort. BioNet notes 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 (2023, 2024), 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 (2023, 2024), December	No	Species was not found during the targeted survey effort.
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	Low	Yes	Yes Targeted survey October 2024.	No	Species was not found during the targeted survey effort. BioNet notes species is only known in NSW from records in the Darling River region and from Kinchega National Park. Records of the species are over

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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							
				open Bluebush Plain amongst 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.					280 km from the subject 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	Low	Yes	Yesa Targeted survey October 2023 and 2024.	No	Species was not found during the targeted survey effort. Habitats present within the subject land are marginal, with limited presence of BioNet listed associated species.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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							
				Transition Woodlands and Inland 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 (2023, 2024), 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 2023 and October 2023 and 2024.	No	Species was not found during the targeted survey effort.
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.	Low	Yes	Yes Targeted survey October 2024.	No	Species was not found during the targeted survey effort. BioNet notes 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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	Yes Targeted survey September 2023 and October 2023 and 2024.	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	Yes Targeted survey September 2023 and October 2023 and 2024.	No	Species was not found during the targeted survey effort.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.					

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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, August 2024	No	Species not recorded during survey
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	Low	Yes	Yes Surveyed - August, November 2021 and July, October 2022, October 2024	No	Species not recorded during survey

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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							
				and carrion. Roosts and makes nest in trees.					
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, October 2024	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, October 2024	No	Species not recorded during survey
Lophochroa leadbeateri Pink 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, October 2024	Yes	Species recorded on multiple occasions, with breeding activity noted and assumed.
Lophoictinia isura Square-tailed Kite	-	Vu	Species/Ecosystem	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, 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	Low	Yes	Yes Surveyed - November 2021 and October 2022, October 2024	No	Species not recorded during survey

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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							
				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.	Low	Yes	Yes Incidental surveys completed over four nights in February 2023, August 2024	No	Species not recorded during targeted survey.
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 burrows 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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							
									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.	Low	Yes	No Assessed by Expert Report	No	BAM Species Expert concluded the subject land does not support suitable habitat for the species.
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.	Low	Yes	No Assumed present	Yes	Assumed present. 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.	Low	Yes	No Assumed present	Yes	Assumed present. 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Appendix 3. Flora

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Appendix 3.1. BAM plot field data

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 54	Datum GDA94	Plot ID	37502_B13	Plot dimensions	20x50	Orientation of middle	132
Easting 730589	Northing 6143331	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.	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 Recorders		
Date	06/12/2022	37502 plot B64 pct 163		Moderate	NL CW		
Zone 54	Datum GDA94	Plot ID	37502_B64	Plot dimensions	50x20	Orientation of middle	348
Easting 745679	Northing 6132980	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	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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 proluta*. 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*

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Appendix 4. Fauna

Appendix 4.1. Fauna species recorded at the subject land

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*
Pink 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*

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Appendix 4.2. Qualitative bird and bat risk assessment (Biosis)

Table A 17 Bird and bat collision risk and barrier risk likelihood assessment

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Birds										
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Inland Thornbill	*Acanthiza apicalis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Striated Thornbill	*Acanthiza lineata*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow Thornbill	*Acanthiza nana*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Brown Thornbill	*Acanthiza pusilla*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Buff-rumped Thornbill	*Acanthiza reguloides*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Chestnut-rumped Thornbill	*Acanthiza uropygialis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Spinebill	*Acanthorhynchus tenuirostris*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Collared Sparrowhawk	*Accipiter cirrocephalus*	-	-	Rare	Low	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Brown Goshawk	*Accipiter fasciatus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Grey Goshawk	*Accipiter novaehollandiae*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Reed-Warbler	*Acrocephalus australis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Common Sandpiper	*Actitis hypoleucos*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Australian Owlet-nightjar	*Aegotheles cristatus*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian King-Parrot	*Alisterus scapularis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Striated Grasswren	*Amytornis striatus*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Murray Mallee Striated Grasswren	*Amytornis striatus howei*	EN	EN	Rare	Moderate	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Chestnut Teal	*Anas castanea*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Grey Teal	*Anas gracilis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Pacific Black Duck	*Anas superciliosa*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australasian Darter	*Anhinga novaehollandiae*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Magpie Goose	*Anseranas semipalmata*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Red Wattlebird	*Anthochaera carunculata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Pipit	*Anthus novaeseelandiae*	-	-	Likely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Southern Whiteface	*Aphelocephala leucopsis*	VU	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Fork-tailed Swift	*Apus pacificus*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Wedge-tailed Eagle	*Aquila audax*	-	-	Almost certain	Moderate	Moderate	Likely	Low	Low	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Great Egret	*Ardea alba*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Eastern Great Egret	*Ardea alba modesta*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Intermediate Egret	*Ardea intermedia*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-necked Heron	*Ardea pacifica*	-	-	Likely	Negligible	Negligible	Likely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Bustard	*Ardeotis australis*	-	EN	Rare	Moderate	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Ruddy Turnstone	*Arenaria interpres*	VU	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act. This species is a listed migratory species under the EPBC Act.
Black-faced Woodswallow	*Artamus cinereus*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	-	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
White-breasted Woodswallow	*Artamus leucorynchus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Masked Woodswallow	*Artamus personatus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-browed Woodswallow	*Artamus superciliosus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Hardhead	*Aythya australis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Ringneck	*Barnardius zonarius*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Mallee Ringneck	*Barnardius zonarius barnardi*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Musk Duck	*Biziura lobata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australasian Bittern	*Botaurus poiciloptilus*	EN	EN	Rare	High	Low	Unlikely	Moderate	Low	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Eastern Cattle Egret	*Bubulcus coromandus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Bush Stone-curlew	*Burhinus grallarius*	-	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Sulphur-crested Cockatoo	*Cacatua galerita*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Corella	*Cacatua sanguinea*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Long-billed Corella	*Cacatua tenuirostris*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Rufous Fieldwren	*Calamanthus campestris*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Striated Fieldwren	*Calamanthus fuliginosus*	-	EN	Rare	Moderate	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Sharp-tailed Sandpiper	*Calidris acuminata*	VU	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act. This species is a listed migratory species under the EPBC Act.
Red Knot	*Calidris canutus*	VU	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act. This species is a listed migratory species under the EPBC Act.
Curlew Sandpiper	*Calidris ferruginea*	CE	CE	Rare	High	Low	Unlikely	Moderate	Low	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. This species is a listed migratory species under the EPBC Act.
Pectoral Sandpiper	*Calidris melanotos*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Little Stint	*Calidris minuta*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Ruff	*Calidris pugnax*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Red-necked Stint	*Calidris ruficollis*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Long-toed Stint	*Calidris subminuta*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Great Knot	*Calidris tenuirostris*	VU	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. This species is a listed migratory species under the EPBC Act.
Yellow-faced Honeyeater	*Caligavis chrysops*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Pied Honeyeater	*Certhionyx variegatus*	-	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Azure Kingfisher	*Ceyx azureus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Horsfield's Bronze-Cuckoo	*Chalcites basalis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Shining Bronze-Cuckoo	*Chalcites lucidus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-eared Cuckoo	*Chalcites osculans*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Double-banded Plover	*Charadrius bicinctus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Red-capped Plover	*Charadrius ruficapillus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Wood Duck	*Chenonetta jubata*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-backed Swallow	*Cheramoeca leucosterna*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Spotted Bowerbird	*Chlamydera maculata*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Whiskered Tern	*Chlidonias hybrida*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-winged Black Tern	*Chlidonias leucopterus*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Silver Gull	*Chroicocephalus novaehollandiae*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Brown Songlark	*Cincloramphus cruralis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Rufous Songlark	*Cincloramphus mathewsi*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Chestnut Quail-thrush	*Cinclosoma castanotum*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Spotted Quail-thrush	*Cinclosoma punctatum*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Swamp Harrier	*Circus approximans*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Spotted Harrier	*Circus assimilis*	-	VU	Unlikely	Moderate	Low	Rare	Low	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Golden-headed Cisticola	*Cisticola exilis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Banded Stilt	*Cladorhynchus leucocephalus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-browed Treecreeper	*Climacteris affinis*	-	E2	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. A population for this species is listed as threatened under the BC Act, however is not relevant to this project.
Brown Treecreeper	*Climacteris picumnus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	VU	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Grey Shrike-thrush	*Colluricincla harmonica*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Ground Cuckoo-shrike	*Coracina maxima*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-bellied Cuckoo-shrike	*Coracina papuensis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-winged Chough	*Corcorax melanorhamphos*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-throated Treecreeper	*Cormobates leucophaea*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Crow	*Corvus bennetti*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Raven	*Corvus coronoides*	-	-	Likely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Raven	*Corvus mellori*	-	-	Likely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Stubble Quail	*Coturnix pectoralis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Pied Butcherbird	*Cracticus nigrogularis*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Grey Butcherbird	*Cracticus torquatus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black Swan	*Cygnus atratus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Laughing Kookaburra	*Dacelo novaeguineae*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Varied Sittella	*Daphoenositta chrysoptera*	-	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Wandering Whistling-Duck	*Dendrocygna arcuata*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Plumed Whistling-Duck	*Dendrocygna eytoni*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Mistletoebird	*Dicaeum hirundinaceum*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Emu	*Dromaius novaehollandiae*	-	E2	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species is a flightless species unlikely to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. A population for this species is listed as threatened under the BC Act, however is not relevant to this project.
Southern Scrub-robin	*Drymodes brunneopygia*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Little Egret	*Egretta garzetta*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-faced Heron	*Egretta novaehollandiae*	-	-	Unlikely	Negligible	Negligible	Likely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Pied Heron	*Egretta picata*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-shouldered Kite	*Elanus axillaris*	-	-	Unlikely	Low	Negligible	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Letter-winged Kite	*Elanus scriptus*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Black-fronted Dotterel	*Elseyornis melanops*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Blue-faced Honeyeater	*Entomyzon cyanotis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Galah	*Eolophus roseicapilla*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Galah	*Eolophus roseicapilla albiceps*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Yellow Robin	*Eopsaltria australis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-fronted Chat	*Epthianura albifrons*	-	VU, E2	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act. A population for this species is listed as threatened under the BC Act, however is not relevant to this project.
Orange Chat	*Epthianura aurifrons*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Crimson Chat	*Epthianura tricolor*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Red-kneed Dotterel	*Erythrogonys cinctus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Spotted Nightjar	*Eurostopodus argus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Dollarbird	*Eurystomus orientalis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Brown Falcon	*Falco berigora*	-	-	Likely	Low	Low	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Nankeen Kestrel	*Falco cenchroides*	-	-	Likely	Moderate	Moderate	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Nankeen Kestrel	*Falco cenchroides cenchroides*	-	-	Likely	Moderate	Moderate	Unlikely	Low	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Grey Falcon	*Falco hypoleucos*	VU	VU	Rare	Low	Negligible	Rare	Low	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the EPBC Act and BC Act.
Australian Hobby	*Falco longipennis*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Peregrine Falcon	*Falco peregrinus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Black Falcon	*Falco subniger*	-	VU	Unlikely	Moderate	Low	Rare	Low	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the BC Act.
Shrike-tit	*Falcunculus frontatus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Shrike-tit	*Falcunculus frontatus frontatus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eurasian Coot	*Fulica atra*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Latham's Snipe	*Gallinago hardwickii*	VU	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. This species is a listed migratory species under the EPBC Act.
Swinhoe's Snipe	*Gallinago megala*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Pin-tailed Snipe	*Gallinago stenura*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Dusky Moorhen	*Gallinula tenebrosa*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Singing Honeyeater	*Gavicalis virescens*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Tern	*Gelochelidon macrotarsa*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Gull-billed Tern	*Gelochelidon nilotica*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Diamond Dove	*Geopelia cuneata*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Bar-shouldered Dove	*Geopelia humeralis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Peaceful Dove	*Geopelia placida*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Zebra Dove	*Geopelia striata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Western Gerygone	*Gerygone fusca*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-throated Gerygone	*Gerygone olivacea*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Tawny-crowned Honeyeater	*Gliciphila melanops*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Magpie-lark	*Grallina cyanoleuca*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Painted Honeyeater	*Grantiella picta*	VU	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Brolga	*Grus rubicunda*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Australian Magpie	*Gymnorhina tibicen*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Pied Oystercatcher	*Haematopus longirostris*	-	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	-	VU	Likely	Moderate	Moderate	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Brahminy Kite	*Haliastur indus*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Whistling Kite	*Haliastur sphenurus*	-	-	Likely	Moderate	Moderate	Likely	Low	Low	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Black-breasted Buzzard	*Hamirostra melanosternon*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the BC Act.
Pallid Cuckoo	*Heteroscenes pallidus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Eagle	*Hieraaetus morphnoides*	-	VU	Unlikely	Moderate	Low	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the BC Act.
Black-winged Stilt	*Himantopus himantopus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-throated Needletail	*Hirundapus caudacutus*	VU	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. This species is a listed migratory species under the EPBC Act.
Welcome Swallow	*Hirundo neoxena*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Barn Swallow	*Hirundo rustica*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Caspian Tern	*Hydroprogne caspia*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Shy Heathwren	*Hylacola cauta*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Buff-banded Rail	*Hypotaenidia philippensis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Little Bittern	*Ixobrychus dubius*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-winged Triller	*Lalage sueurii*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Pacific Gull	*Larus pacificus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Swift Parrot	*Lathamus discolor*	CE	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Malleefowl	*Leipoa ocellata*	VU	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Lewin's Rail	*Lewinia pectoralis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Purple-gaped Honeyeater	*Lichenostomus cratitius*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Brown Honeyeater	*Lichmera indistincta*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Bar-tailed Godwit	*Limosa lapponica*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Black-tailed Godwit	*Limosa limosa*	EN	VU	Rare	Moderate	Negligible	Rare	Low	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. This species is a listed migratory species under the EPBC Act.
Pink Cockatoo	*Lophochroa leadbeateri*	-	VU	Unlikely	Moderate	Low	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Pink Cockatoo (eastern)	*Lophochroa leadbeateri leadbeateri*	EN	-	Unlikely	Moderate	Low	Unlikely	Low	Negligible	This species has not been recorded within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act.
Square-tailed Kite	*Lophoictinia isura*	-	VU	Rare	Low	Negligible	Rare	Low	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is listed as threatened under the BC Act.
Pink-eared Duck	*Malacorhynchus membranaceus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Purple-backed Fairy-wren	*Malurus assimilis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Superb Fairy-wren	*Malurus cyaneus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Variegated Fairy-wren	*Malurus lamberti*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-winged Fairy-wren	*Malurus leucopterus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Splendid Fairy-wren	*Malurus splendens*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Yellow-throated Miner	*Manorina flavigula*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Noisy Miner	*Manorina melanocephala*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-eared Miner	*Manorina melanotis*	EN	CE	Rare	Moderate	Negligible	Rare	Low	Negligible	This species has not been recorded within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Hooded Robin	*Melanodryas cucullata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	EN	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Brown-headed Honeyeater	*Melithreptus brevirostris*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-chinned Honeyeater	*Melithreptus gularis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
White-naped Honeyeater	*Melithreptus lunatus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Budgerigar	*Melopsittacus undulatus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Rainbow Bee-eater	*Merops ornatus*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Pied Cormorant	*Microcarbo melanoleucos*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Jacky Winter	*Microeca fascinans*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black Kite	*Milvus migrans*	-	-	Almost certain	Moderate	Moderate	Likely	Low	Low	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. Turbine strikes by commonly occurring raptors are likely, based on experience at other wind farms in south-eastern Australia. This species is not listed as threatened under the EPBC Act or BC Act.
Horsfield's Bushlark	*Mirafra javanica*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow Wagtail	*Motacilla flava*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Satin Flycatcher	*Myiagra cyanoleuca*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Restless Flycatcher	*Myiagra inquieta*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Leaden Flycatcher	*Myiagra rubecula*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Scarlet Honeyeater	*Myzomela sanguinolenta*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Red-browed Finch	*Neochmia temporalis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Blue-winged Parrot	*Neophema chrysostoma*	VU	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Turquoise Parrot	*Neophema pulchella*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
White-eared Honeyeater	*Nesoptilotis leucotis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Boobook	*Ninox boobook*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Barking Owl	*Ninox connivens*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Powerful Owl	*Ninox strenua*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Blue Bonnet	*Northiella haematogaster*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Curlew	*Numenius minutus*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Nankeen Night Heron	*Nycticorax caledonicus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Cockatiel	*Nymphicus hollandicus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Crested Pigeon	*Ocyphaps lophotes*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Crested Bellbird	*Oreoica gutturalis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Olive-backed Oriole	*Oriolus sagittatus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Blue-billed Duck	*Oxyura australis*	-	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Gilbert's Whistler	*Pachycephala inornata*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Golden Whistler	*Pachycephala pectoralis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Rufous Whistler	*Pachycephala rufiventris*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Red-lored Whistler	*Pachycephala rufogularis*	VU	CE	Rare	Moderate	Negligible	Rare	Negligible	Negligible	This species has not been recorded within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Spotted Pardalote	*Pardalotus punctatus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow-rumped Pardalote	*Pardalotus punctatus xanthopyge*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Striated Pardalote	*Pardalotus striatus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Plains-wanderer	*Pedionomus torquatus*	CE	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Australian Pelican	*Pelecanus conspicillatus*	-	-	Likely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Inland Dotterel	*Peltohyas australis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Fairy Martin	*Petrochelidon ariel*	-	-	Likely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Nature Advisory recorded this species flying within RSA at impact sites. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Tree Martin	*Petrochelidon nigricans*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Scarlet Robin	*Petroica boodang*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Red-capped Robin	*Petroica goodenovii*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Flame Robin	*Petroica phoenicea*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Great Cormorant	*Phalacrocorax carbo*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Black Cormorant	*Phalacrocorax sulcirostris*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Pied Cormorant	*Phalacrocorax varius*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Red-necked Phalarope	*Phalaropus lobatus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Common Bronzewing	*Phaps chalcoptera*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Brush Bronzewing	*Phaps elegans*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Friarbird	*Philemon citreogularis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Noisy Friarbird	*Philemon corniculatus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
New Holland Honeyeater	*Phylidonyris novaehollandiae*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Crescent Honeyeater	*Phylidonyris pyrrhoptera*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow-billed Spoonbill	*Platalea flavipes*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Royal Spoonbill	*Platalea regia*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Green Rosella	*Platycercus caledonicus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Crimson Rosella	*Platycercus elegans*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow Rosella	*Platycercus elegans flaveolus*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Rosella	*Platycercus eximius*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Striped Honeyeater	*Plectorhyncha lanceolata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Glossy Ibis	*Plegadis falcinellus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Pacific Golden Plover	*Pluvialis fulva*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Grey Plover	*Pluvialis squatarola*	VU	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act. This species is a listed migratory species under the EPBC Act.
Tawny Frogmouth	*Podargus strigoides*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Great Crested Grebe	*Podiceps cristatus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Hoary-headed Grebe	*Poliocephalus poliocephalus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Regent Parrot	*Polytelis anthopeplus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Regent Parrot (eastern subspecies)	*Polytelis anthopeplus monarchoides*	VU	EN	Unlikely	Moderate	Low	Rare	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Superb Parrot	*Polytelis swainsonii*	VU	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Chestnut-crowned Babbler	*Pomatostomus ruficeps*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-browed Babbler	*Pomatostomus superciliosus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	-	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Little Grassbird	*Poodytes gramineus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Purple Swamphen	*Porphyrio porphyrio*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Spotted Crake	*Porzana fluminea*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Mulga Parrot	*Psephotellus varius*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Red-rumped Parrot	*Psephotus haematonotus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Purple-crowned Lorikeet	*Psitteuteles porphyrocephala*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Little Lorikeet	*Psitteuteles pusillus*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Fuscous Honeyeater	*Ptilotula fusca*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Yellow-plumed Honeyeater	*Ptilotula ornata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-plumed Honeyeater	*Ptilotula penicillata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Grey-fronted Honeyeater	*Ptilotula plumula*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
White-fronted Honeyeater	*Purnella albifrons*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Red-capped Parrot	*Purpureicephalus spurius*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Redthroat	*Pyrrholaemus brunneus*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Speckled Warbler	*Pyrrholaemus sagittatus*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Red-necked Avocet	*Recurvirostra novaehollandiae*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Grey Fantail	*Rhipidura albiscapa*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Willie Wagtail	*Rhipidura leucophrys*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Painted Snipe	*Rostratula australis*	EN	EN	Rare	Moderate	Negligible	Rare	Low	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Weebill	*Smicrornis brevirostris*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australasian Shoveler	*Spatula rhynchotis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Diamond Firetail	*Stagonopleura guttata*	VU	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act.
Freckled Duck	*Stictonetta naevosa*	-	VU	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Australian Pratincole	*Stiltia isabella*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Mallee Emu-wren	*Stipiturus mallee*	EN	-	Rare	Moderate	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act.
Pied Currawong	*Strepera graculina*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Grey Currawong	*Strepera versicolor*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Apostlebird	*Struthidea cinerea*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black Honeyeater	*Sugomel nigrum*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Brown Quail	*Synoicus ypsilophorus*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australasian Grebe	*Tachybaptus novaehollandiae*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian Shelduck	*Tadorna tadornoides*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Zebra Finch	*Taeniopygia guttata*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Australian White Ibis	*Threskiornis molucca*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Straw-necked Ibis	*Threskiornis spinicollis*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Red-backed Kingfisher	*Todiramphus pyrrhopygius*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Sacred Kingfisher	*Todiramphus sanctus*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Black-tailed Native-hen	*Tribonyx ventralis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Musk Lorikeet	*Trichoglossus concinna*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Rainbow Lorikeet	*Trichoglossus haematodus*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Wood Sandpiper	*Tringa glareola*	-	-	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Common Greenshank	*Tringa nebularia*	EN	-	Rare	Moderate	Negligible	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act. This species is a listed migratory species under the EPBC Act.
Marsh Sandpiper	*Tringa stagnatilis*	-	-	Unlikely	Low	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. This species is a listed migratory species under the EPBC Act.
Red-chested Button-quail	*Turnix pyrrhothorax*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Painted Button-quail	*Turnix varius*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Little Button-quail	*Turnix velox*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Barn Owl	*Tyto javanica*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Eastern Grass Owl	*Tyto longimembris*	-	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act.
Masked Lapwing	*Vanellus miles*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Banded Lapwing	*Vanellus tricolor*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Terek Sandpiper	*Xenus cinereus*	VU	VU	Rare	Low	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. This species is a listed migratory species under the EPBC Act.
Baillon's Crake	*Zapornia pusilla*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Spotless Crake	*Zapornia tabuensis*	-	-	Rare	Negligible	Negligible	Rare	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Silvereye	*Zosterops lateralis*	-	-	Unlikely	Negligible	Negligible	Rare	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act.
Microbats										
White-striped Freetail-bat	*Austronomus australis*	-	-	Almost Certain	Low	Low	Unlikely	Low	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. Prefers open foraging areas above canopy. A very common widespread species recorded in high numbers during site surveys. Recognised as an at risk bat species in relation to wind farm developments due to their foraging and flight behaviour. Due to its poor ability to detect and avoid obstacles, particularly mobile ones, such as turbine blades, White-striped Free-tail Bats are one of the most commonly recorded species in carcass monitoring at Australian windfarms. Highly susceptible to collision mortality regularly, however, populations generally secure and dense to withstand moderate instances of mortality should it occur.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
Gould's Wattled Bat	*Chalinolobus gouldii*	-	-	Almost Certain	Low	Low	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A common and widespread large microbat that is fast, high flier with restricted manoeuvrability. This species has a poor ability to detect and avoid obstacles while pursuing prey, particularly mobile ones such as turbine blades. Highly susceptible to collision mortality regularly, however populations generally secure and dense to withstand moderate instances of mortality should it occur.
Chocolate Wattled Bat	*Chalinolobus morio*	-	-	Likely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A relatively common and widespread microbat that is fast with increased manoeuvrability than the Gould's Wattled Bat. Generally restricted to canopies and fringing vegetation, may be susceptible to collision mortality on occasion, however populations generally secure and dense to withstand low instances of mortality should it occur.
Little Pied Bat	*Chalinolobus picatus*	-	VU	Rare	Moderate	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act. A declining species that occurs in dry open forest and woodlands. Roosts in caves and occasionally within tree hollows and other structures. Relatively confined to canopies and timbered areas but may fly within RSA on occasion. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Southern Myotis	*Myotis macropus*	-	VU	Rare	Moderate	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act. Generally found around riparian areas. Not known to fly within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences in gullies and surrounding waterways.
Corben's Long-eared Bat	*Nyctophilus corbeni*	VU	VU	Rare	Moderate	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. This species has a low liklihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. Generally restricted to foraging within or beneath the canopy however may forage within open areas. This species is a slow flying agile bat that roosts in tree hollows, crevices and under loose bark. Unlikely to fly within RSA. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A relatively common and widespread microbat that is fast with high manoeuvrability. Generally restricted to foraging within or beneath the canopy however may forage within open areas, especially where lights have attracted large insect numbers. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Gould's Long-eared Bat	*Nyctophilus gouldi*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										Act or BC Act. A relatively common and widespread microbat that is fast with high manoeuvrability. Generally restricted to foraging within or beneath the canopy however may forage within open areas or within areas fringing remnant vegetation. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Inland Free-tailed Bat	*Ozimops petersi*	-	-	Likely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. Widespread species of varying habitats, but rare within the locality. Fast and direct fliers of unobstructed air-spaces from just above to well above the canopy as well as above grasslands. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Southern Free-tailed bat	*Ozimops planiceps*	-	-	Likely	Low	Low	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. Widespread species of varying habitats, but rare within the locality. Fast and direct fliers of unobstructed air-spaces from just above to well above the canopy as well as above grasslands. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Eastern Free-tailed Bat	*Ozimops ridei*	-	-	Likely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. Widespread species of varying habitats, but rare within the locality. Fast and direct fliers of unobstructed air-spaces from just above to well above the canopy as well as above grasslands. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Grey-headed Flying-fox	*Pteropus poliocephalus*	VU	VU	Rare	Moderate	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the EPBC Act and BC Act. May occur on an intermittent basis transiting through the landscape, however the occurrence of known camps and forage resources mean regular flights through the development footprint are considered unlikely. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Little Red Flying-fox	*Pteropus scapulatus*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. May occur on an intermittent basis transiting through the landscape, however the occurrence of known camps and forage resources mean regular flights through the development footprint are considered unlikely. Should a collision occur, it is likely only a very small number of individuals would be impacted.
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	-	VU	Unlikely	Moderate	Low	Unlikely	Low	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act. A widespread species within a range of habitats including rainforest, woodland and grassland. High and fast flier over the forest canopy, but lower in more open areas and fringing vegetation. Roosts within

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										tree hollows. Has potential to fly within RSA. In the unlikely event that collisions occur, impacts to the local population of the species may eventuate.
Inland Broad-nosed Bat	*Scotorepens balstoni*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A widespread species that generally fly within riparian areas but may also fly above canopies on occasion. Highly mobile, however, not recorded within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.
Little Broad-nosed Bat	*Scotorepens greyii*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A common widespread species. Generally fly within riparian areas and woodland along the fringing areas of vegetation but may also fly above canopies and RSA on occasion. Highly mobile and susceptible to collision mortality, however populations generally secure and dense to withstand moderate instances of mortality should it occur.
Inland Forest Bat	*Vespadelus baverstocki*	-	VU	Unlikely	Moderate	Low	Unlikely	Negligible	Negligible	There are some records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The threatened nature of this species makes population impacts possible. This species is listed as threatened under the BC Act. A poorly known species that may cover an extensive foraging area. Like other Vespadelus, is not considered to be at risk of collision due to their favoured foraging and roosting preferences in drier woodland habitats with bias towards riparian areas.
Large Forest Bat	*Vespadelus darlingtoni*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A large widespread bat with restricted manoeuvrability due to its size. Not known to fly within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.
Eastern Forest Bat	*Vespadelus pumilus*	-	-	Rare	Negligible	Negligible	Unlikely	Negligible	Negligible	There are minimal records within the locality. This species has a low likelihood of flying at RSA height. There have been no recorded collisions with wind turbines for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A poorly known species that may cover an extensive foraging area. Like other Vespadelus, is not considered to be at risk of collision due to their favoured foraging and roosting preferences in drier woodland habitats with bias towards riparian areas.
Southern Forest Bat	*Vespadelus regulus*	-	-	Unlikely	Low	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. This species has a low likelihood of flying at RSA height. Turbine collisions have been reported for this species in NSW. The widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A moderate sized widespread bat. Not known to fly within RSA and not considered to be at risk of collision due to their favoured foraging and roosting preferences. In the unlikely event a collision occurs, populations generally secure and dense to withstand low instances of mortality should it occur.
Little Forest Bat	*Vespadelus vulturnus*	-	-	Unlikely	Negligible	Negligible	Unlikely	Negligible	Negligible	There are many records within the locality. There is potential for this species to fly at RSA height. Turbine collisions have been reported for this species in NSW. The

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Common name	Scientific name	Threat listing		Collision with operating turbine			Indirect disturbance including barrier effects			Reasoning
		EPBC Act	BC Act	Likelihood	Consequence	Risk rating	Likelihood	Consequence	Risk rating	
										widespread and common status of these species makes population impacts unlikely. This species is not listed as threatened under the EPBC Act or BC Act. A small sized, very common and widespread bat. They are highly agile fast fliers with high manoeuvrability. May fly beneath and above canopy height and on occasion within RSA. Should a collision occur, it is likely only a very small number of individuals would be impacted.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 2024c). Potential occurrence is noted throughout most of inland, semi arid and arid NSW (Cth DCCEEW 2025b), 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 2025).

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 18 below.

Table A 18 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Table A 19 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. 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. 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 2024c)**. 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. 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. 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. 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. 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. 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for vulnerable species
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. 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. 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. The project would not interfere with Conservation Actions identified in the Conservation Advice.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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. This assessment has found the project is unlikely to: • Lead to the long-term decrease in the population of this species. • Reduce the area of occupancy of this species. • Fragment an existing important population into two or more populations. • Adversely affect habitat critical to the survival of a species. • Disrupt the breeding cycle of an important population. • Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. • Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat. • Introduce disease that may cause the species to decline. • 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 2024c). 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).

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 20 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). To prevent a long-term decrease in the size of the population of this species, the following avoid and minimise steps will be undertaken: • 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. 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. This species was not recorded flying at RSA height, and collisions are not expected to occur. 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 2024). 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for critically endangered or endangered species
• Fragment an existing important population into two or more populations. • Adversely affect habitat critical to the survival of a species. • Disrupt the breeding cycle of an important population. • Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. • Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat. • Introduce disease that may cause the species to decline. • 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 2024c). 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 2020).

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 21 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. 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). 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for vulnerable species
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 2020). 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: • For activities such as foraging, breeding, roosting, or dispersal • 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) • To maintain genetic diversity and long-term evolutionary development, or • For the reintroduction of populations or recovery of the species or ecological community. 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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:

- Invasive species: Predation by cats.
- Climate change: Increased temperatures in arid and semi-arid Australia.
- Demographic and genetic stochastic events: Small population size.
- Habitat loss and fragmentation: Grazing by exotic herbivores, Nest shortage.
- Disturbance: Birdwatchers and photographers.
- Direct mortality: Collision with traffic, Collision with fences and powerlines.
- Harvesting: Egg collecting, Falconry.

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.

This assessment has found the project is unlikely to:

- Reduce the area of occupancy of an important population.
- Fragment an existing important population into two or more populations.
- Adversely affect habitat critical to the survival of a species.
- Disrupt the breeding cycle of an important population.
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
- Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.
- Introduce disease that may cause the species to decline.
- Interfere substantially with the recovery of the species.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 2024c). 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 2023d).

Habitat requirements

The approved conservation advice for this species (Cth DCCEEW 2023d) 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 22 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: • Key source populations either for breeding or dispersal. • Populations that are necessary for maintaining genetic diversity, and/or • Populations that are near the limit of the species range. As such the population is not considered an important population of the species. 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 2023d). 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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: • Relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both; • Habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat; • Living and dead trees with hollows and crevices which are essential for roosting and nesting. 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. 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 2023d).
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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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. The project would result in direct impacts to 4% of suitable habitat for this species within the subject land. 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 This assessment has found the project is unlikely to: • Reduce the area of occupancy of an important population. • Fragment an existing important population into two or more populations. • Disrupt the breeding cycle of an important population. • Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. • Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat. • Introduce disease that may cause the species to decline. • Interfere substantially with the recovery of the species.

Appendix 5.5. Pink Cockatoo – Endangered

Distribution

Pink 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

Pink 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.

Pink 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).

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Pink 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

Pink 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, Pink 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 Pink 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 Pink Cockatoo several times throughout the survey program, observations from Nature Advisory and earlier by NGH Consulting identified that Pink 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Table A 23 SIC assessment for Pink 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 Pink 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. 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. 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 Pink Cockatoo will generally remain unchanged. The species is not expected to regularly fly at RSH, and therefore operation turbines are not expected to result in connectivity impacts to the species.
Adversely affect habitat critical to the survival of a species.
Yes. The Conservation Advice for Pink Cockatoo describes habitat critical to the survival of Pink Cockatoo as consisting of: • Arid and semi-arid woodlands dominated by Mulga, mallee and box eucalypts, Slender Cypress Pine or Belah. • Known habitat containing suitable attributes, including potential habitat for the subspecies, especially where there are large mature trees with suitable hollows; and • Surrounding matrix of these areas for the role of providing movement corridors for dispersal across the landscape (DCCEEW, 2023). 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), 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for vulnerable species

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 Pink 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 Pink 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.

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 Pink Cockatoos are susceptible to. In addition to this the project will implement several controls and management plans including a Bird and

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for vulnerable species
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: • Arrest the current decline and achieve a stable or increasing population trend. • Increase nesting habitat availability within the subspecies' range, and improve connectivity of woodland habitat. 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 Pink 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. Based on the current level of understanding of impacts to Pink Cockatoo, and based on consideration of the above eight factors, the project is considered to be a significant impact to Pink Cockatoo.

Appendix 5.6. Australasian Bittern – Endangered

Distribution

This species occurs throughout the Murray-Darling Basin as well as coastal NSW (NSW DCCEEW 2024c). 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 (TSSC 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 (TSSC 2019).

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.

© Biosis 2025 — Leaders in Ecology and Heritage 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.

Table A 24 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for critically endangered or endangered species

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.

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.

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.

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 reduction in the area of occupancy of this species.

Fragment an existing population into two or more populations.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for critically endangered or endangered species
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.' 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.
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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for critically endangered or endangered 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: • Reduced wetland availability due to changes water regimes. • Habitat loss and/or alteration. • Climate variability and change. • Reduced water quality. • Invasive species. • Loss of genetic diversity. 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. This assessment has found the project is unlikely to: • Lead to the long-term decrease in the population of this species. • Reduce the area of occupancy of this species. • Fragment an existing population into two or more populations. • Adversely affect habitat critical to the survival of the species. • Disrupt the breeding cycle of this species. • Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. • Result in invasive species that are harmful to a vulnerable species becoming established in the species' habitat. • Introduce disease that may cause the species to decline. • 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).

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 25 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. 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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. 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. This assessment has found the project is unlikely to: • Substantially modify, destroy or isolate an area of important habitat for a migratory species. • Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species. • 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 (Cth DCCEEW 2025c).

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. (Cth DCCEEW 2025c)

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 26 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. 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. 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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. This assessment has found the project is unlikely to: • Substantially modify, destroy or isolate an area of important habitat for a migratory species. • Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species. • 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 2025). 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 2024c).

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Table A 27 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. 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. 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. 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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: • Substantially modify, destroy or isolate an area of important habitat for a migratory species. • Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species. • 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 2024).

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 2024)..

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 2024).

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Table A 28 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. 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. 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. 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

SIC assessment for listed migratory species

Conclusion.

The project is unlikely to significantly impact this species, as the project is unlikely to:

- Substantially modify, destroy or isolate an area of important habitat for a migratory species.
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.
- Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 8 Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing north.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Photo 9 **Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing south.**

Photo 10 **Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing south-west.**

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Photo 11 **Planted native non-indigenous Eucalypts along the Sturt Highway, Balranald facing north-east.**

Photo 12 **Planted native indigenous mallee trees within the subject land facing west (note tree guards).**

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Photo 13 **Planted native indigenous mallee trees within the subject land facing south.**

Photo 14 **Planted native indigenous mallee trees within the subject land facing north-west (note tree guards).**

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Photo 15 **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 29 below.

Table A 29 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 **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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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: • **a. a species recovery project** • **b. Saving our Species project** • **c. other types of government funded restoration project** • **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** • **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)** • **f. ecological rehabilitation to re-establish a PCT or TEC that was, or is carried out under a mine operations plan, or** • **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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 16 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).

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Photo 17 **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 18 **1990 aerial imagery of planted native indigenous mallee tree area within the subject land (no trees present at this time) (NSW Government 2023).**

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Appendix 7. Streamlined assessment module – Scattered trees assessment

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 30 below provides information on the tree cover benchmarks for the PCTs relevant to this assessment.

Table A 30 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 30 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.

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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 31 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 31 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
6	*Eucalyptus dumosa*	3	1

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Tree ID	Species	Class	Number of hollows
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
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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Tree ID	Species	Class	Number of hollows
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
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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Table A 32 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 32 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 33 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.

Table A 33 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

PCT	Class	Contains hollows	No. of trees	Credit required
	2	No	3	3
Totals			66	

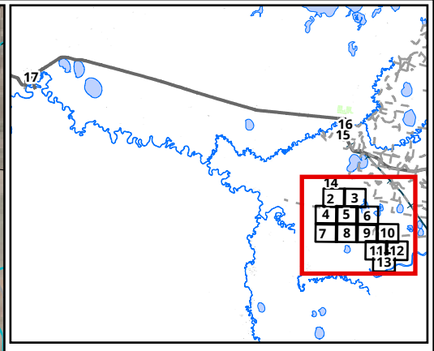
Threatened ecological communities

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 34 below.

Table A 34 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

© Biosis 2025 — Leaders in Ecology and Heritage Consulting



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

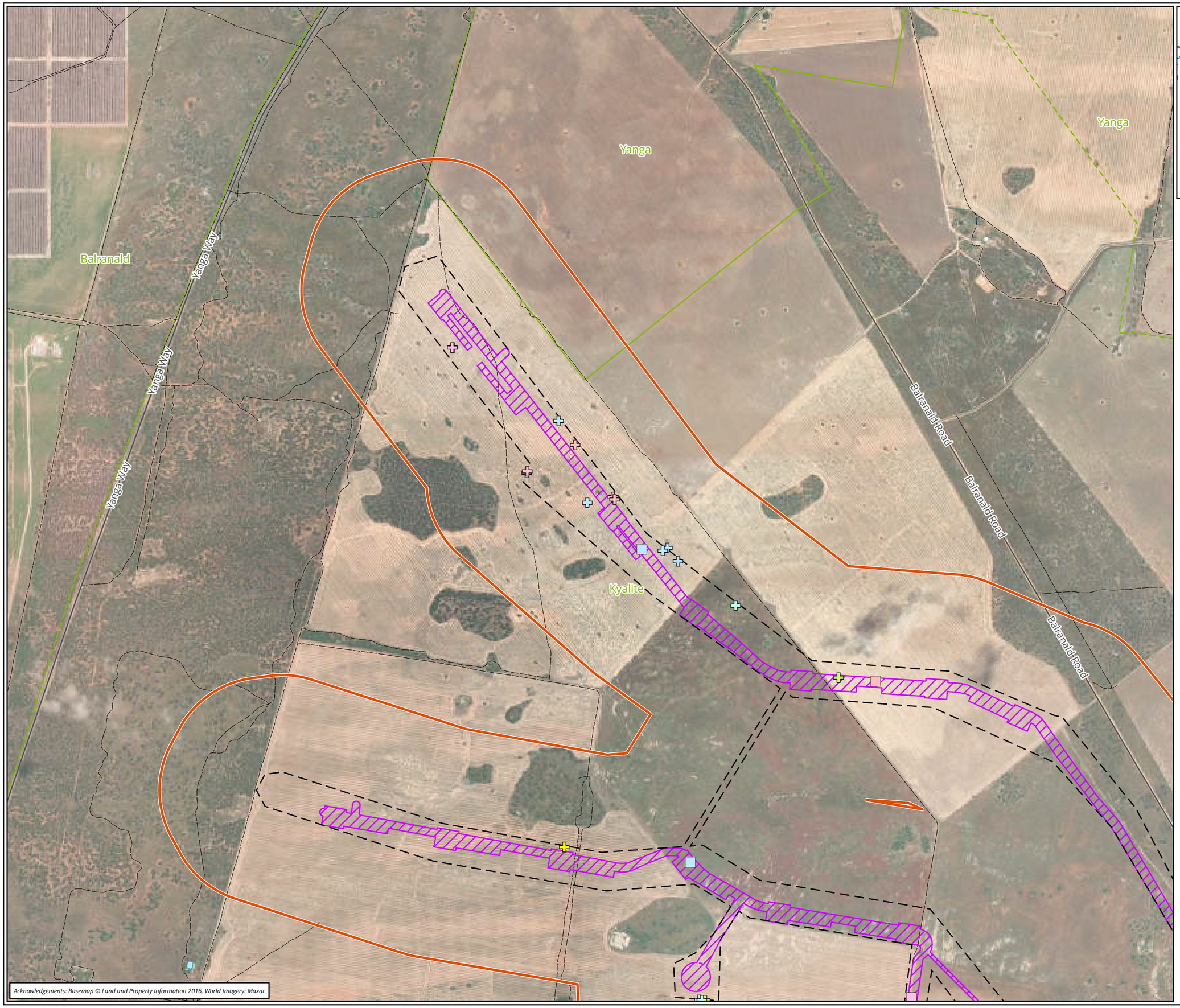
Scale: 1:80,000 @ A3

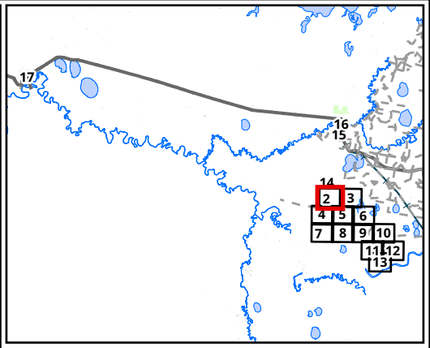
Coordinate System: GDA2020 MGA Zone 54

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

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

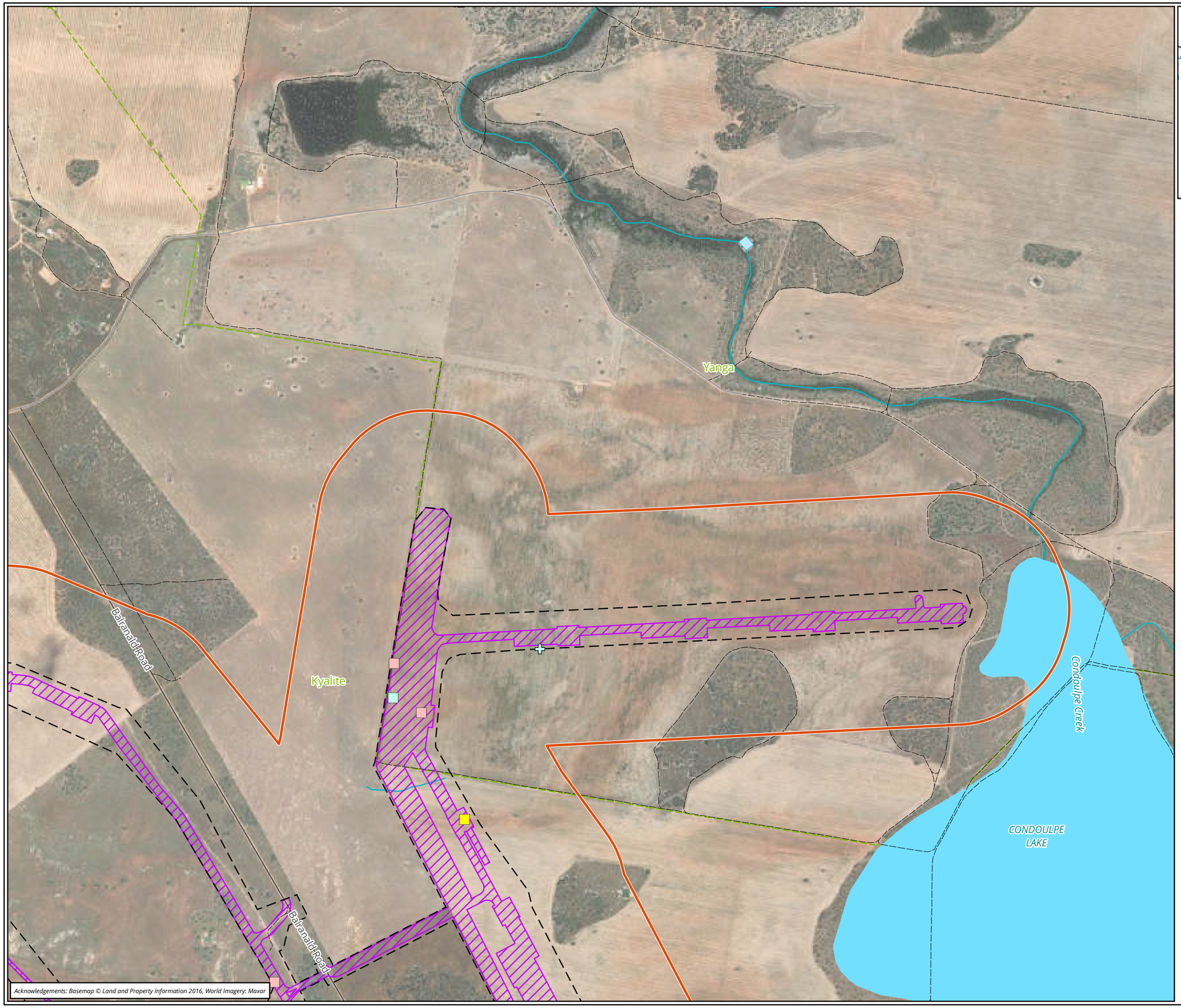
Meters

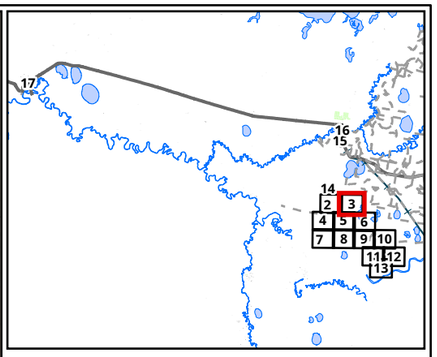
Scale: 1:18,000 @ A3

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*

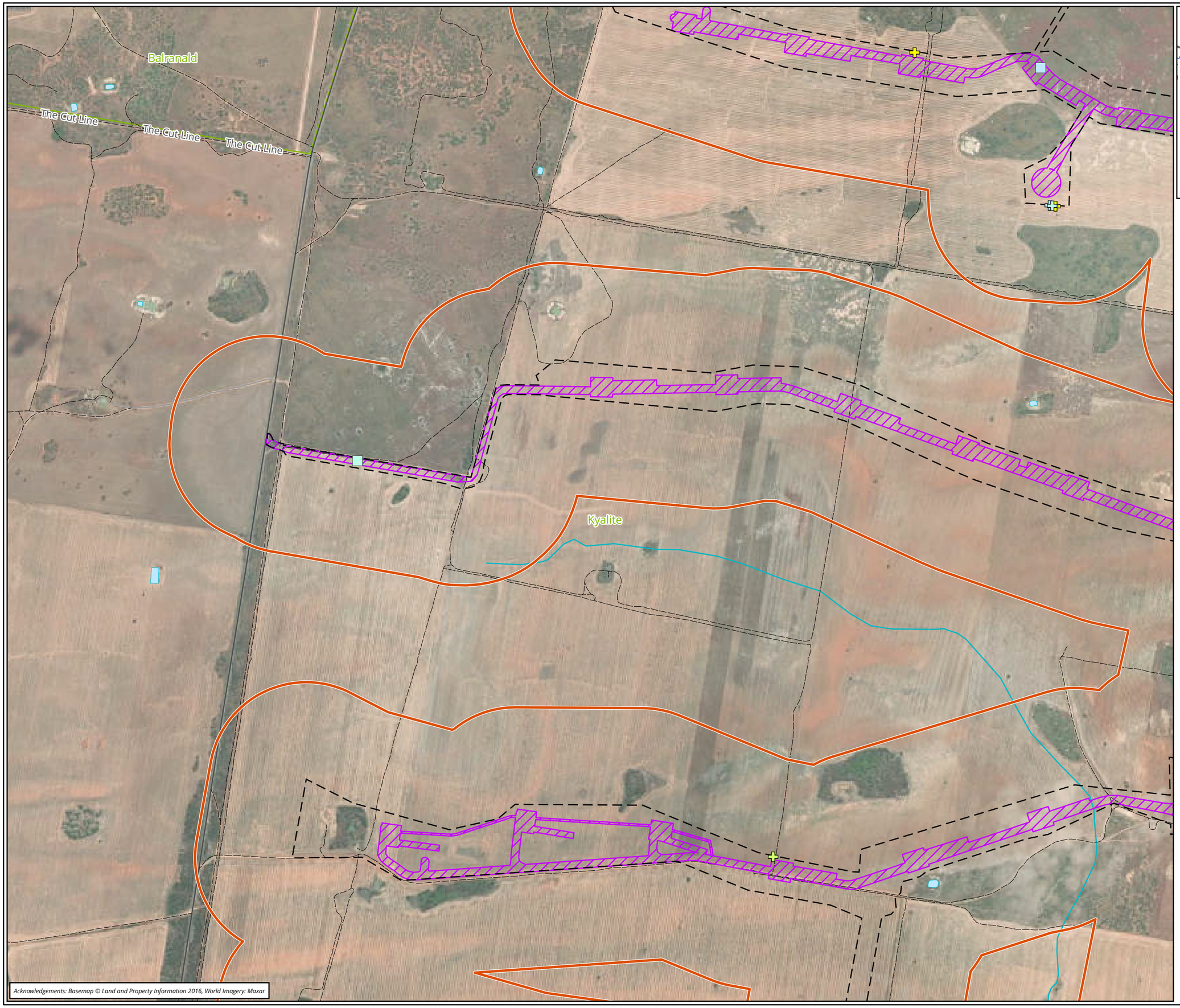
Figure 23.3 Scattered trees mapped within the subject land

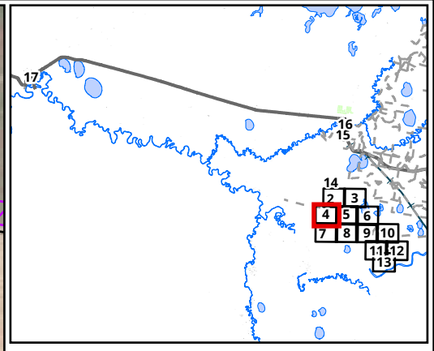
0 230 460 690 920 N

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 largiflorens*
- Other

Paddock Trees - To be removed

- *Alectryon oleifolius*
- *Eucalyptus largiflorens*

Figure 23.4 Scattered trees mapped within the subject land

0 230 460 690 920

Meters

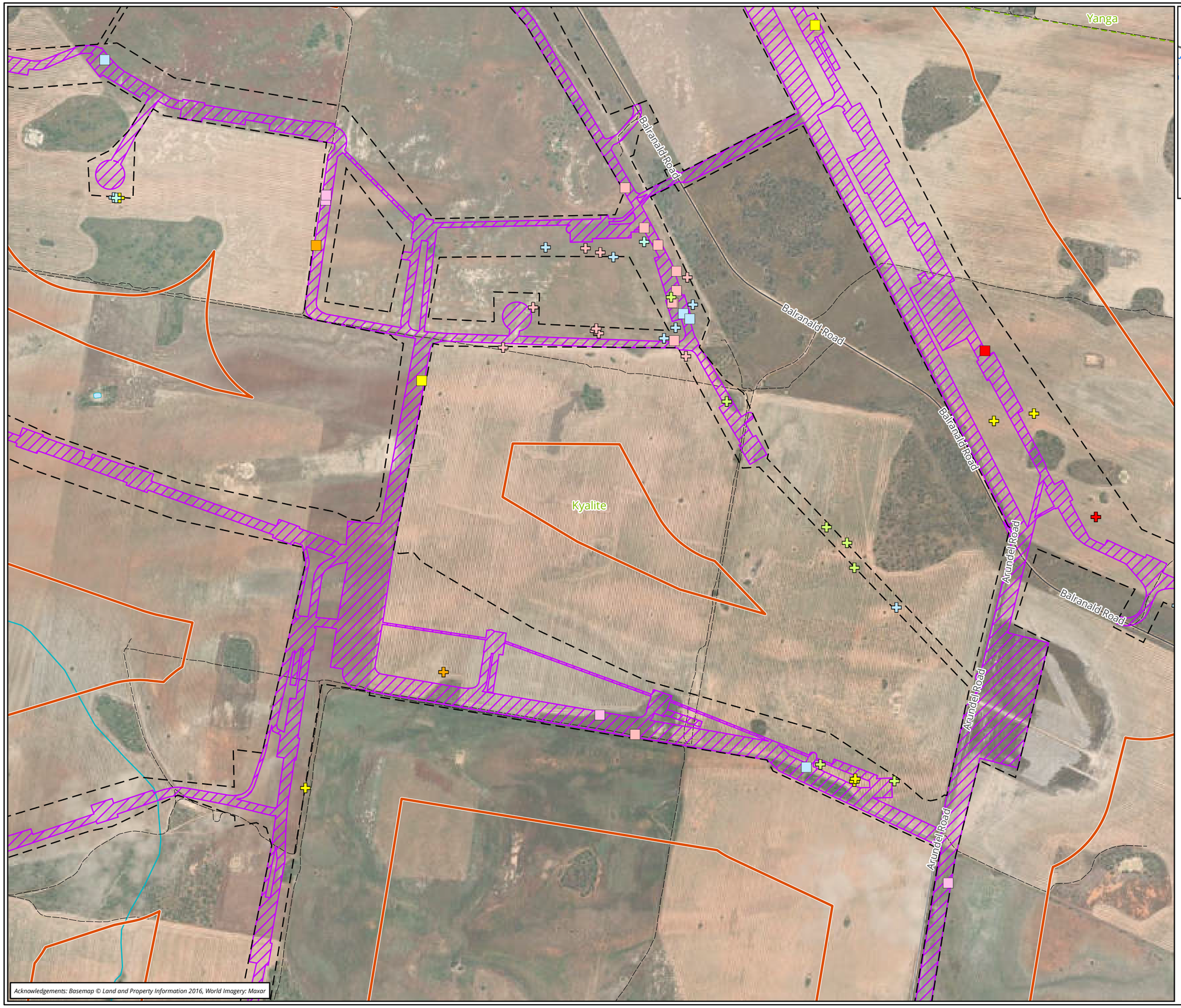
Scale: 1:18,000 @ A3

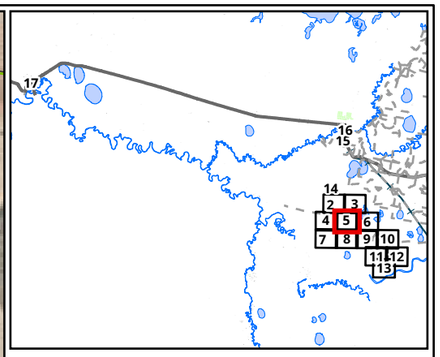
Coordinate System: GDA2020 MGA Zone 54

N

biosis

Matter: 37502, Date: 18 March 2024
GIS: JET, Checked by: CW, Last edited by: jtownsend
Location: P:\37500s\37502\Mapping\37502_BDAR 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

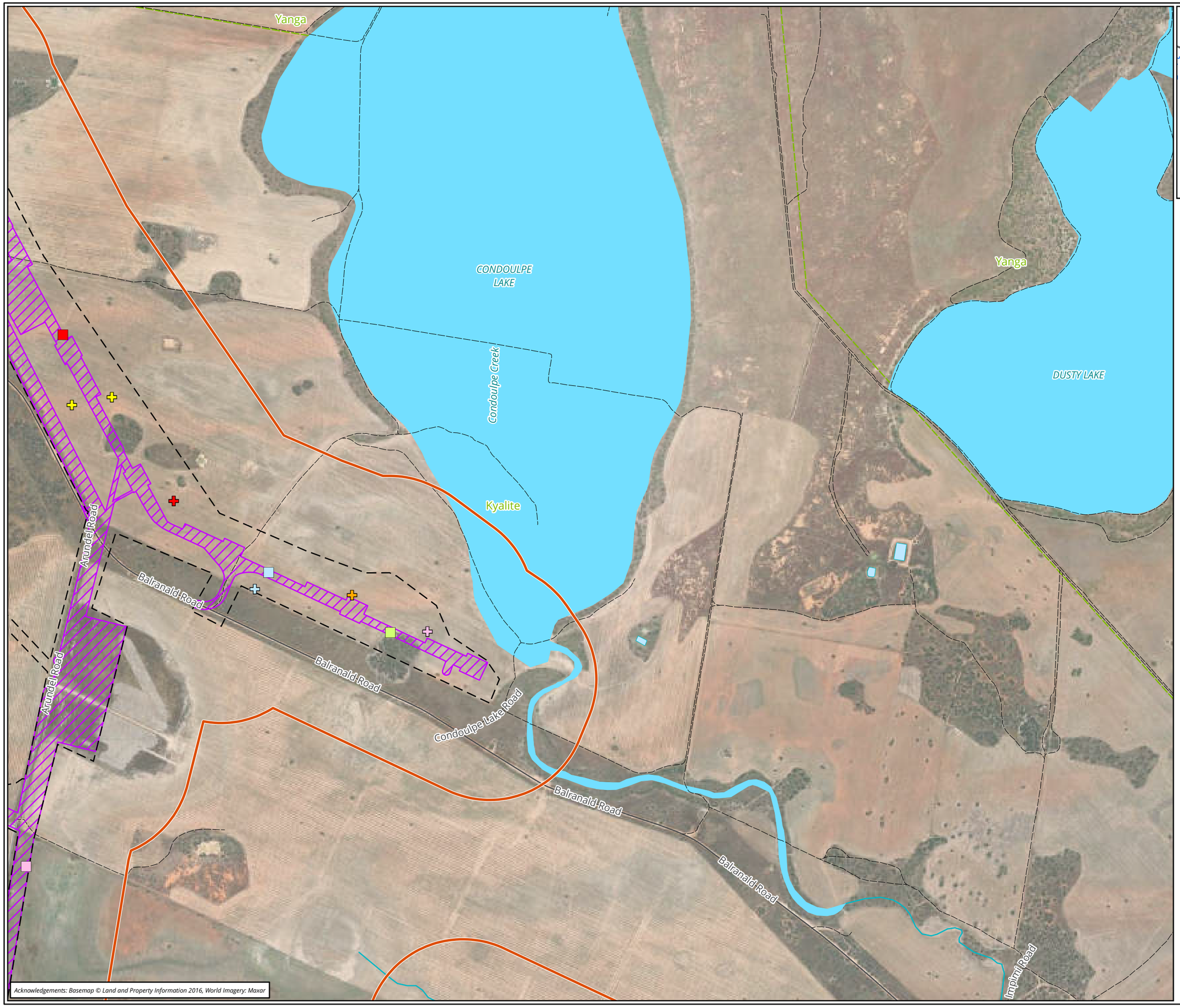
Meters

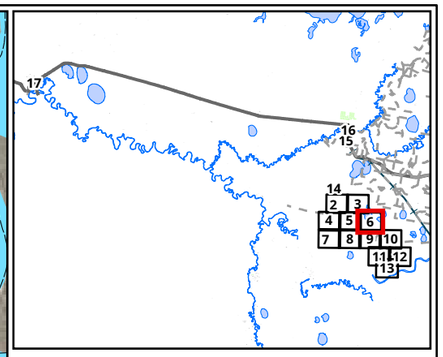
Scale: 1:18,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

- *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

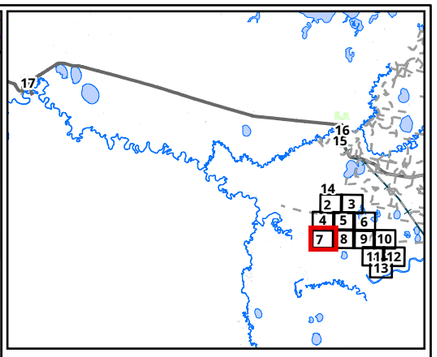
Meters

Scale: 1:18,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

- *Casuarina pauper*
- *Eucalyptus largiflorens*
- Other

Paddock Trees - To be removed

- *Acacia melvillei*
- Other

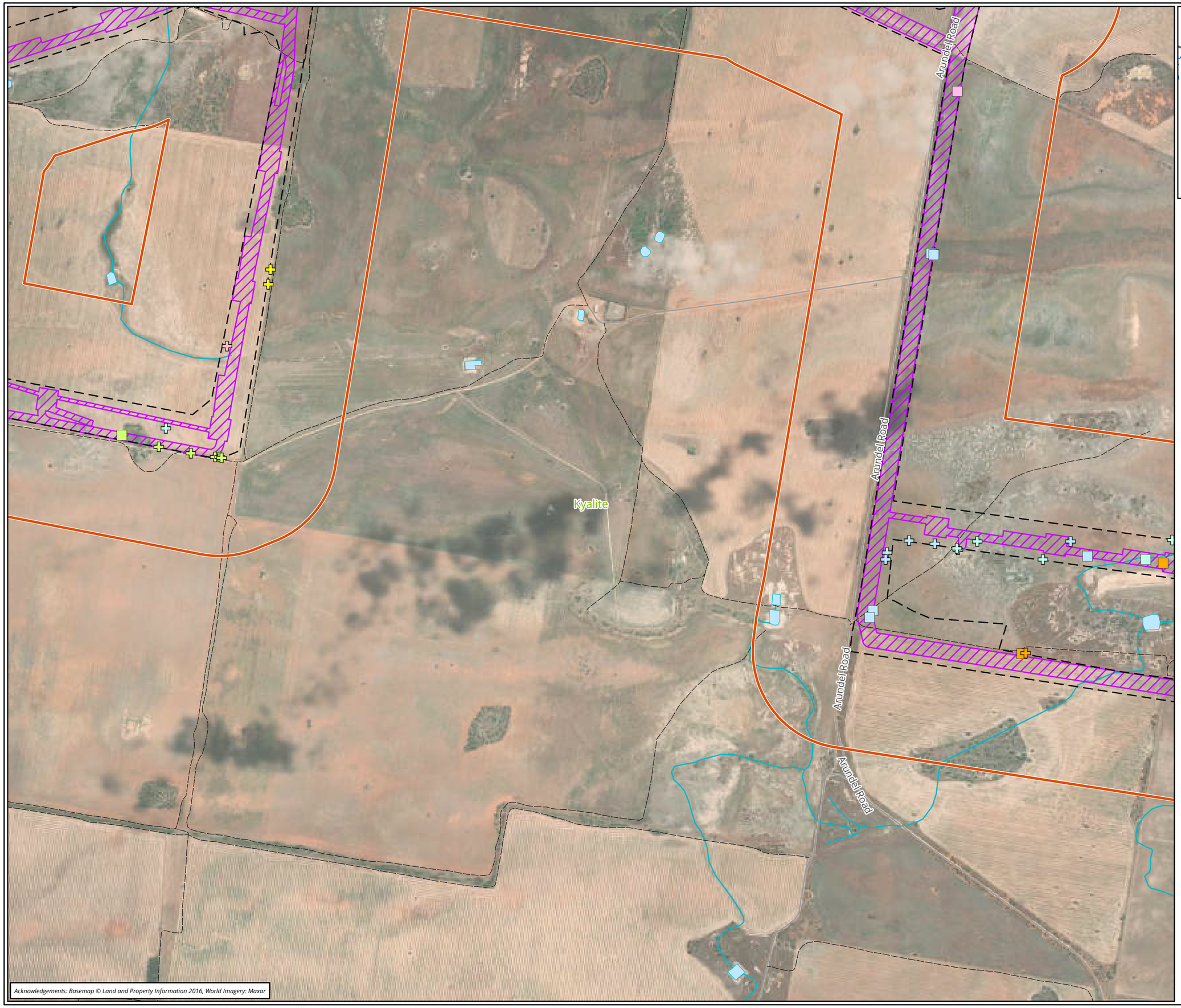
Figure 23.7 Scattered trees mapped within the subject land

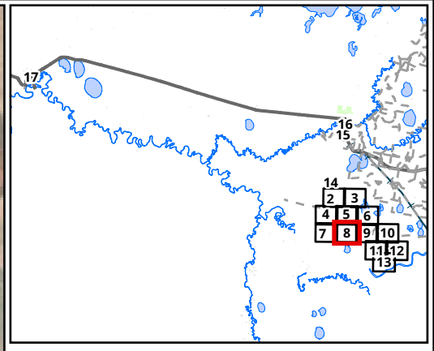
0 230 460 690 920 N

Meters
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*
- *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

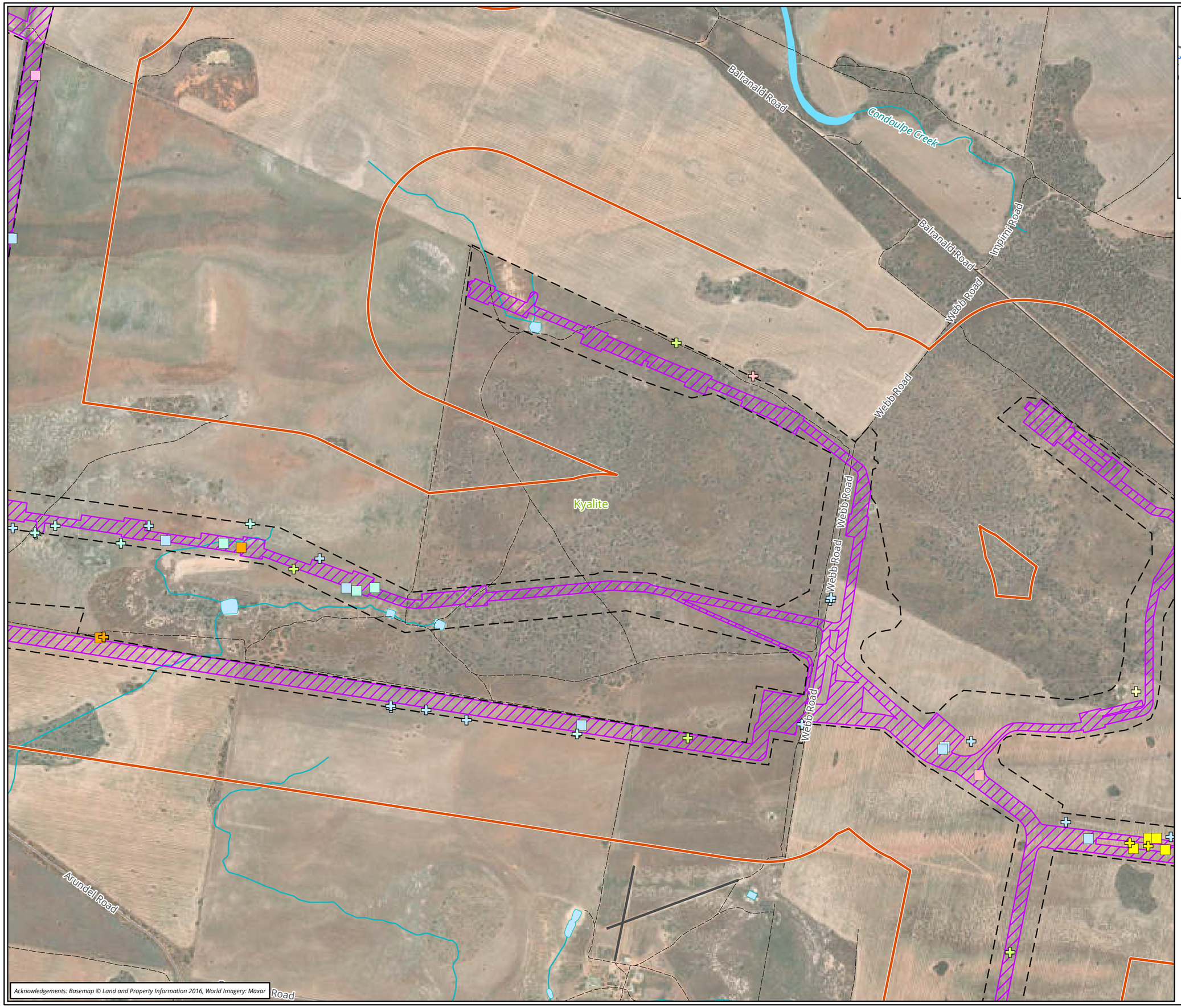
Scale: 1:18,000 @ A3

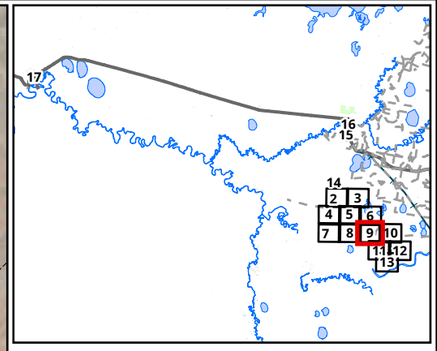
Coordinate System: GDA2020 MGA Zone 54

N

biosis

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

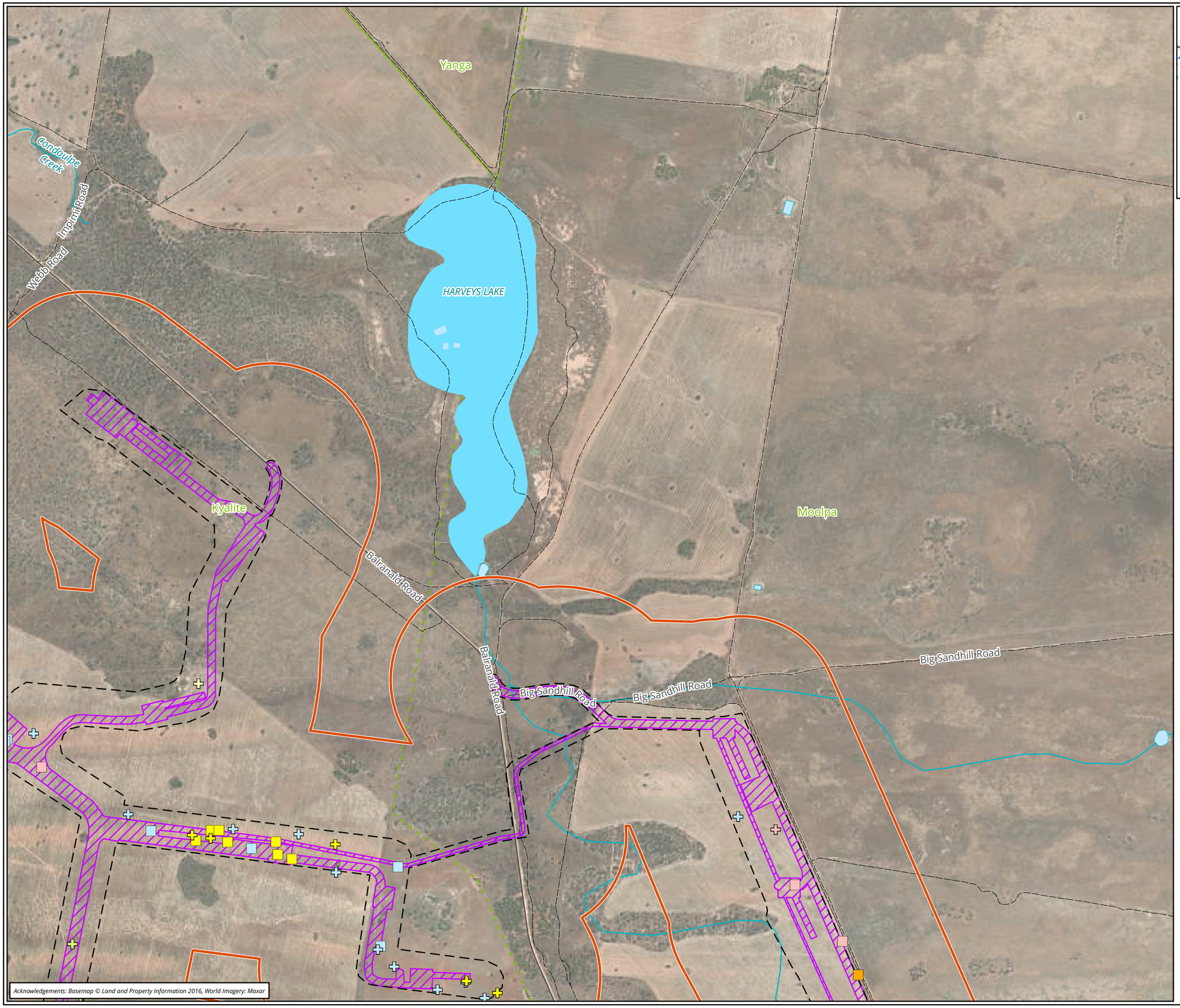
Figure 23.9 Scattered trees mapped within the subject land

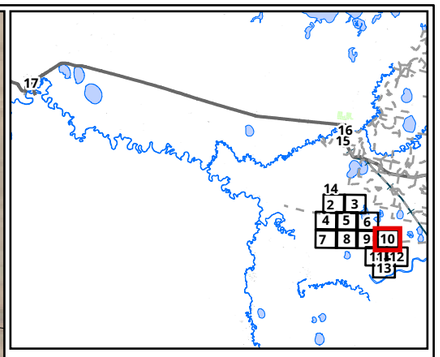
0 230 460 690 920 N

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

- *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

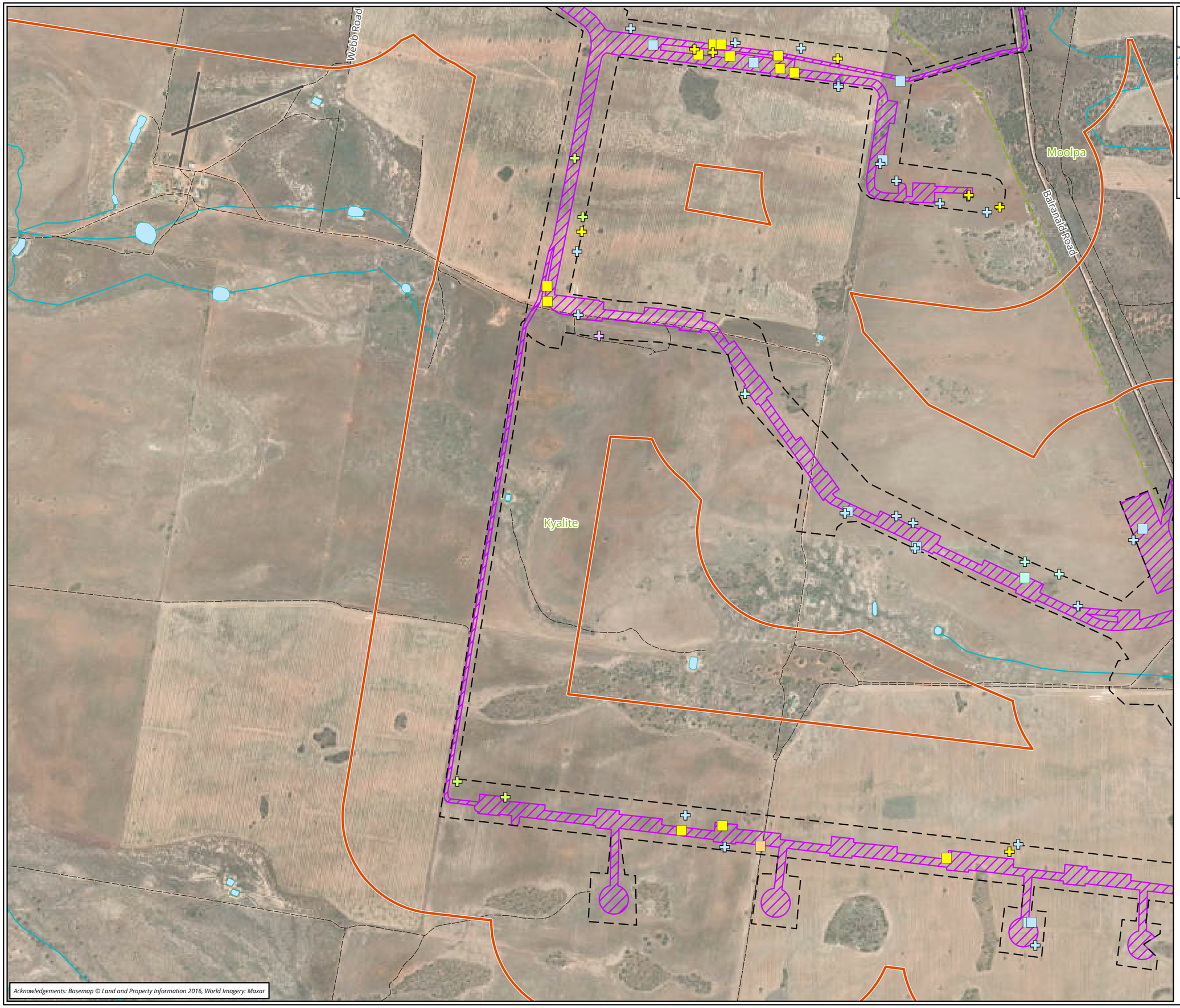
Meters

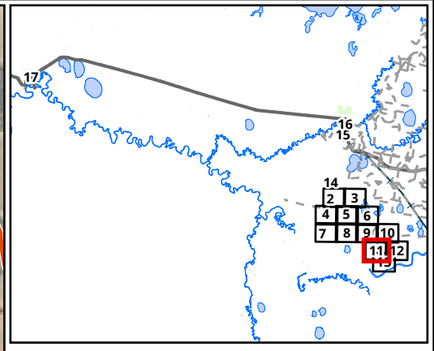
Scale: 1:18,000 @ A3

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*

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

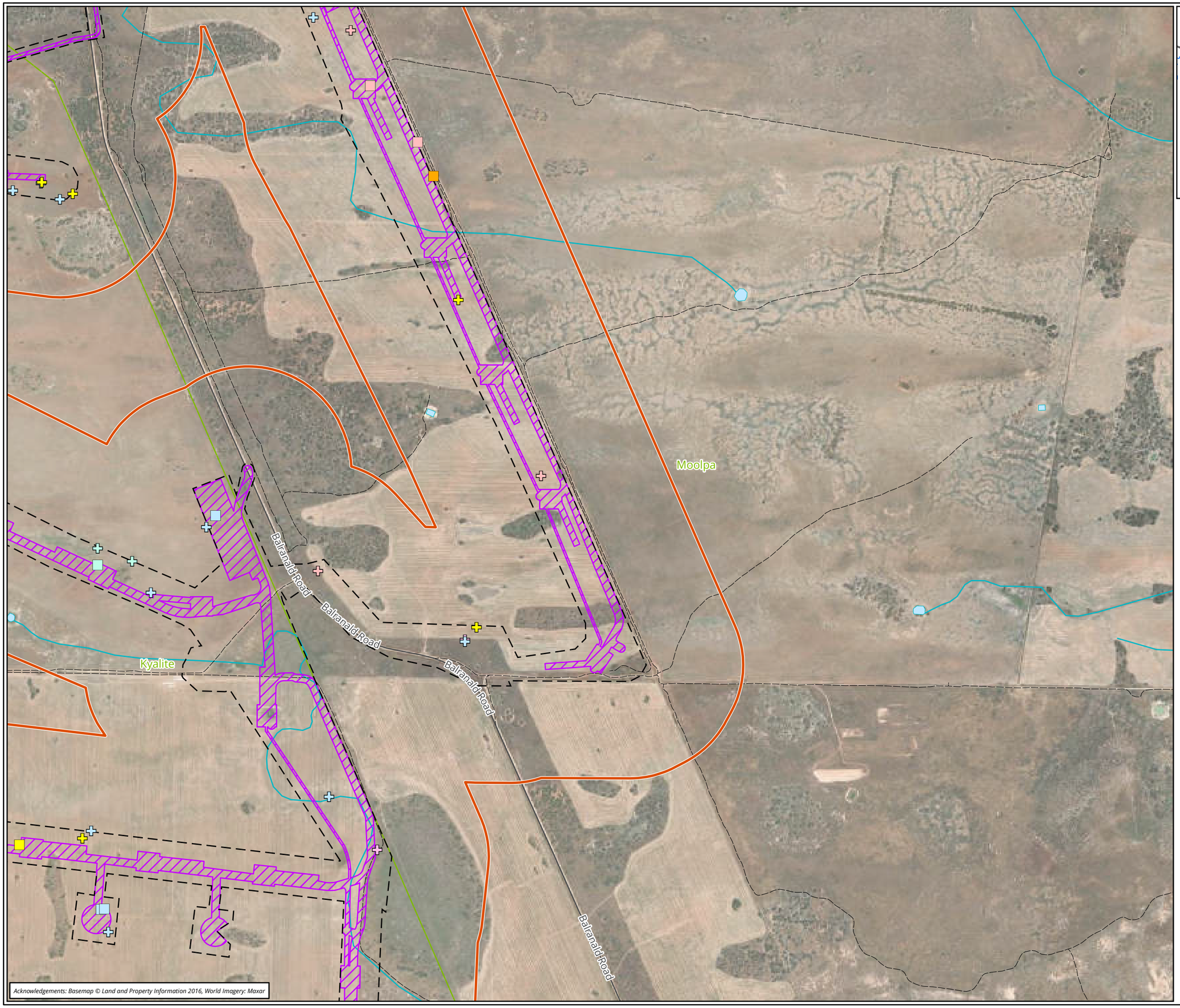
Figure 23.11 Scattered trees mapped within the subject land

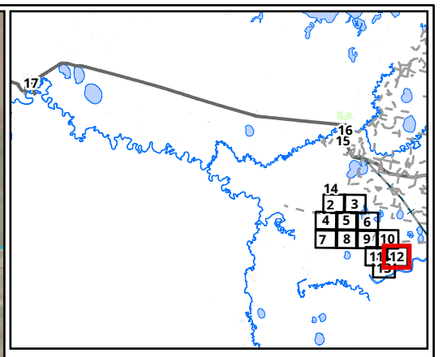
0 230 460 690 920 N

Meters
Scale: 1:18,000 @ A3
Coordinate System:
GDA2020 MGA Zone 54

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

- *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

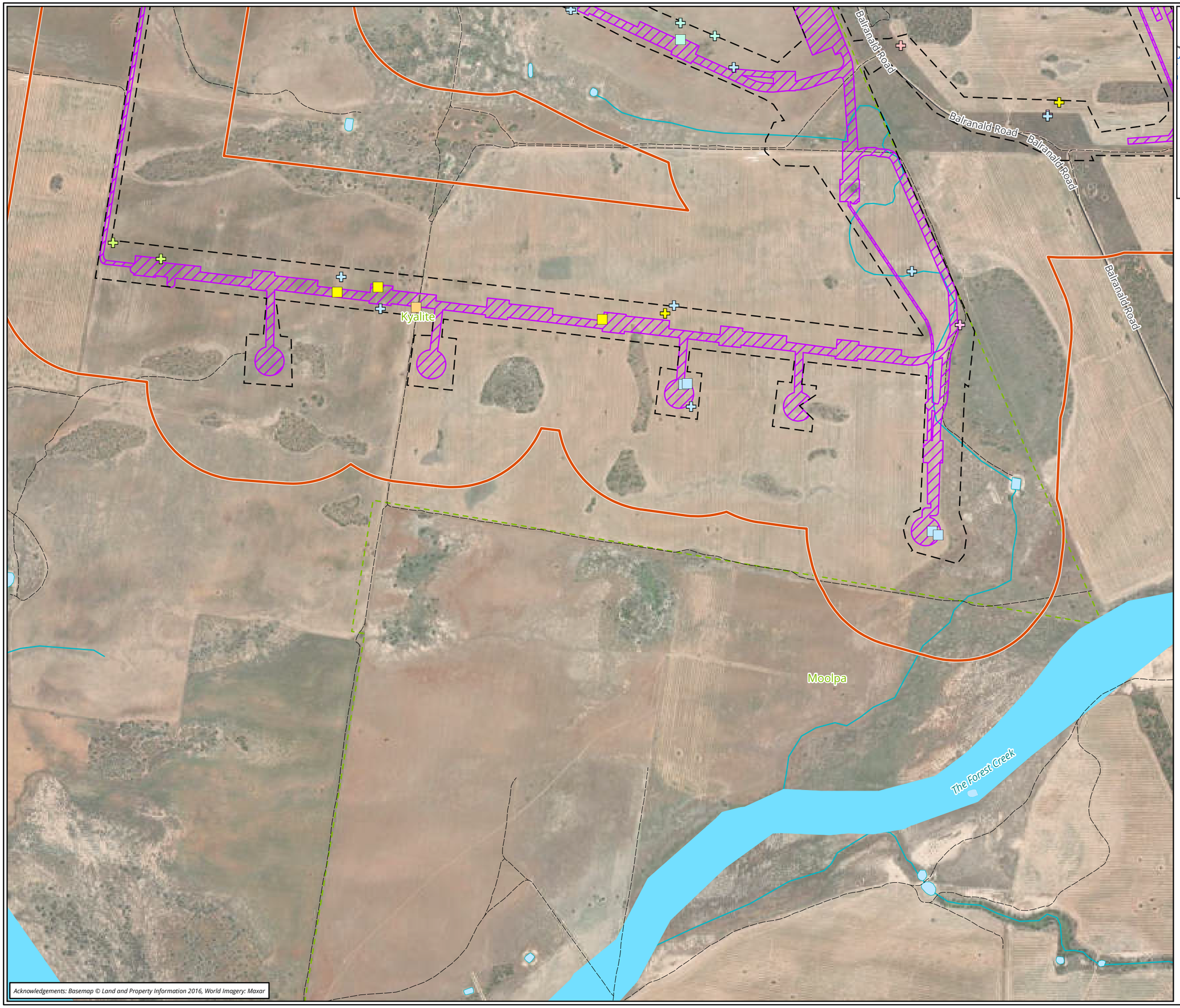
Meters

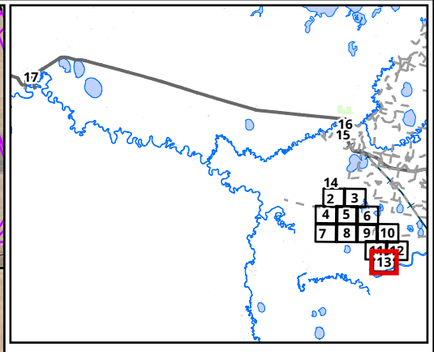
Scale: 1:18,000 @ A3

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

- *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

Meters

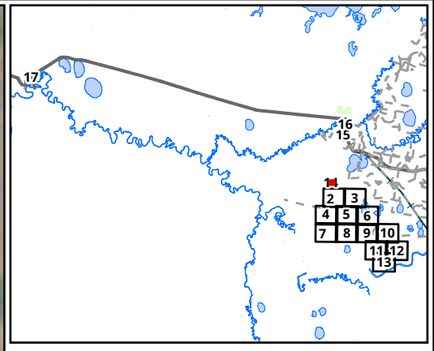
Scale: 1:18,000 @ A3

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 10 +.aprx
Layout: 37502_F23_Scatteredtrees



Legend

- Subject land
- Development corridor
- Development footprint

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

Figure 23.14 Scattered trees mapped within the subject land

0 25 50 75 100

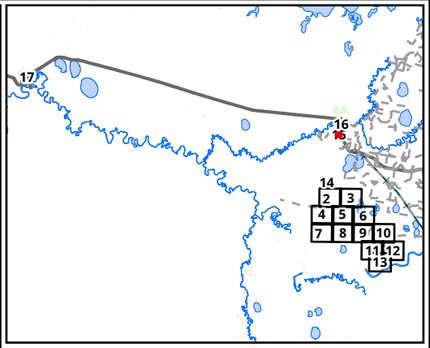
Meters

Scale: 1:2,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

Figure 23.15 Scattered trees mapped within the subject land

0 25 50 75 100

Meters

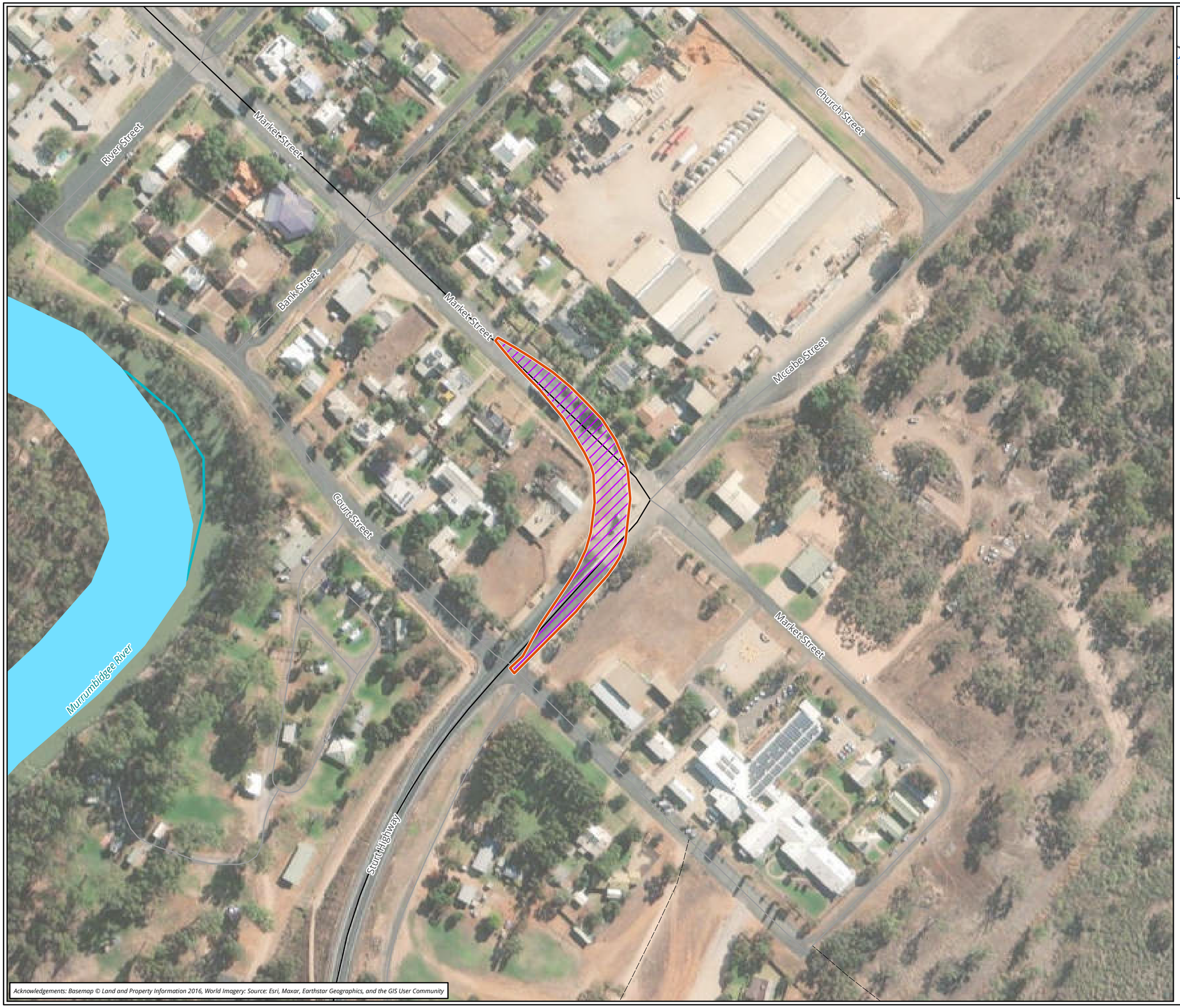
Scale: 1:2,000 @ A3

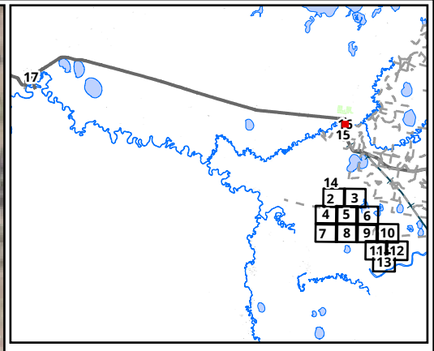
Coordinate System: GDA2020 MGA Zone 54

N

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

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

Figure 23.16 Scattered trees mapped within the subject land

0 25 50 75 100 N

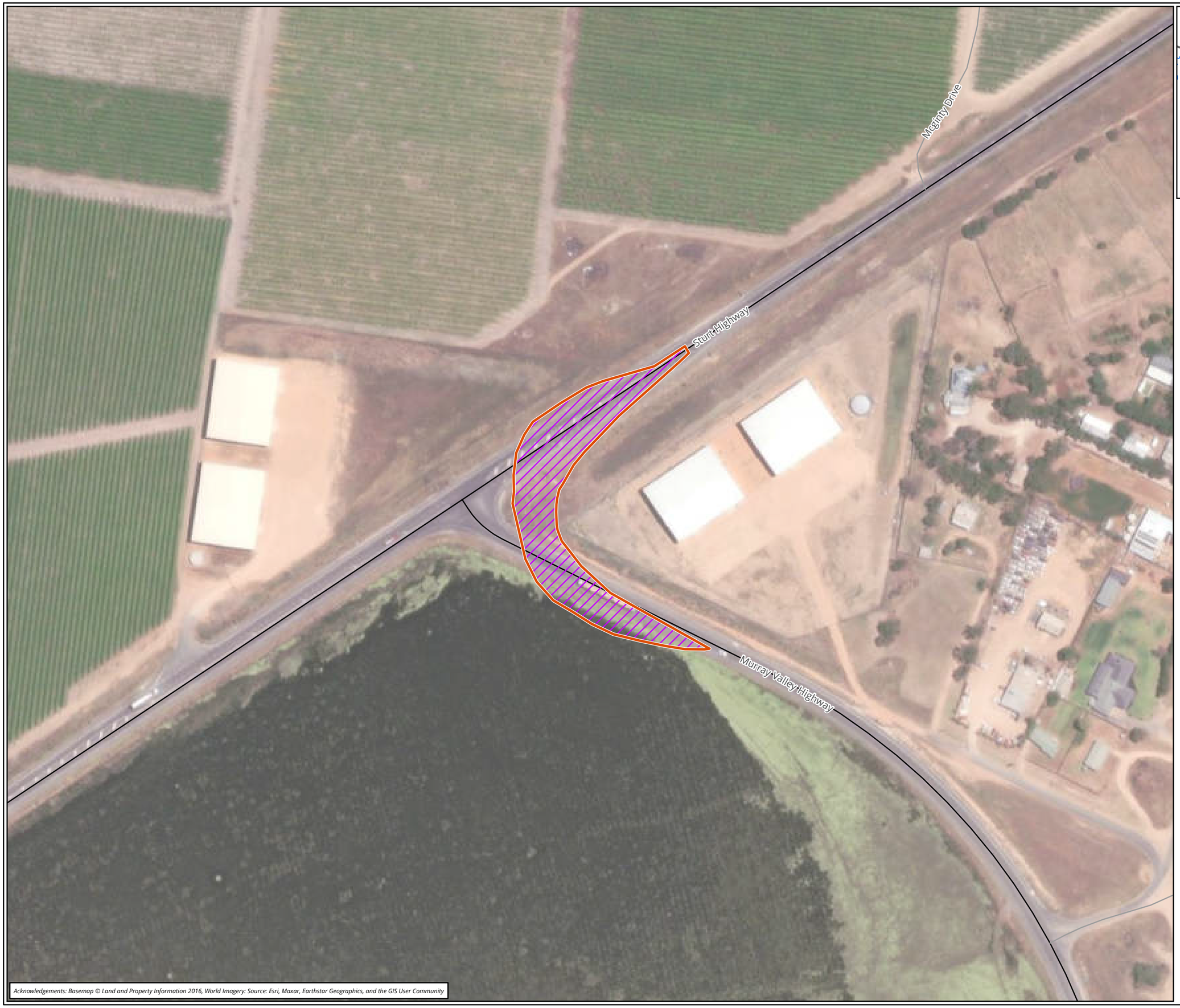
Meters

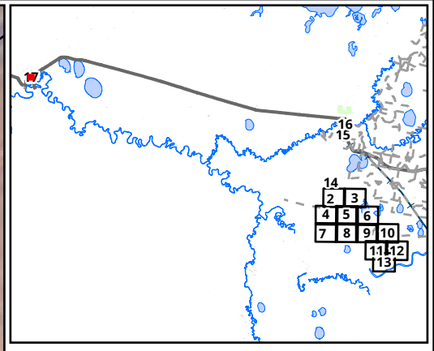
Scale: 1:2,000 @ A3

Coordinate System: GDA2020 MGA Zone 54

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

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

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

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

Appendix 8. Bird and Bat Adaptive Management Plan - Working draft

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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

This Working Draft BBAMP has not been updated from the version submitted with the EIS BDAR (Biosis 2024).

Updates have been made to items relevant to this BBAMP including; at-risk species, mitigation measures, adaptive management triggers, etc, in the Updated BDAR – Response to Submissions (Biosis 2025), and that document should be considered current where any misalignment occurs.

This BBAMP will be finalised following project approval as required by any Conditions of Consent.

© Biosis 2025 – Leaders in Ecology and Heritage Consulting

Biosis offices

New South Wales

Albury

Phone: (02) 6069 9200
Email: albury@biosis.com.au

Gosford

Phone: (02) 9101 8700
Email: gosford@biosis.com.au

Newcastle

Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Western Sydney

Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong

Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

Victoria

Ballarat

Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Melbourne

Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Wangaratta

Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

Document information

Report to:	Umwelt (Australia) Pty Ltd on behalf of Windlab Pty Ltd
Prepared by:	Dr Caragh Heenan Dimity Bambrick
Biosis project no.:	39259
File name:	39259.Junction.Rivers.Wind.Farm.BBAMP.DFT00.20240411
Citation:	Biosis 2024. Junction Rivers Wind Farm Bird and Bat Adaptive Management Plan. Report prepared for Umwelt (Australia) Pty Ltd on behalf of Windlab Pty Ltd. Authors: Heenan, C. Bambrick, D. Biosis Pty Ltd, Newcastle. Project no. 39259

Document control

Version	Internal reviewer	Date issued
Draft version 01	Matt Looby	21/03/2024
Final version 01	TBC	TBC

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Umwelt (Australia) Pty Ltd
- Windlab Pty Ltd
- Nature Advisory
- NGH

Biosis staff involved in this project were:

- Caragh Heenan, Dimity Bambrick (reporting)
- Callan Wharfe, Lauren Harley, James Shepard & Jennifer Townsend (mapping).
- Callan Wharfe, Matt Looby (Quality assurance).

Biosis acknowledges the Aboriginal and Torres Strait Islander peoples as Traditional Custodians of the land on which we live and work.

We pay our respects to the Traditional Custodians and Elders past and present and honour their connection to Country and ongoing contribution to society.

© Biosis Pty Ltd
This document is subject to copyright and may only be used for the purposes in respect of which it was commissioned and in accordance with the Terms of Engagement of the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Disclaimer:
Biosis Pty Ltd has completed this assessment in accordance with the relevant federal, state and local legislation and current industry best practice. The company accepts no liability for any damages or loss incurred as a result of reliance placed upon the report content or for any purpose other than that for which it was intended.

Contents

Glossary vii

1 Introduction 1

1.1 Project background 1
1.2 Land to which this plan applies 1
1.3 Purpose and objectives of this BBAMP 2
1.4 Roles and responsibilities 3
1.5 Sources of information 4

2 Baseline information 6

2.1 Pre-construction bird and bat surveys 6
2.2 Additional survey recommendations 7
2.2.1 Bird surveys 7
2.2.2 Microbat surveys 7

3 Bird and bat impact risk assessment 9

3.1 Approach to risk assessment 9
3.1.1 Qualitative risk assessment 9
3.1.2 Collision risk modelling 10
3.2 Collision risk 11
3.2.1 Bird collision risk assessment 11
3.2.2 Microbat collision risk assessment 12
3.3 Summary of collision risk 12
3.4 Turbine risk assessment 15

4 Significant impact and trigger levels 19

4.1 Guiding principles for determining significance of impacts 19
4.2 Defining performance criteria 20
4.3 Trigger levels for management responses to bird and bat collisions 20
4.4 Trigger levels for barrier effects 24
4.5 Monitoring of performance 24
4.6 Adaptive management framework 24

5 Preventative mitigation measures 26

5.1 Setbacks 26
5.1.1 Setbacks from wetland habitat 26
5.1.2 Setbacks from threatened species habitat 28
5.2 Turbine mitigation for birds 28
5.2.1 Automated avian detection systems 28
5.2.2 Improving blade and turbine visibility 30

© Biosis 2024 – Leaders in Ecology and Heritage Consulting

5.3 Turbine mitigation for microbats 31
5.3.1 Smart curtailment 31
5.3.2 Minimising artificial lighting 33
5.4 Minimising raptor perch sites 33
5.5 Pest animal control 34
5.6 Large animal carcass removal 34
6 Monitoring strikes and effectiveness of impact minimisation 36
6.1 Ongoing operational monitoring 36
6.1.1 Bird surveys 36
6.1.2 Microbat surveys 36
6.2 Monitoring of turbine collisions 37
6.2.1 Carcass search method 37
6.2.2 Fall zone and estimation for unsearchable zones 38
6.2.3 Turbines to be searched 39
6.2.4 Search duration and frequency 39
6.2.5 Carcass data collection and management 40
6.2.6 Carcass persistence trials 41
6.2.7 Searcher efficiency trials 42
6.2.8 Incidental finds of bird and bat carcasses 43
6.3 Injured birds and bats 44
6.4 Analyses of results 44
6.5 Reporting 45
6.5.1 Impact trigger reporting 45
6.5.2 Annual reports 46
6.5.3 BBAMP review 47
7 Adaptive management measures and corrective actions 49
7.1 Mitigation and adaptive management measures 50
7.1.1 Increased monitoring and carcass searches 50
7.1.2 Acoustic and ultrasonic deterrents 50
7.1.3 Transmission line warning markers 50
7.1.4 Installation of additional mitigation units 50
7.1.5 Altered land management practices 50
7.1.6 Modification of smart curtailment system 51
7.1.7 Temporary shutdown of turbines 51
7.2 Trigger Action Response Plan 51
7.3 Adaptive management for decreasing curtailment 53
7.4 Residual prescribed impacts and compensatory measures 53

© Biosis 2024 – Leaders in Ecology and Heritage Consulting

8 Management actions 55
8.1 Summary of management actions 55
References 56
Appendices 60
Appendix 1 Consolidated observation map 61
Appendix 1.1. Consolidated bird observation map 61
Appendix 1.2. Consolidated bat observation map 63
Appendix 2 Baseline bird and bat survey methods, risk assessment and results 65
Appendix 2.1. Bird strike collision risk survey and diurnal bird survey 65
Appendix 2.2. Microbat ultrasonic surveys and monitoring 68
Appendix 3 Qualitative assessment of turbine collision risk 70
Appendix 3.1. Qualitative assessment of turbine collision risk for birds 70
Appendix 3.2. Qualitative assessment of turbine collision risk for bats 90
Appendix 4 Qualitative risk assessment for turbines prior to implementation of safeguards 92
Appendix 5 Turbine mortality survey data sheet 96
Appendix 6 Dead or injured bird/bat data sheet 98
Appendix 7 Approval to use proxy carcasses 100
Appendix 8 Carcass persistence trial data sheet 102
Appendix 9 Searcher efficiency trial data sheet 104
Appendix 10 Management actions 106

Figures

Figure 1 Location of the wind farm 5
Figure 2 Wind farm monitoring and management 48
Figure 3 Consolidated bird observation map 62
Figure 4 Consolidated bat observation map 64

Graphs

Graph 1 Recommended solution for turbine shutdowns (MTR is migration traffic rate, and relates to birds flying per hour, per kilometre) 30
Graph 2 Measures to be implemented in the event of reaching a trigger-level 52
Graph 3 Framework for adjusting the turbine risk ratings according to the alerts recorded during monitoring (EXAMPLE ONLY – HOLD POINT) 53

© Biosis 2024 – Leaders in Ecology and Heritage Consulting

Tables

Table 1 Qualitative risk assessment criteria for likelihood and consequences of the impacts of turbine strike for birds and microbats 10
Table 2 Qualitative risk assessment matrix for significance of impacts of potential turbine collisions for birds and microbats 10
Table 3 Species determined to be at-risk through qualitative risk assessments 13
Table 4 Species not subject to qualitative risk assessment determined to be at-risk 14
Table 5 Adapted BCD turbine strike consequence matrix 16
Table 6 Turbine strike likelihood criteria 17
Table 7 Turbine risk assessment matrix 17
Table 8 Turbine risk assessment summary 18
Table 9 General investigation and monitoring triggers for bird and bat strike 21
Table 10 General investigation and monitoring triggers for bird and bat strike 21
Table 11 Mitigation measures 22
Table 12 Scoring system applied in the assessment of monitoring technologies (Skov et al. 2023) 29
Table 13 Monitoring requirements for carcass searches 40

Appendix Tables

Table A 1 Bird species recorded flying at rotor swept height 67
Table A 2 Microbat utilisation survey effort 68
Table A 3 Qualitative assessment of turbine collision risk for birds (Nature Advisory 2023b) 70
Table A 4 Qualitative assessment of turbine collision risk for bats (Nature Advisory 2023b) 90
Table A 5 Qualitative risk assessment for turbines prior to implementation of safeguards 92
Table A 6 Summary of management actions and performance criteria – HOLD POINT 106

© Biosis 2024 – Leaders in Ecology and Heritage Consulting

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

© Biosis 2024 – Leaders in Ecology and Heritage Consulting

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. • 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. • 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. • 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** 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** An event could occur during most circumstances (>50% - <95%).
Relevant habitat features occur within 500 m to 1000 m buffer from blade tip.	**Unlikely** An event could occur during some circumstances (>5 - <50%).
Relevant habitat features occur greater than 1000 m from blade tip.	**Rare** 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: – Any impact that is likely to reduce the total species' population by more than 1% over a two-year period; or • Where population numbers are not known: – 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. • 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; – Any impact that is likely to reduce the total species' population by more than 1% over a five-year period; or • Where population numbers are not known; – 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. • 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. • Periodic review of the turbine mitigation strategy and monitoring program every two years. See Section 6.5.3. • Incorporate any operational mitigation measures developed during the preparation of the Biodiversity Management Plan (BMP) relating to active nests/ nest trees. • Minimising availability of raptor perches on infrastructure within close proximity to turbines and overhead powerlines. See Section 5.4. • 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. • 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. • 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. • Investigation of feasibility and suitability of potential deterrents or evolving technologies (Section 5), such as: – Ultrasonic technologies, such as the SMART system by Wildlife Acoustics (Section 5.2.1). – Radar (or optical sensor) or live camera technologies for automatic, reactive and temporary curtailment of turbines at high-risk turbines (Section 5.2.1). – 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). – Consider novel deterrent techniques related to blade visibility (i.e., painting one blade a different colour, Section 5.2.2). – 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). • 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): – 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. – 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. – 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). • 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): – 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: – 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. – Increased frequency of carcass removal, or increased use of other methods of deterrence (where relevant). See Section 7.1.1. – 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. – 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. – 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. • Consider temporarily ceasing operation of a turbine(s) relevant to the impact trigger event during the rapid investigation. See Section 7.1.7. • 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. • 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. • 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): – 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. – 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. – 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. – Consider novel deterrent techniques related to blade visibility (i.e., painting one blade a different colour). See Section 5.2.2. – 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. – 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. – 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. – 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.

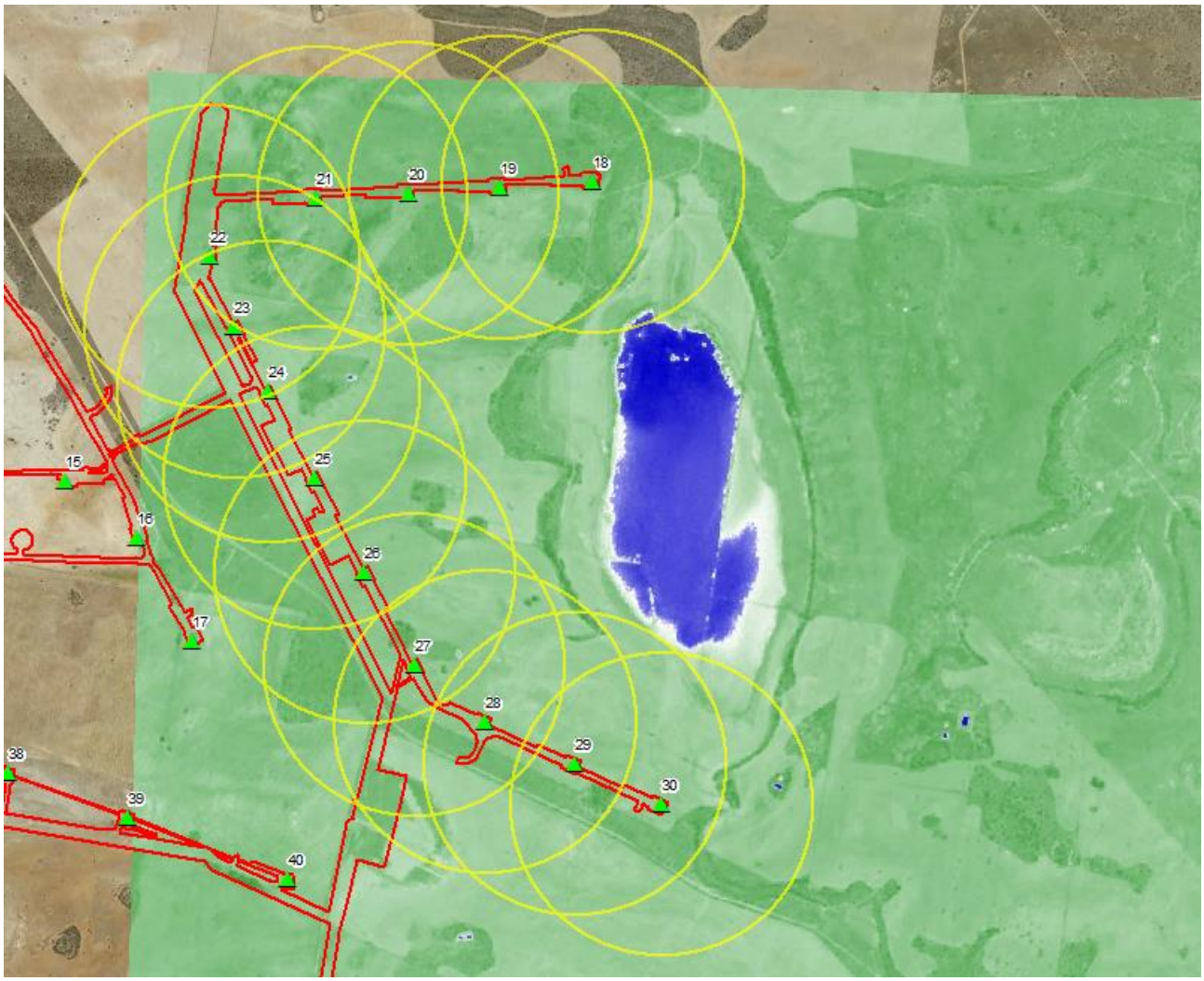


Plate 1 NDWI imagery of Condoulpe Lake from January 2023 illustrating wetland habitat during flooding remains approximately 1 km from operational turbine blades

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.

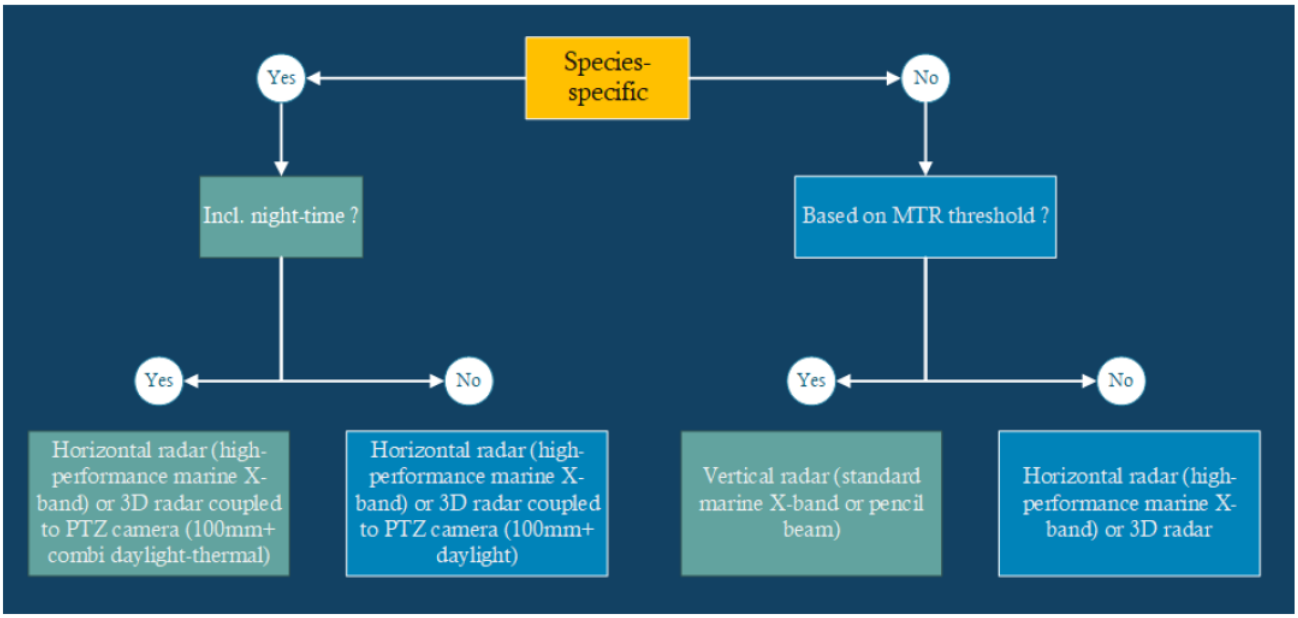
The paper goes on to recommend the combination of technologies considered to best meets the aims of the mitigation. For example, if the mitigation objective was to remotely shut down a turbine to prevent collision with a certain highly at-risk species, Skov et al. (2023) recommend the following combination 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).

DRAFT

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

DRAFT

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.

DRAFT

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.

DRAFT

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,

DRAFT

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.

DRAFT

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

DRAFT

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

DRAFT

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.

DRAFT

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.

DRAFT

Table 13 Monitoring requirements for carcass searches

Turbines	Monitoring schedule
Pre-commissioning	
All operational turbine clusters	• Monthly inspections by the project ecologist. • 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: – 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). – 120 m search area around relevant turbines, with no pulse searches required from April to September (6 in total). • 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: – 120 m search area (outer search zone) around relevant turbines, with 60 m pulse searches* (inner search zone) throughout. • 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).

DRAFT

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.

DRAFT

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.

DRAFT

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.

DRAFT

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

DRAFT

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).

DRAFT

- 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.

DRAFT

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

DRAFT

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.

DRAFT

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.

DRAFT

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:

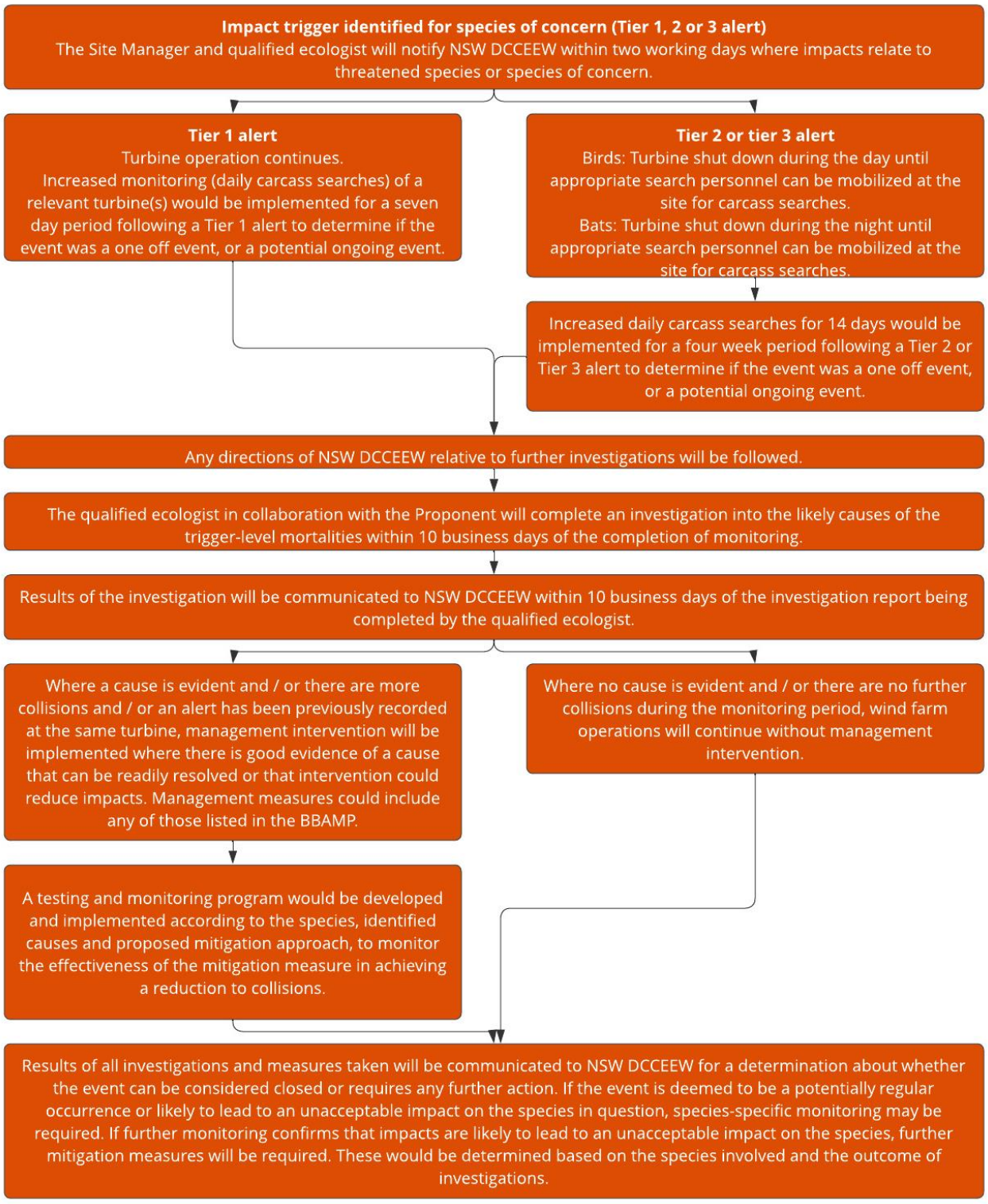
- Periods of low visibility (fog), if it were suspected that fog was the cause of documented collisions.
- Short-term seasonal shutdowns based on migratory periods, ephemeral wetland flood events, or nesting events (for example in the case of at-risk species or threatened species nesting within 200 m 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.

DRAFT

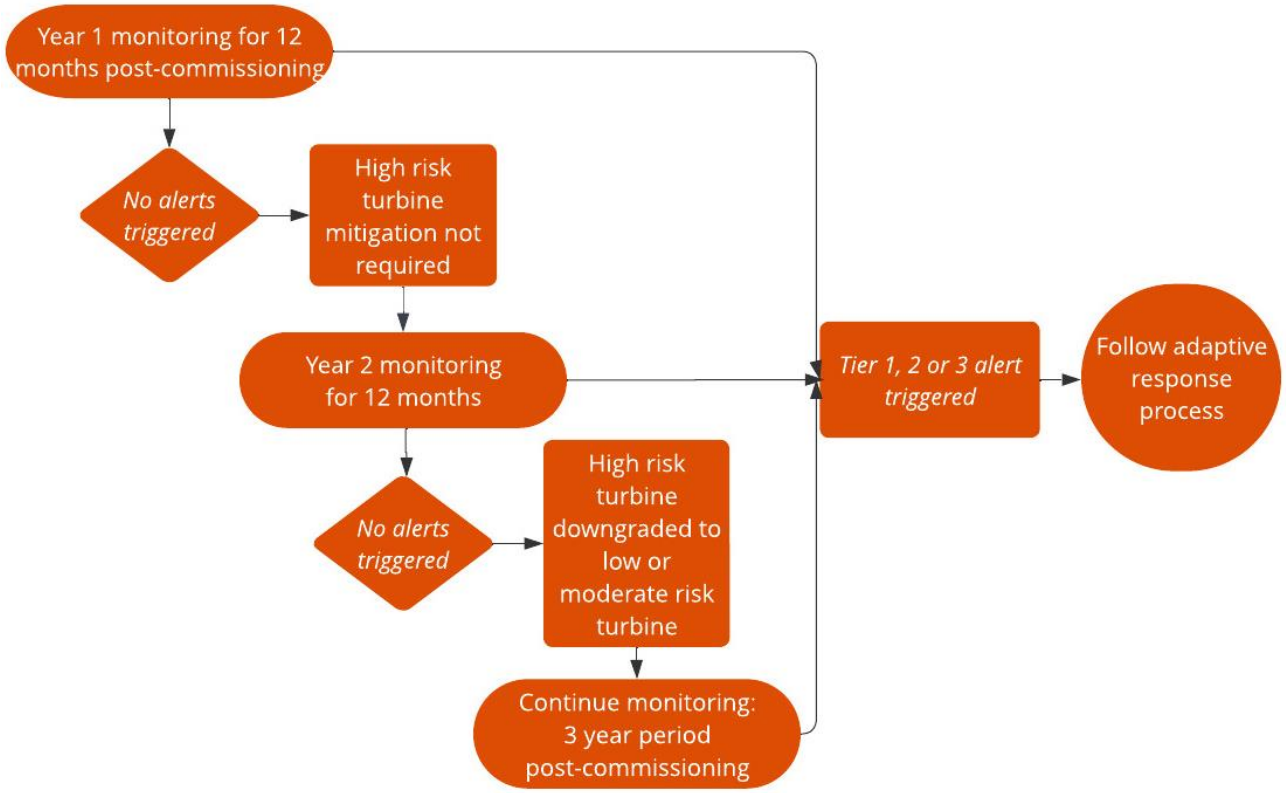


Graph 2 Measures to be implemented in the event of reaching a trigger-level

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).

DRAFT

8 Management actions

8.1 Summary of management actions

Management actions required under the BBAMP is summarised in Appendix 10.

DRAFT

References

ARC 2022. *Multi-year La Nina events*, *Climate Extremes. ARC Centre of Excellence*, accessed 3 July 2024, https://climateextremes.org.au/multi-year-la-nin%CC%83a-events/.

AusWEA 2002. *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*,.

AusWEA 2005. *Wind Farms and Birds: Interim Standards For Risk Assessment*, Report prepared for Australian Wind Energy Association. Brett Lane & Associates Pty Ltd, Carlton North, VIC, https://tethys.pnnl.gov/sites/default/files/publications/BrettLane-2005.pdf.

Baerwald EF, D'Amours GH, Klug BJ, & Barclay RMR 2008. 'Barotrauma is a significant cause of bat fatalities at wind turbines', *Current Biology*, 18, 16: 695–696.

Biosis 2024a. *Junction Rivers Biodiversity Development Assessment Report*, Report for Umwelt (Australia) Pty Ltd on behalf of Windlab Pty Ltd. Authors: Wharfe, C, Bambrick, D, Williams, F and Lloyd, N. Biosis Pty Ltd, Sydney, NSW. Project no. 37502.

Biosis 2024b. *37502. Junction Rivers Wind Farm BDAR. Report for Umwelt (Windlab).*,.

Boycott TJ, Mullis SM, Jackson BE, & Swaddle JP 2021. 'Field testing an "acoustic lighthouse": Combined acoustic and visual cues provide a multimodal solution that reduces avian collision risk with tall human-made structures', *PLoS ONE*, 16, 4: e0249826.

Clean Energy Council 2018. *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*,.

Copernicus 2024. *Copernicus Data Space Ecosystem*, *Copernicus*, accessed 3 July 2024, https://dataspace.copernicus.eu/.

Dalthorp D, Huso M, & Dail D 2017. 'Evidence of absence (v2.0) software user guide: U.S', *Geological Survey Data Series*, 1055: 109.

DAWE 2022. 'Onshore Wind Farms - interim guidance on bird and bat management',.

DEWHA 2009. 'EPBC Act Policy Statement 2.3 Wind Farm Industry', Department of Environment, Water, Heritage and the Arts. Barton, ACT. https://www.environment.gov.au/system/files/resources/c707cc9d-8e11-4d15-a2cb-dabc070f716e/files/wind-farm-industry.pdf.

DEWHA 2010a. *Survey Guidelines for Australia's Threatened Birds: Guidelines for detecting birds listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*, Australian Government Department of the Environment Water Heritage and the Arts. Canberra, Australian Capital Territory.

DEWHA 2010b. *Survey Guidelines for Australia's Threatened Bats: Guidelines for detecting bats listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*, Department of the Environment Water Heritage and the Arts.

DoE 2013. 'Matters of National Environmental Significance Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999', accessed 14 February 2024, Department of the Environment, Canberra, ACT. https://www.dcceew.gov.au/environment/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance.

DRAFT

DoE 2015. 'Referral guideline for 14 birds listed as migratory species under the EPBC Act', http://www.environment.gov.au/system/files/resources/c05f5b87-0a99-4998-897e-7072c236cf83/files/migratory-birds-draft-referral-guideline.pdf.

DPIE 2016. 'State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469', https://datasets.seed.nsw.gov.au/dataset/riverina-regional-native-vegetation-map-version-v1-0-vis_id-4449.

DPIE 2020. *Biodiversity Assessment Method (BAM)*, Department of Planning, Industry & Environment, https://www.environment.nsw.gov.au/research-and-publications/publications-search/biodiversity-assessment-method-2020.

Ferrer M, de Lucas M, Janss GFE, Casado E, Munoz AR, Bechard MJ, & Calabuig CP 2011. 'Weak relationship between risk assessment studies and recorded mortality in wind farms', *Journal of Applied Ecology*, 49, 1: 38–46.

Hayes MA, Hooton LA, Gilland KL, Grandgent C, Smith RL, Lindsay SR, Collins JD, Schumacher SM, Rabie PA, Gruver JC, & Goodrich-Mahoney J 2019. 'A smart curtailment approach for reducing bat fatalities and curtailment time at wind energy facilities', *The Ecological Society of America*, 29, 4.

Hodos W, Potocki A, Storm T, & Gaffnew M 2000. *in*, *Raptor acuity and wind turbine blade conspicuity*, Proceedings of the National Avian-Wind Power Planning Meeting IV, Avian Subcommittee of th eNational Wind Coordinating Committee, Carmel, California.

Hull CL & Cawthen L 2013. 'Bat fatalities at two wind farms in Tasmania, Australia: bat characteristics, and spatial and temporal patterns', *New Zealand Journal of Zoology*, 40: 5–15.

Hull CL & Muir S 2010. 'Search areas for monitoring bird and bat carcasses at wind farms using a Monte-Carlo model', *Australiasian Journal of Environmental Management*, 17: 77–87.

Huso M & Dalthorp D 2014. 'Accounting for Unsearched Areas in Estimating Wind Turbine-Caused Fatality', *The Journal of Wildlife Management*, 78, 2: 347–358.

Huso M, Dalthorp D, & Korner-Nievergelt F 2017. *in* Perrow MR (ed.), *Wildlife and Wind Farms, Conflicts and Solutions. Onshore: Monitoring and Mitigation*, Pelagic Publishing, Exeter, UK.

Jeninga L, Kappers EF, Kleyheeg-Hartman J, Klop E, & Potiek A 2023. *in*, *Does a single black rotor blade reduce bird mortality?*, 7th Conference on Wind energy and Wildlife impacts, Sibenik, Croatia, https://cww2023.org/.

Klein JP & Moeschberger ML 2010. *Survival analysis: techniques for censored and truncated data*, 2. ed., corr. 3. print, Springer, New York, NY, Statistics for biology and health.

Law B, Gonsalves L, Tap P, Penman T, & Chide M 2015. 'Optimizing ultrasonic sampling effort for monitoring forest bats', *Austral Ecology*, 40, 8: 886–897.

de Lucas M, Janss GFE, Whitfield DP, & Ferrer M 2008. 'Collision fatality of raptors in wind farms does not depend on raptor abundance', *Journal of Applied Ecology*, 45: 1695–1703.

Madders M & Whitfield DP 2006. 'Upland raptors and the assessment of wind farm impacts', *Ibis*, 148: 43–56.

Masden EA & Cook ASCP 2016. 'Avian collision risk models for wind energy impact assessments', *Elsevier, Environmental Impact Assessment Review*, 56: 43–49.

DRAFT

Mathews F, Swindells M, Goodhead R, August TA, Hardman P, Linton DM, & Hosken DJ 2013. 'Effectiveness of search dogs compared with human observers in locating bat carcasses at wind-turbine sites: a blinded randomized trial', *Wildlife Society Bulletin*, 37, 1: 34–40.

May R, Nygard T, Falkdalen U, Astrom J, Hamre O, & Stokke BG 2020. 'Paint it black: Efficacy of increased wind turbine rotor blade visibility to reduce avian fatalities', *Ecology and Evolution*, 10, 16: 8927–8935.

McIsaac H 2000. *in*, *Raptor acuity and wind turbine blade conspicuity*, Proceedings of the National Avian-Wind Power Planning Meeting IV, Avian Subcommittee of th eNational Wind Coordinating Committee, Carmel, California.

Nature Advisory 2022a. *Junction Rivers Wind Farm Bat Utilisation Survey*, Report prepared for NGH Consulting. Nature Advisory, Report No. 20195.3(1.0).

Nature Advisory 2022b. *Junction Rivers Wind Farm Bird Utilisation Survey - Year One*, Report prepared for NGH Consulting. Nature Advisory, Report No. 20195.04(1.0).

Nature Advisory 2022c. *Junction Rivers Wind Farm Autumn Bird Utilisation Surveys*, Report prepared for NGH Consulting. Nature Advisory, Report No. 20195.3.

Nature Advisory 2022d. *Junction Rivers Wind Farm Summer Bird Utilisation Surveys*, Report prepared for NGH Consulting. Nature Advisory, Report No. 20195.3.

Nature Advisory 2023a. *Junction Rivers Wind Farm Bird and Bat Baseline Report (Year 2)*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.05(1.1).

Nature Advisory 2023b. *Junction Rivers Wind Farm Initial Bird and Bat Risk Assessment*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.04(2.1).

Nature Advisory 2023c. *Junction Rivers Wind Farm Regent Parrot Targeted Assessment Report*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.06(1.1).

Nature Advisory 2023d. *Junction Rivers Wind Farm Regional Review of Waterbirds in the Riverina*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.07(1.0).

Nature Advisory 2023e. *Junction Rivers Wind Farm Preliminary Literature Review on Habitat Use of the Australiasian Bittern in the Riverina*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.07(1.0).

Nature Advisory 2023f. *Junction Rivers Wind Farm Bird and Bat Baseline Report (Year 1)*, Report prepared for Windlab Pty Ltd. Nature Advisory, Report No. 20195.05(1.0).

NGH Consulting 2022. *Burrawong Wind Farm Spring 2021 Survey Report*, Report prepared for Windlab Pty Ltd. Author: Bambrick, D. NGH Environmental Pty Ltd. Report No. 20-468.

Niche Environment and Heritage 2021. *Scoping Report Burrawong Wind Farm*, Report prepared for Windlab Pty Ltd. Author: Tinley, L. Smith, N. Jokadar, Z. NGH Environmental Pty Ltd. Report No. 20-468.

NSW DCCEEW 2023a. 'Suggested BBUS method (Draft)', NSW DCCEEW BCS SW Branch.

NSW DCCEEW 2023b. 'Draft Turbine Risk Assessment and Avoidance Guidance', NSW DCCEEW BCS SW Branch.

DRAFT

OEH 2017. *Biodiversity Assessment Method (BAM)*, New South Wales Office of Environment and Heritage, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/biodiversity-assessment-method-170206.pdf.

OEH 2018. *'Species credit' threatened bats and their habitats – NSW survey guide for the Biodiversity Assessment Method*, Office of Environment and Heritage, Office of Environment and Heritage, Sydney NSW 2000, 978-1-92575-453-7.

Rollins KE, Meyerholz DK, Johnson GD, Capparella AP, & Loew SS 2012. 'A Forensic Investigation Into the Etiology of Bat Mortality at a Wind Farm: Barotrauma or Traumatic Injury?', *Veterinary Pathology*, 49, 2: 362–371.

Skov H, Brondum R, Baden E, & Ward R 2023. 'Bat and Bird monitoring guidance', https://www.dhigroup.com/upload/publications/2023/bat-and-bird-monitoring-guidance.pdf.

Smales I 2017. *Wildlife and Wind Farms, Conflicts and Solutions. Onshore: Monitoring and Mitigation.* | *Chapter: Modelling collision risk and populations*, Perrow M (ed.), Pelagic Publishing, Exeter, UK.

Stickland MD, Erickson WP, Johnson G, Young D, & Good RE 2000. *in*, *Raptor acuity and wind turbine blade conspicuity*, Proceedings of the National Avian-Wind Power Planning Meeting IV, Avian Subcommittee of th eNational Wind Coordinating Committee, Carmel, California.

Stokke BG, Nygard T, Falkdalen U, Pedersen HC, & May R 2020. 'Effect of tower base painting on Willow Ptarmigan collision rates with wind turbines', *Ecology and Evolution*, 10, 12: 5670–5679.

DRAFT

Appendices

DRAFT

Appendix 1 Consolidated observation map

Appendix 1.1. Consolidated bird observation map

DRAFT

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

DRAFT

Appendix 1.2. Consolidated bat observation map

DRAFT

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

DRAFT

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).

DRAFT

- 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.

DRAFT

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).

DRAFT

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.

DRAFT

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

DRAFT

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.**

DRAFT

Appendix 5 Turbine mortality survey data sheet

DRAFT

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? *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? *Yes / No*	If yes, record total number:	Bird and Bat carcass / injury datasheet completed? *Yes / No*	Photographs taken? *Yes / No*
Additional notes:			

DRAFT

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.

DRAFT

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:				

DRAFT

Appendix 7 Approval to use proxy carcasses

DRAFT

INSERT APPROVAL PAGES ONCE RECEIVED

DRAFT

Appendix 8 Carcass persistence trial data sheet

This carcass deployment sheet must be completed for each turbine used in the scavenger trial.

DRAFT

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:
Additional notes:					

DRAFT

Appendix 9 Searcher efficiency trial data sheet

DRAFT

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:
Additional notes:					

DRAFT

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)							

© Biosis 2024 | Leaders in Ecology and Heritage Consulting

No.	Action	Objective	Measure	Reporting	Adaptive management	Responsibility	Timing/ frequency
Analysis of results (Section 6.4)							
Reporting (Section 6.5)							

DRAFT

Appendix 9. Nature Advisory Bird and Bat Assessments

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

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.

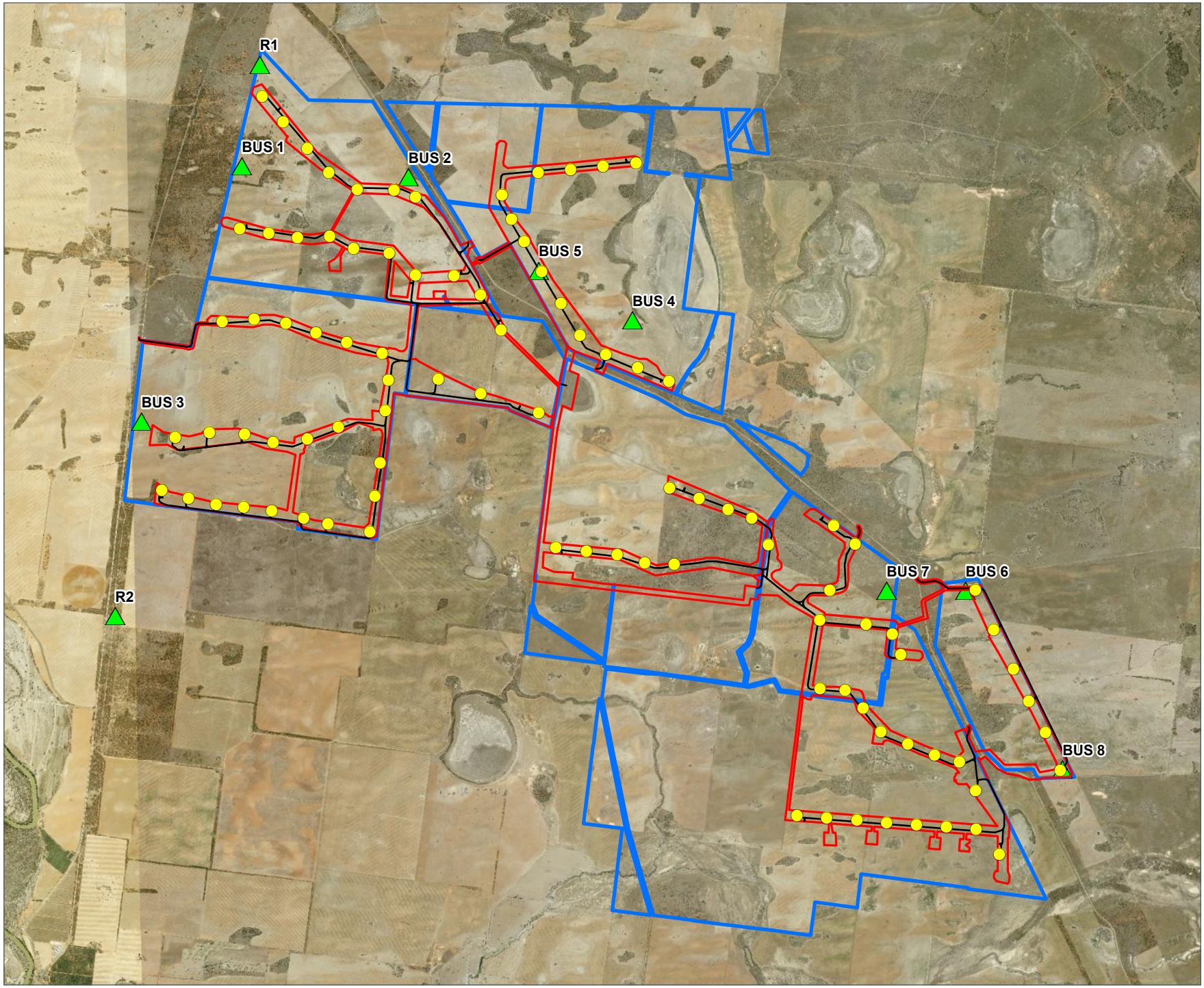


Figure 1: Junction Rivers **Wind** Project **BUS points**

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 >.

Menkhorst, P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K 2017, *The Australian Bird Guide*, CSIRO Publishing, Clayton South, Victoria.

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: 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		

Nature Advisory Pty Ltd
ABN 12 095 541 334
(Formerly Brett Lane & Associates Pty Ltd)

5/61-63 Camberwell Road Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111 www.natureadvisory.com.au

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.

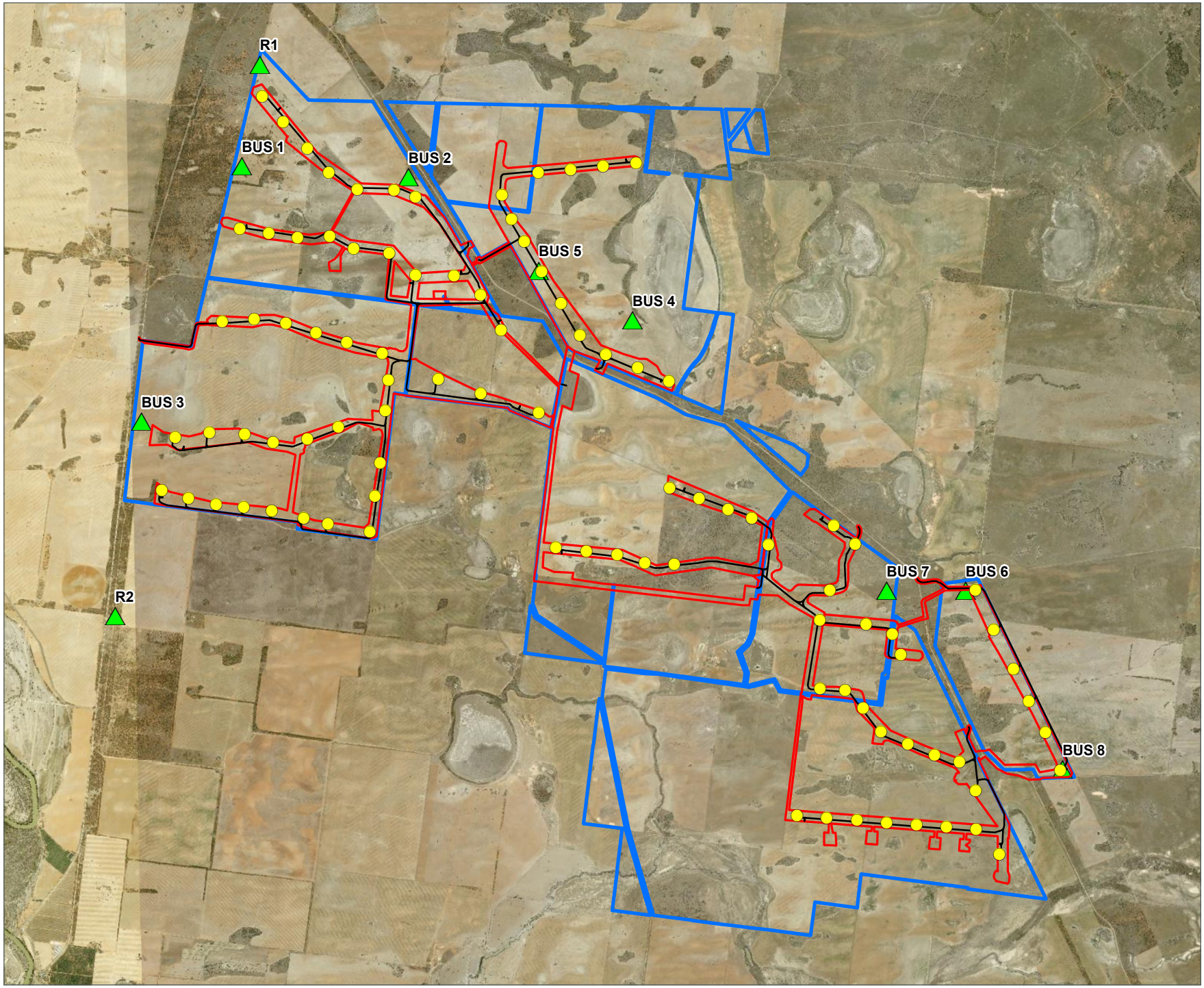


Figure 1: Junction Rivers **Wind** Project **BUS points**

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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

Nature Advisory Pty Ltd
ABN 12 095 541 334
(Formerly Brett Lane & Associates Pty Ltd)

5/61-63 Camberwell Road Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111 www.natureadvisory.com.au

Senior Ecologist and Project Manager
Nature Advisory

(03) 9815 2111 OR 0437 711 328 | mailto:bocallaghan@ecologicalresearch.com.au

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 >.

Menkhorst, P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K 2017, *The Australian Bird Guide*, CSIRO Publishing, Clayton South, Victoria.

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.

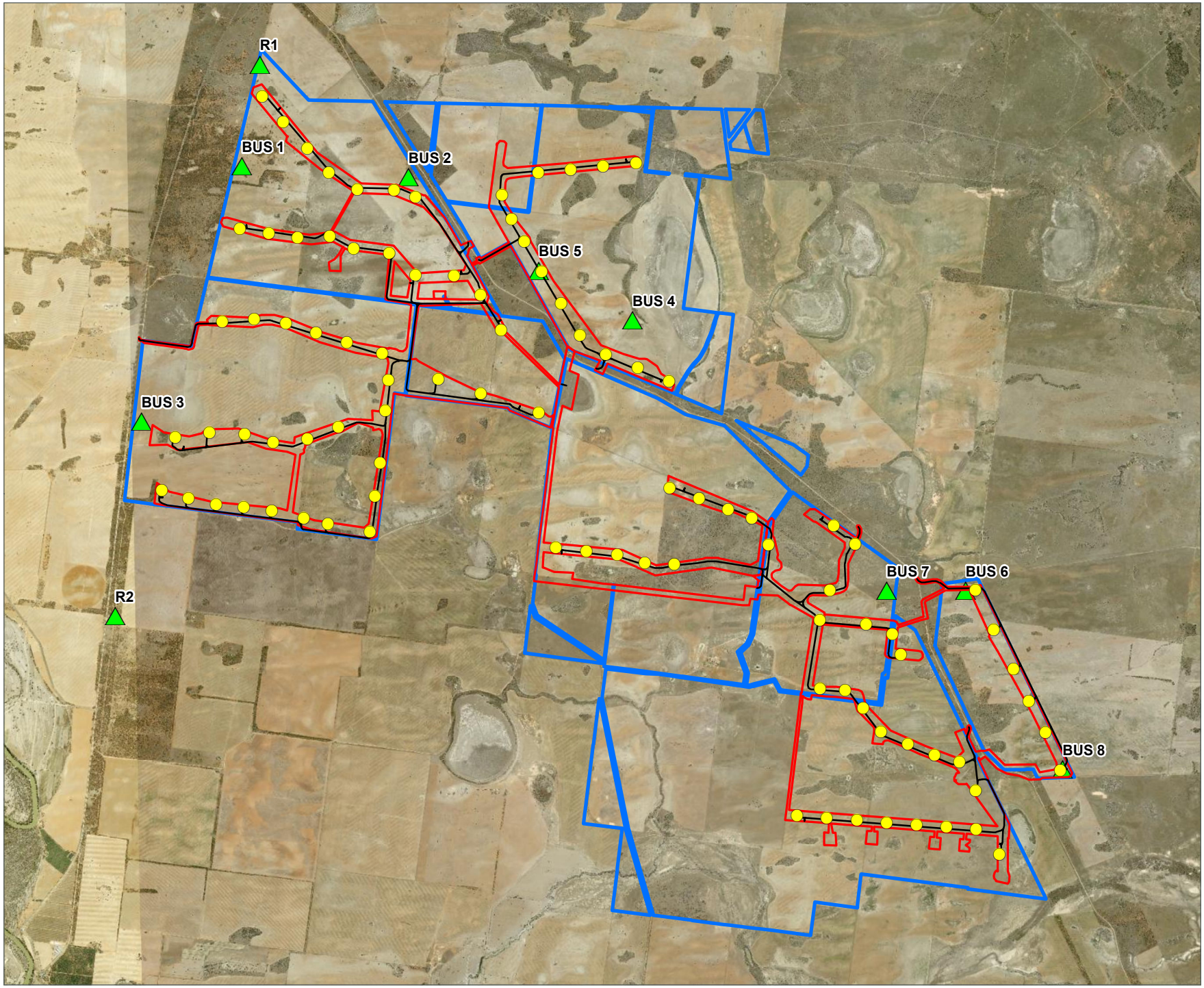


Figure 1: Junction Rivers **Wind** Project **BUS points**

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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

References

Debus, S.J.S., Bauer, A.L. & Mitchell, G.I., 2017, *Breeding biology, behaviour and foraging ecology of the Black Falcon (Falco subniger) near Tamworth, New South Wales*. Corella, v.41, p. 71-82.

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 1st September 2020, <https://www.environment.gov.au/system/files/resources/ 107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds-april-2017.pdf >.

Marchant, S. and Higgins, P.J. (Eds) (1993) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

Menkhorst, P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K 2017, *The Australian Bird Guide*, CSIRO Publishing, Clayton South, Victoria.

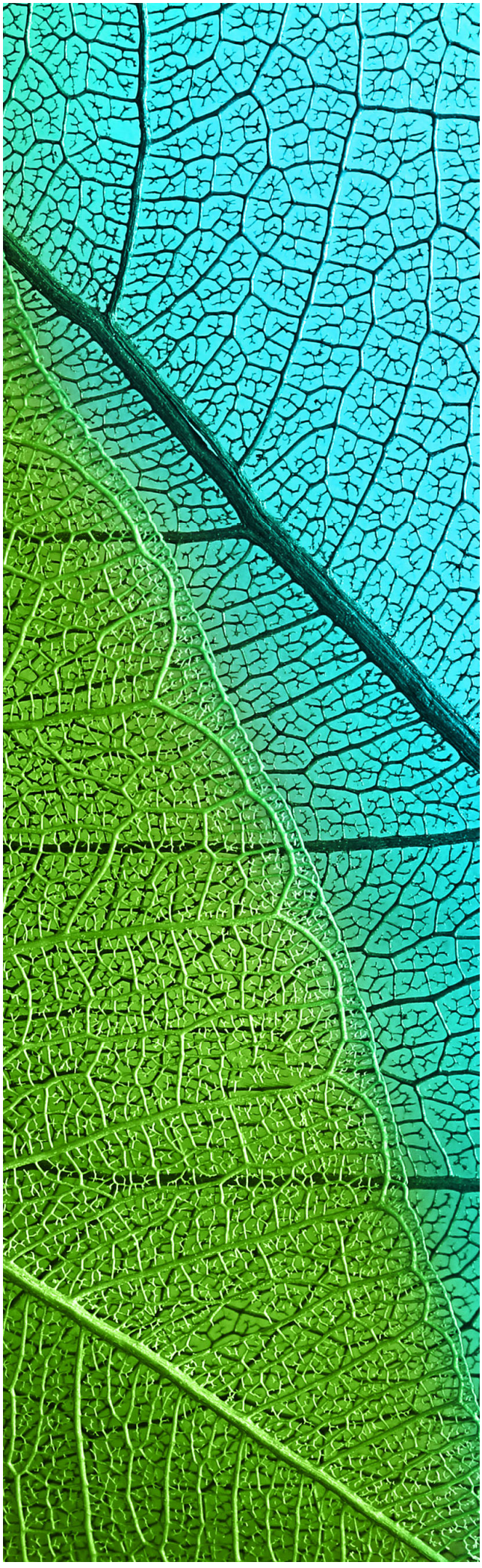
Department of Agriculture, Water and Environment (DAWE) 2021, *Environment Protection and Biodiversity Conservation Act 1999, Protected Matters Search Tool*. Department of Environment and Energy, Canberra, viewed 1st August 2022, <http://www.environment.gov.au >

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)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

1. Introduction 1
2. Methods 2
2.1. Fixed-point bird count 2
2.2. Locations of survey points 3
2.3. Incidental observations 4
2.4. Data preparation and statistical analysis 4
2.5. Limitations 4
3. Results 6
3.1. Survey suitability 6
3.2. Species composition 6
3.3. Flight Heights 10
3.4. Threatened Species 10
3.5. Raptors 11
3.6. Waterbirds 12
4. Conclusions 14
5. References 16

Tables

Table 1: Times when points were counted for each fixed-point bird count survey day 2
Table 2: Habitat associated with each survey point 3
Table 3: The five most common bird species recorded at BUS points at Junction Rivers Wind Project 7
Table 4: Number and height distribution of bird species at survey points during combined four seasons surveys at Junction Rivers Wind Project site 8
Table 5: Summary of birds recorded at the three flight heights 10
Table 6: The five most abundant species flying at RSA height at Junction Rivers Wind Project 10
Table 7: Raptor and Waterbird species recorded at impact survey points during four seasons surveys at Junction Rivers Wind Project 13

Figures

Figure 1: Map of Junction Rivers Wind Project showing the location of bird utilisation survey points 5
Figure 2: The cumulative count of bird species recorded during formal BUS at Junction Rivers Wind Project 2021. 6

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.

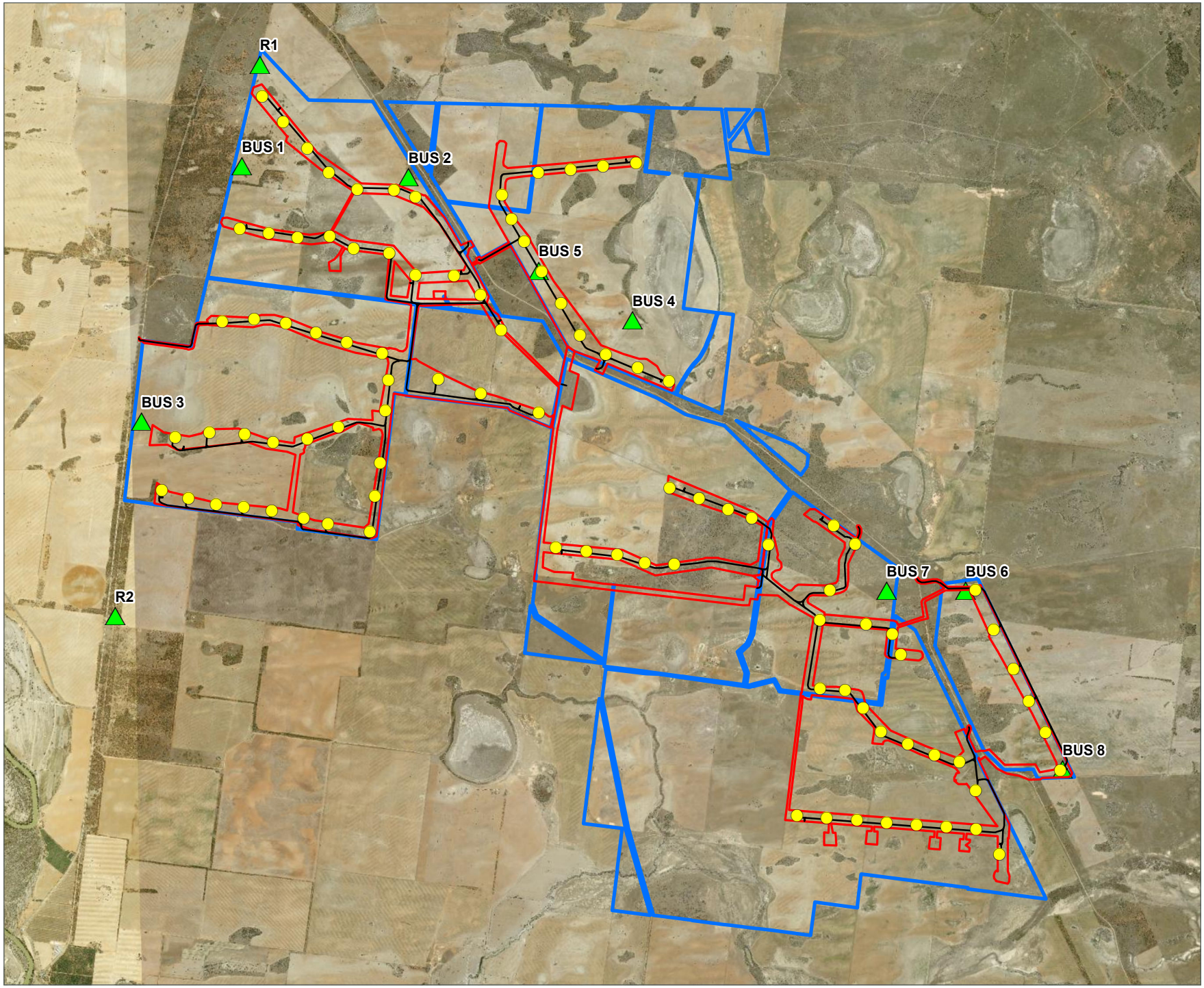


Figure 1: Junction Rivers **Wind** Project **BUS points**

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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.

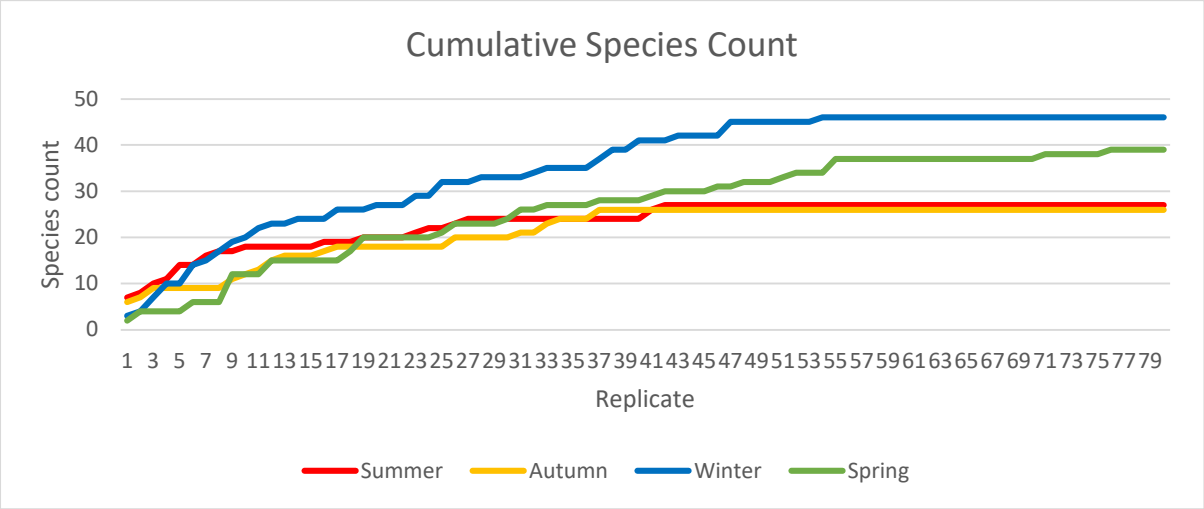


Figure 2: The cumulative count of bird species recorded during formal BUS at Junction Rivers Wind Project 2021.

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

Clean Energy Council 2018, *Best Practice Guidelines – for implementation for wind energy projects in Australia*.

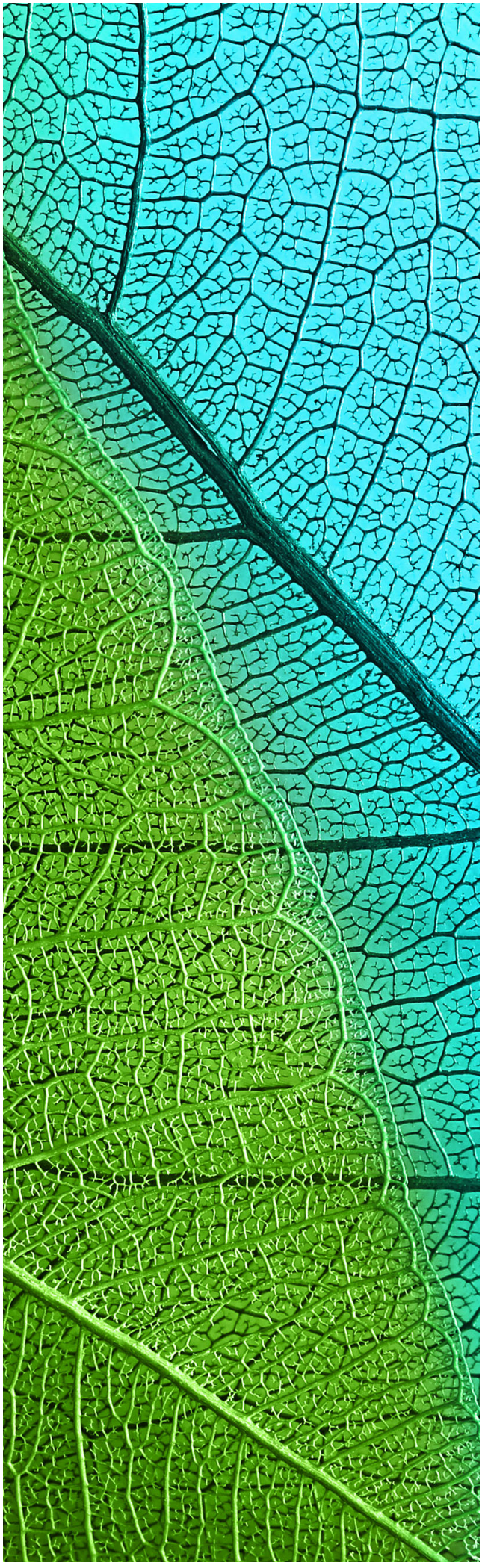
Department of Agriculture, Water and Environment (DAWE) 2017, *Environment Protection and Biodiversity Conservation Act 1999, Survey guidelines for Australia's threatened birds*. Department of Environment and Energy, Canberra, viewed 16th November 2021, <https://www.environment.gov.au/system/files/resources/ 107052eb-2041-45b9-9296-b5f514493ae0/files/survey-guidelines-birds-april-2017.pdf >.

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, 16th November 2021, <http://www.environment.gov.au >.

Higgins, PJ (ed) 1999, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Menkhorst, P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K 2017, *The Australian Bird Guide*, CSIRO Publishing, Clayton South, Victoria.

Saunders, D.L. & Tzaros, C.L. 2011, National Recovery Plan for the Swift Parrot *Lathamus discolor*, Birds Australia, Melbourne.



Junction Rivers Wind Project

Bat Utilisation Survey

Prepared for NGH Consulting

February 2024
Report No. 20195.3 (1.1)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

Appendix 1 ii
1. Introduction 1
2. Methods 2
2.1. Timing of the surveys 2
2.2. Locations of survey points 2
2.3. Limitations 3
3. Results 5
3.1. Bat Activity 5
3.2. Relative abundance of bats 6
3.2.1. Summer 2021 6
3.2.2. Spring 2021 6
3.2.3. Bat species of concern 7
4. Conclusions and Recommendations 10
4.1. Recommendations: 10
5. References 11
Appendix 1 12

Tables

Table 1: Habitat associated with each survey point 2
Table 2: Bat diversity at Junction Rivers Wind Project during summer and spring 2021* 5
Table 3: Total bat calls across summer and spring surveys 5
Table 4: Percentage (%) of detector nights each species was recorded across the six survey sites over six nights of recording during summer 2021 8
Table 5:Percentage (%) of detector nights each species was recorded across the six survey sites during spring 2021 8

Figures

Figure 1: Map of Junction Rivers Wind Project showing the location of bat utilisation survey points 4
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. 9

Appendices

Appendix 1: Examples of bat sonograms recorded at Junction Rivers Wind Project 11

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.

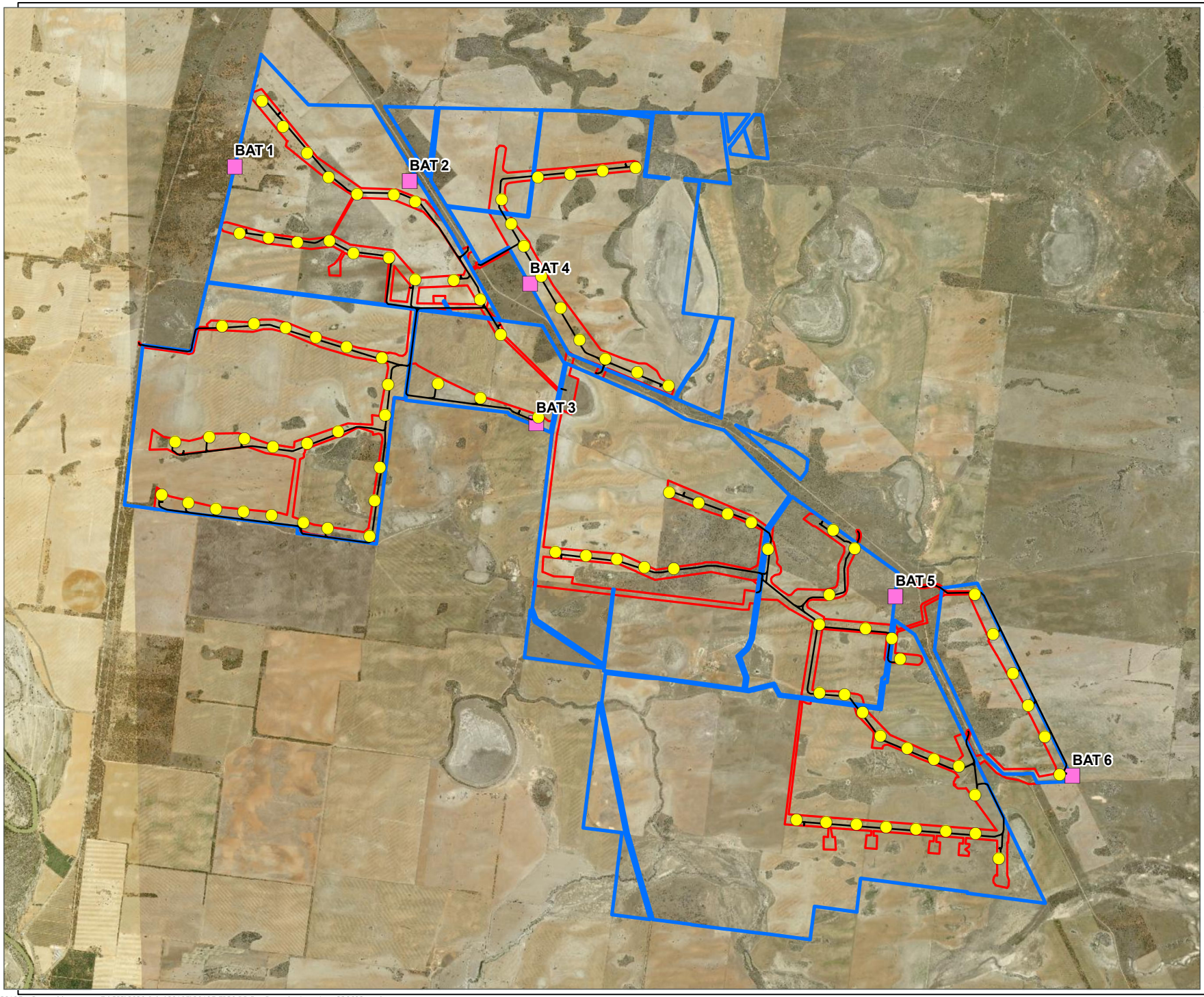


Figure 1: Junction Rivers **Wind** Project
Bat recorder locations

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

20195 - Created by: nm - E:\GIS\2020 Jobs\20195\20195 FIG6 RP Bat Recorder Locations 230602.mxd

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.

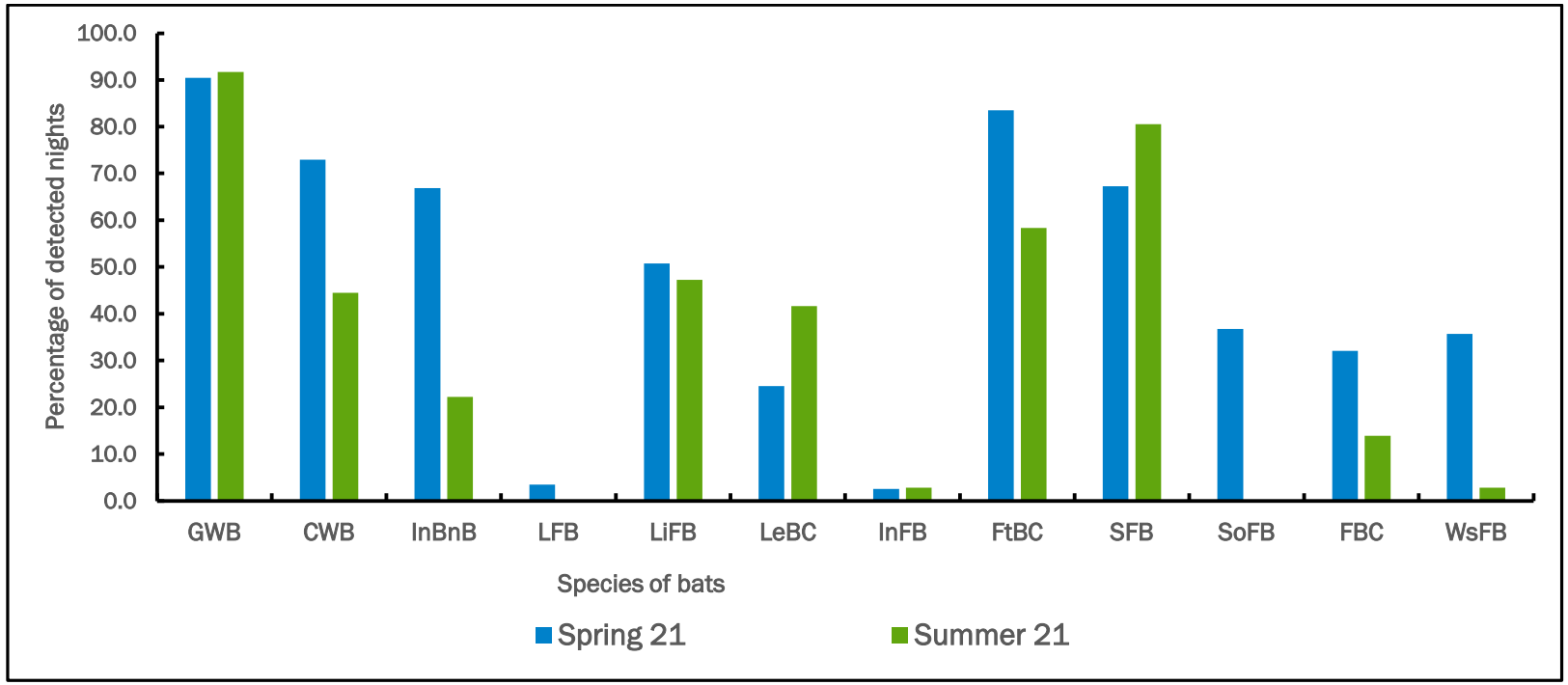
Table 5:Percentage (%) of detector nights each species was recorded across the six survey sites during spring 2021

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:

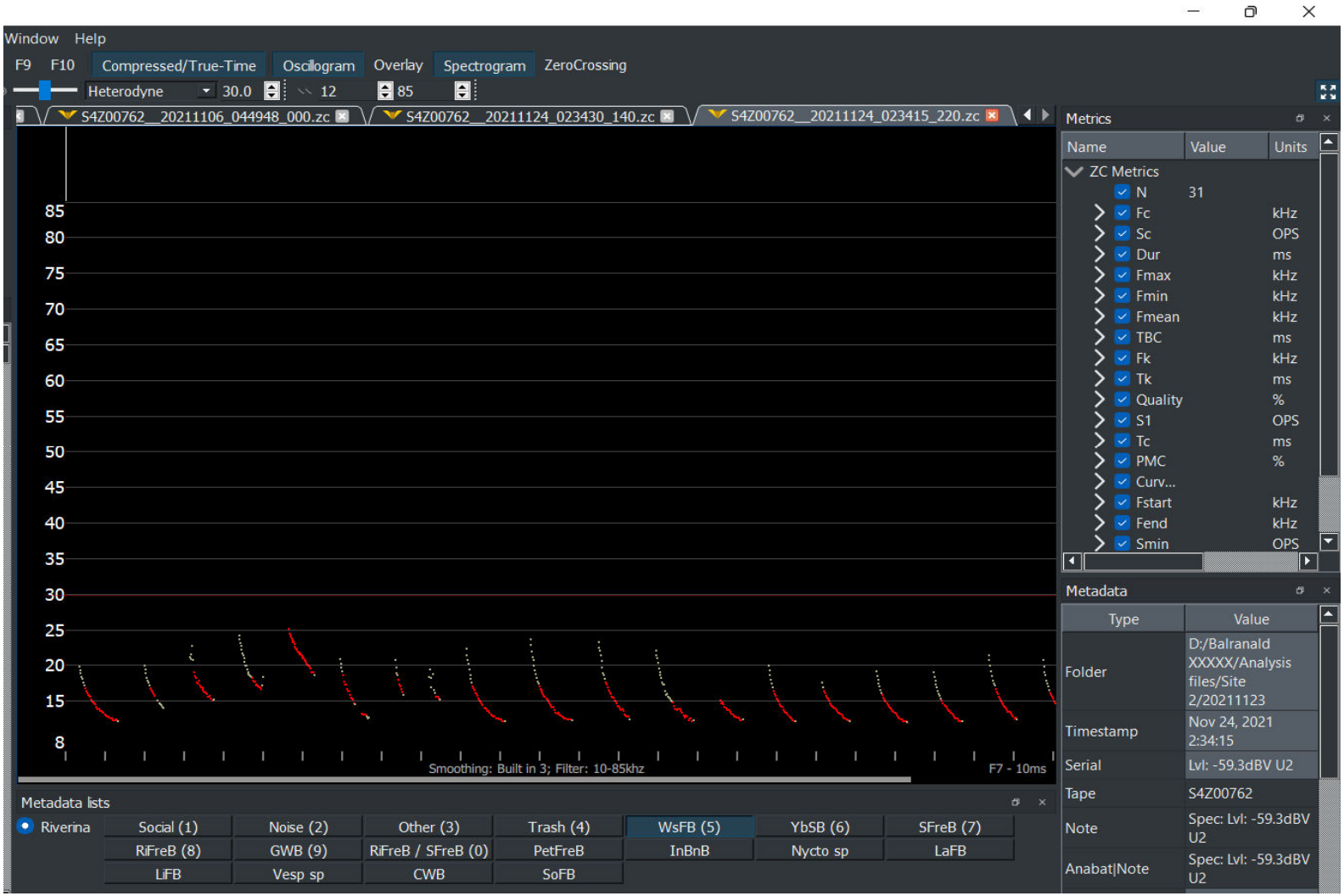
The following is recommended for Junction Rivers Wind Project.

- 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.

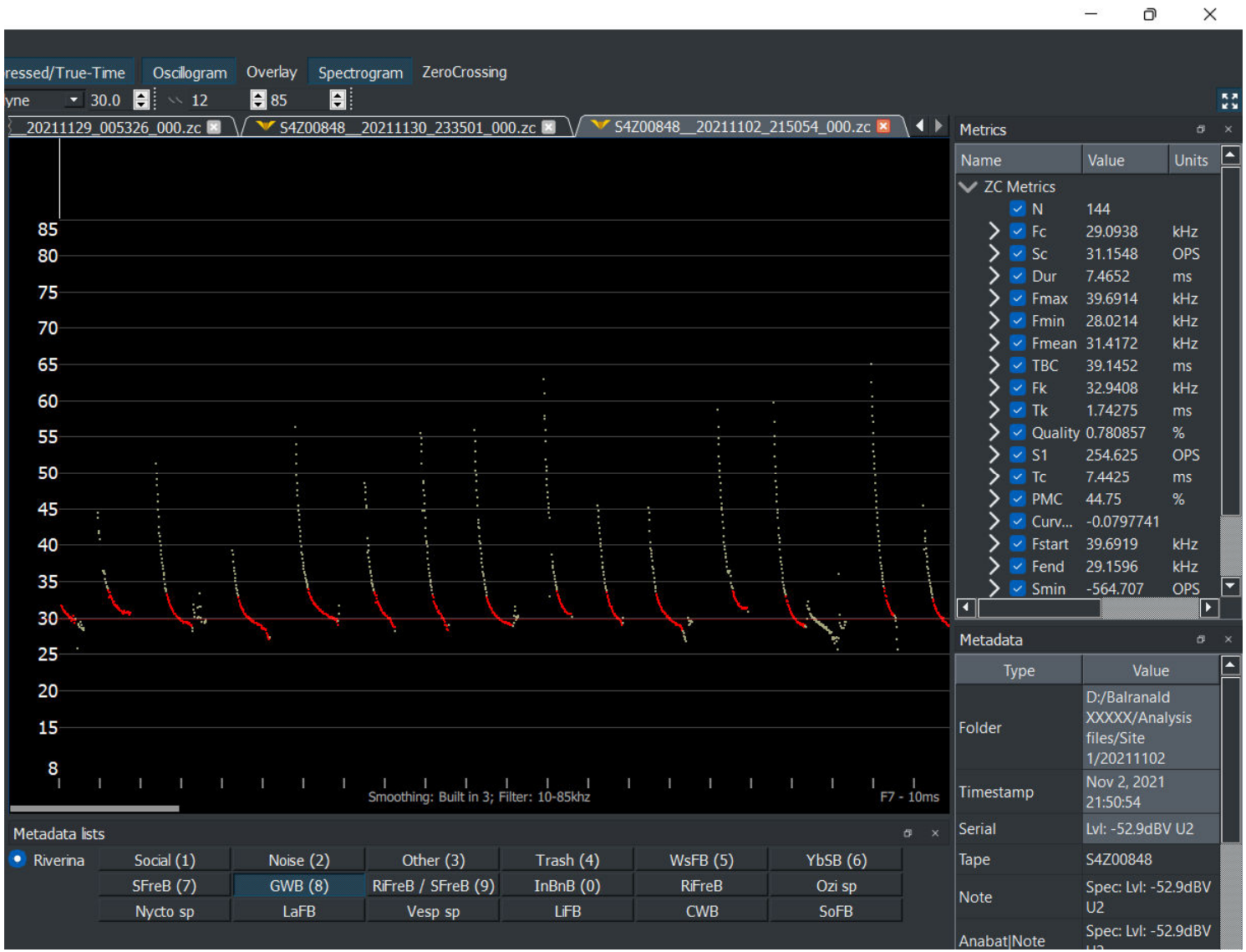
5. References

Department of Environment, Water, Heritage and the Arts 2010. *Survey Guidelines for Australia's threatened bats.* Australian Government. Canberra.

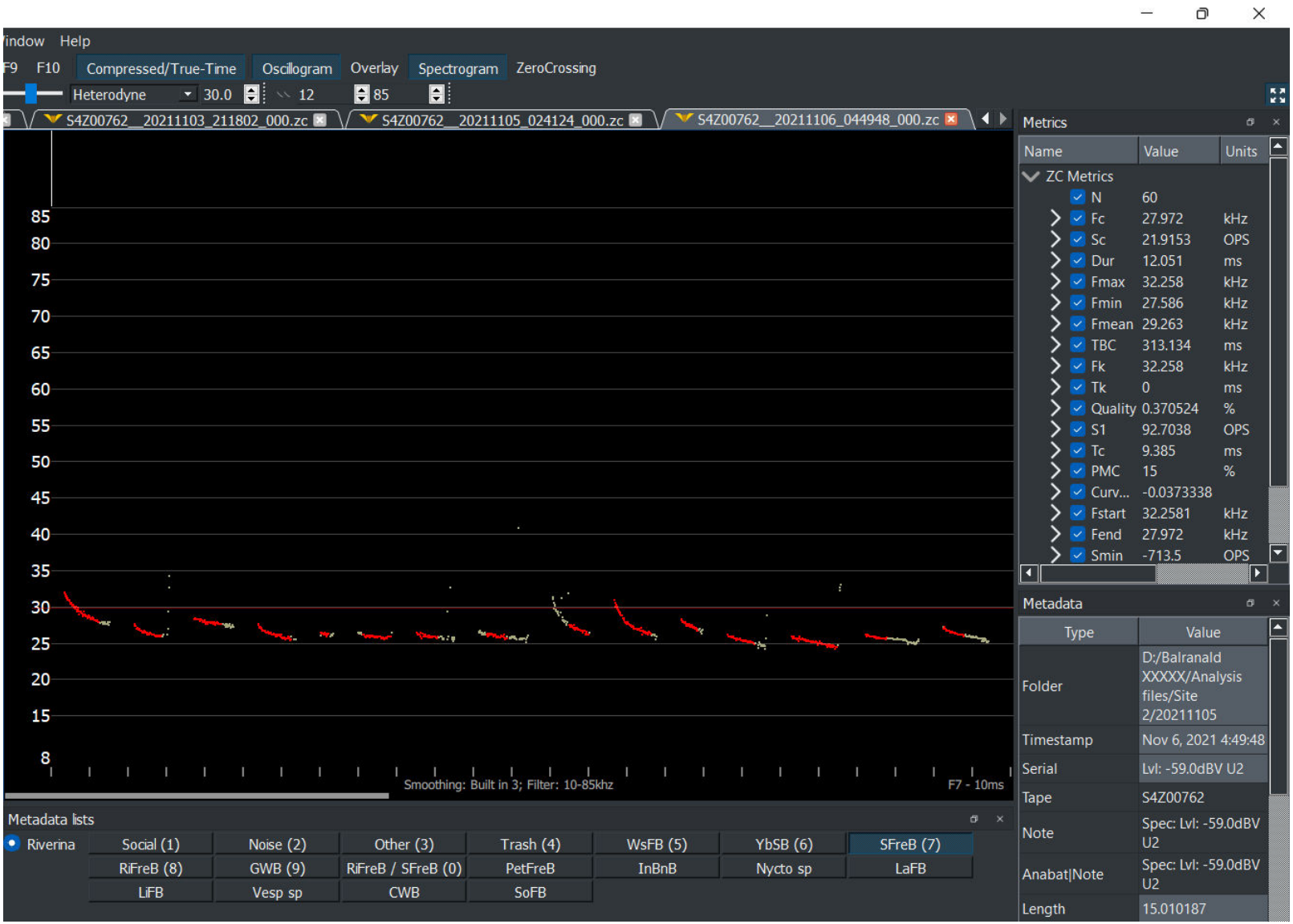
Appendix 1: Examples of bat sonograms recorded at Junction Rivers Wind Project



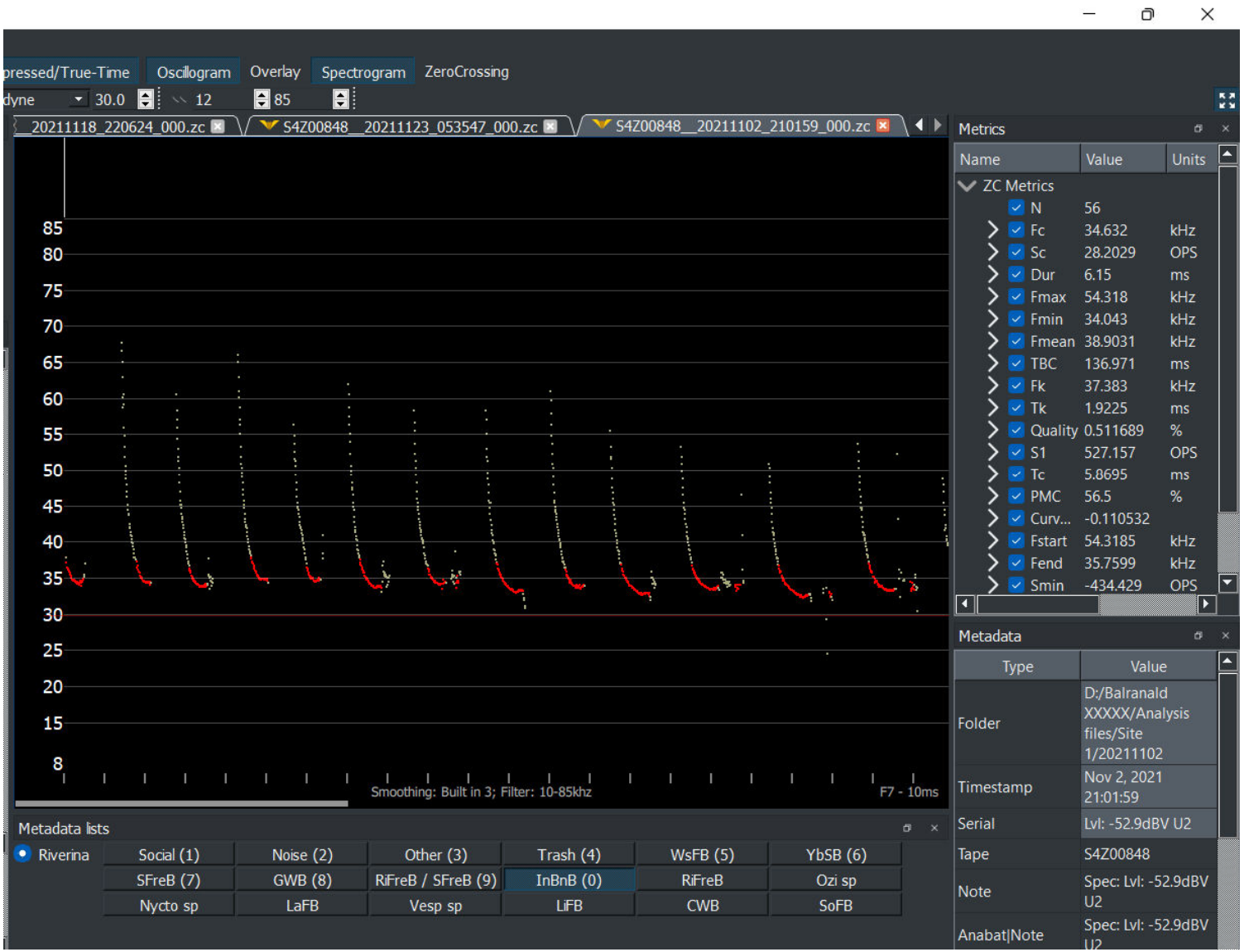
White-striped Freetail Bat



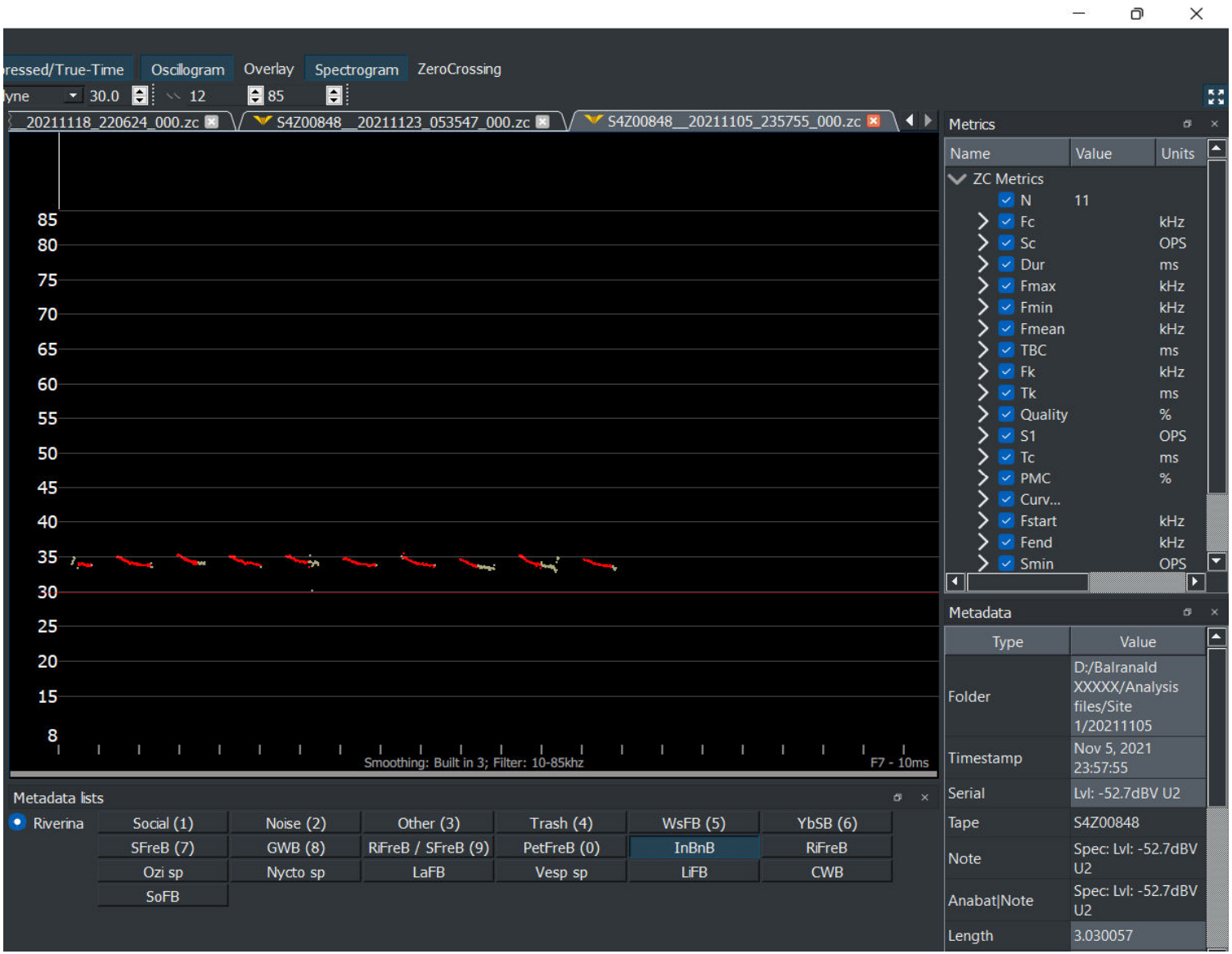
Gould's Wattled Bat



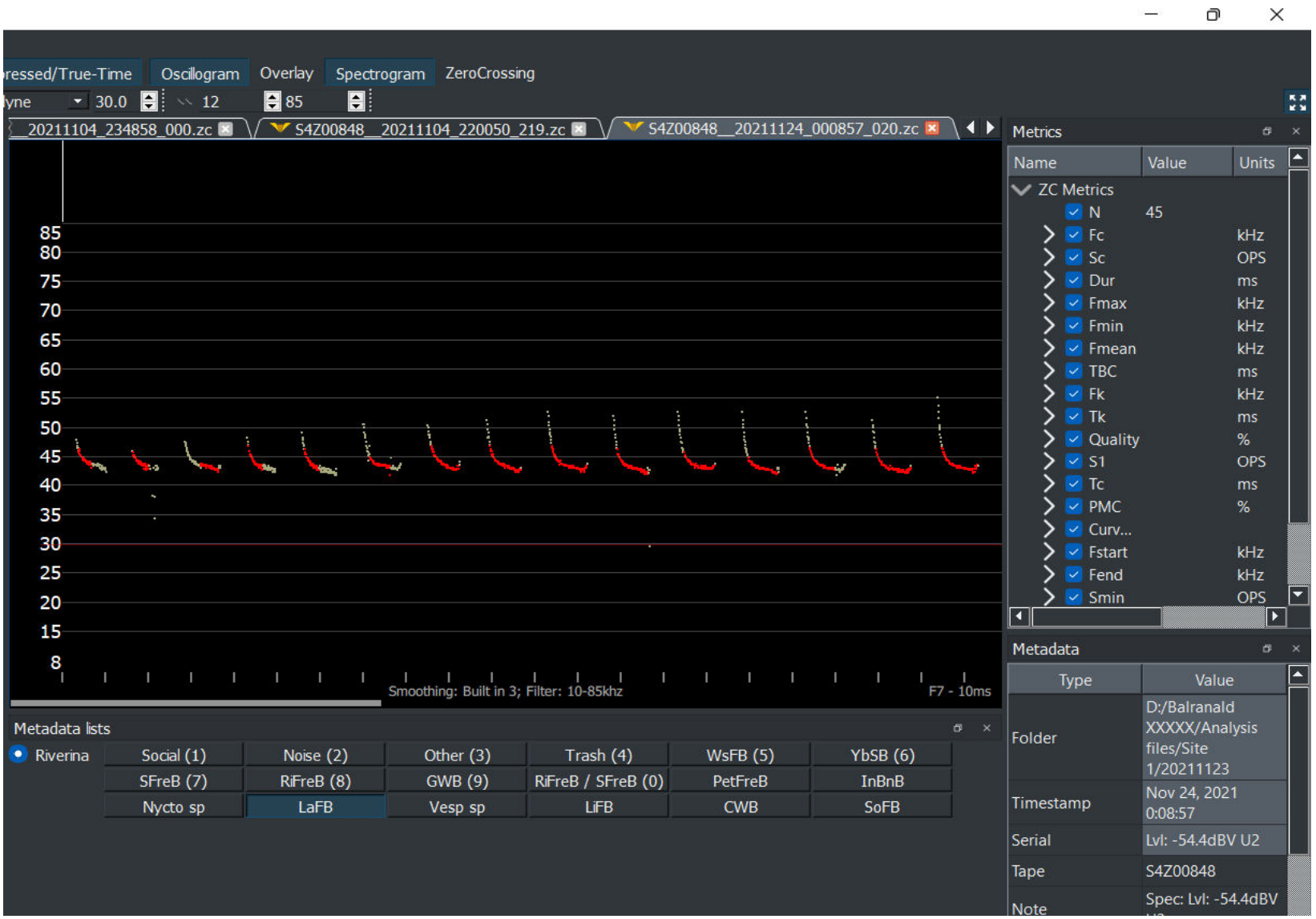
Southern Freetail Bat



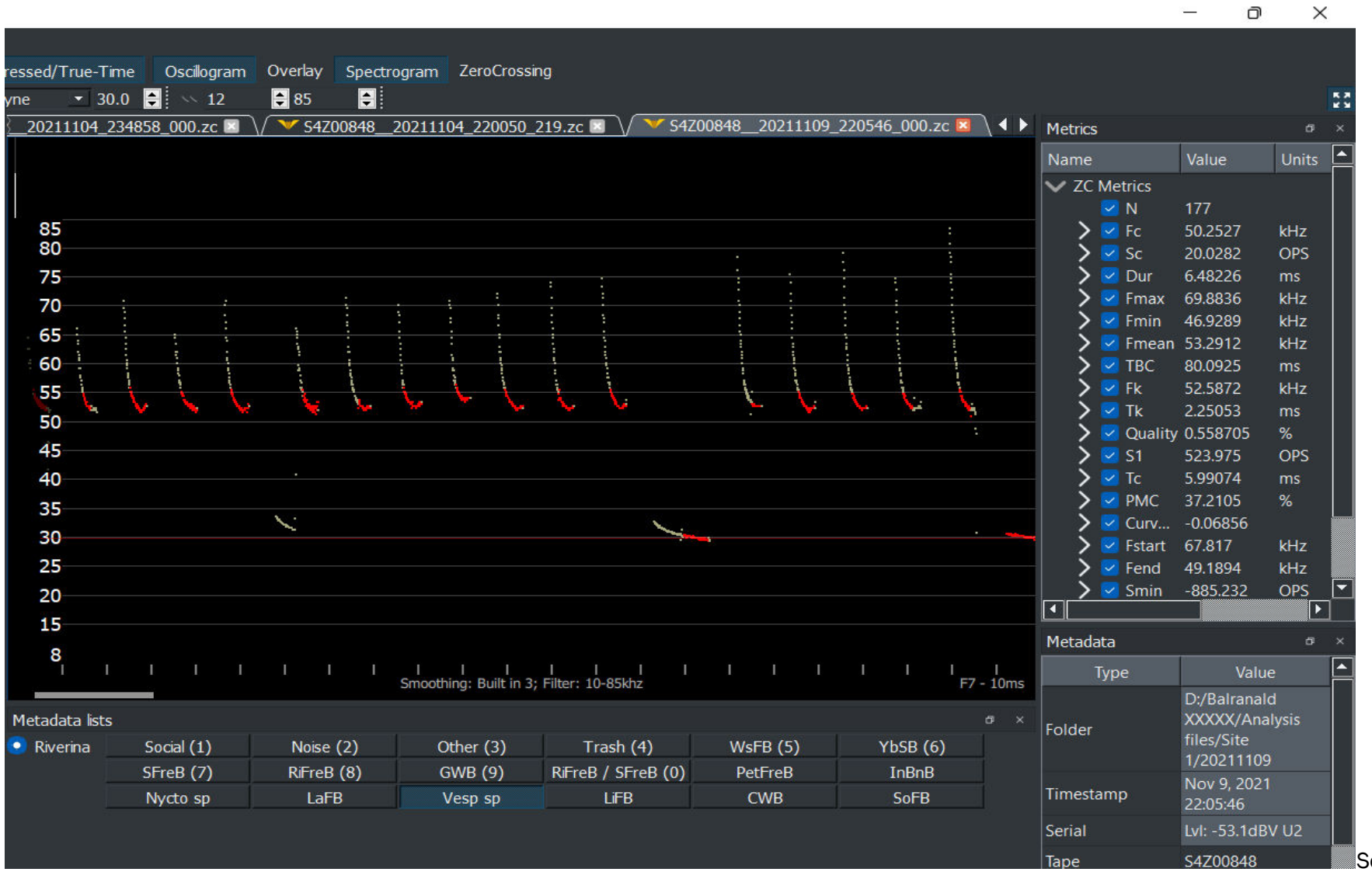
Inland Broad-nosed Bat



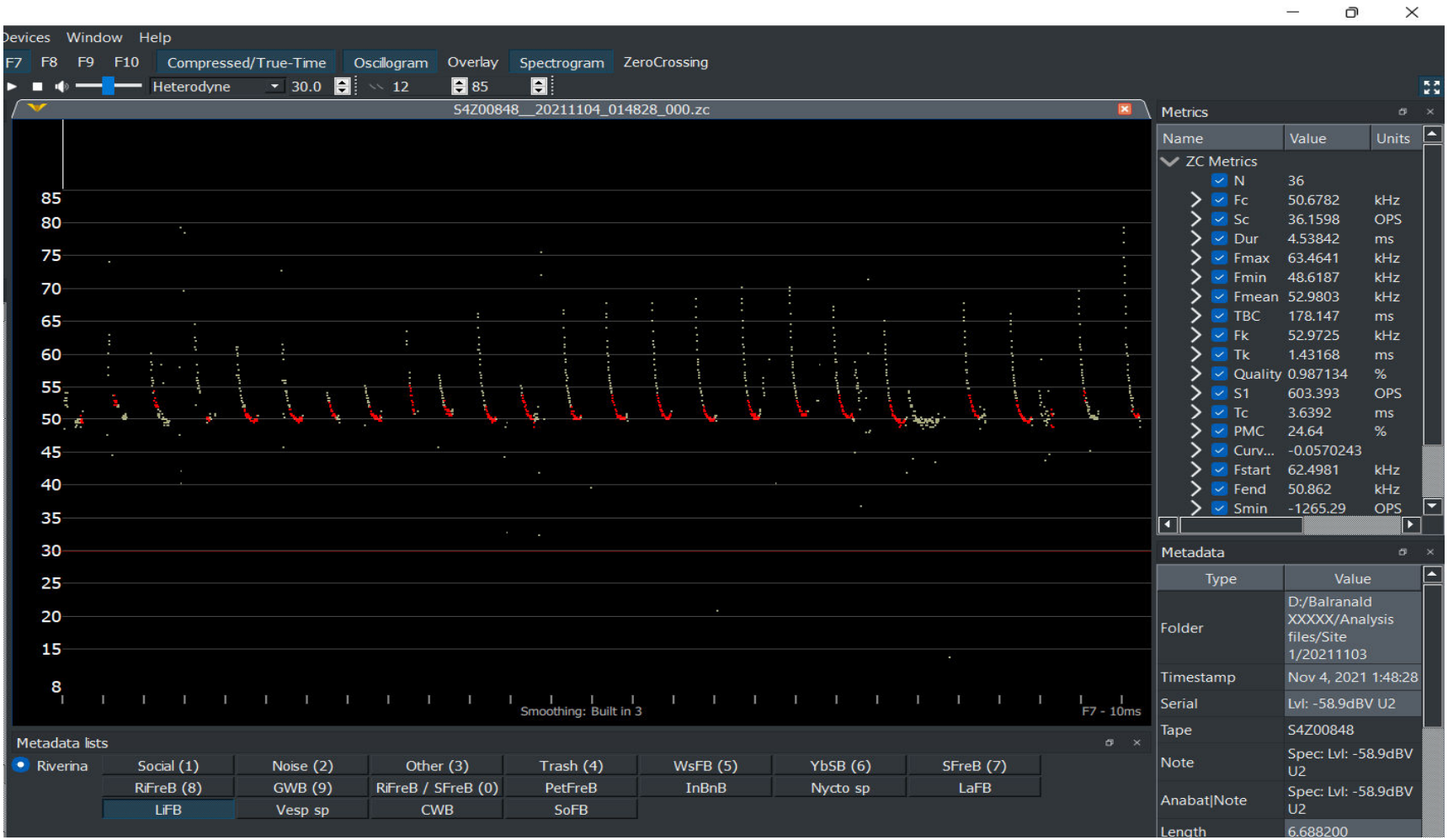
Inland Freetail Bat



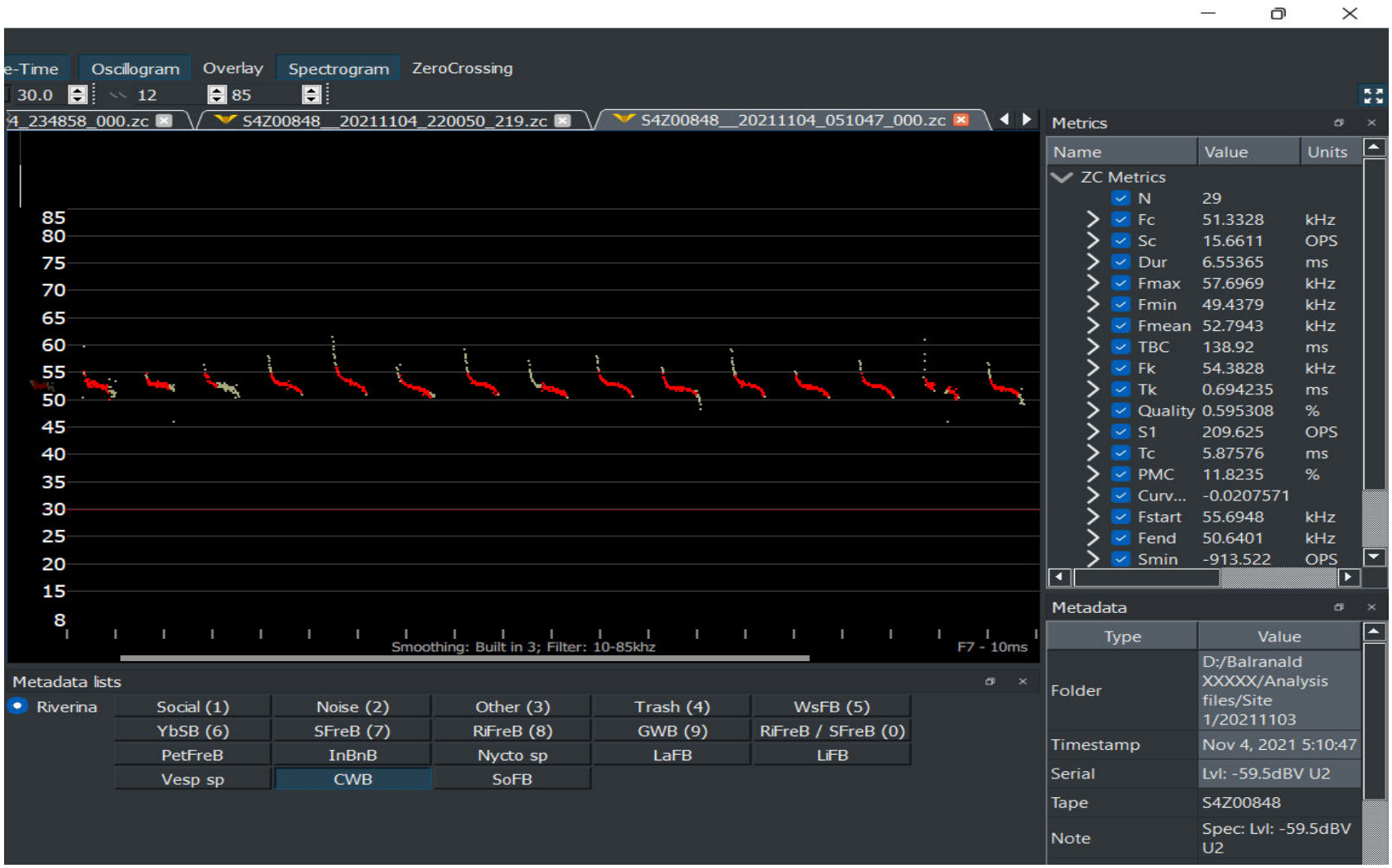
Large Forest Bat



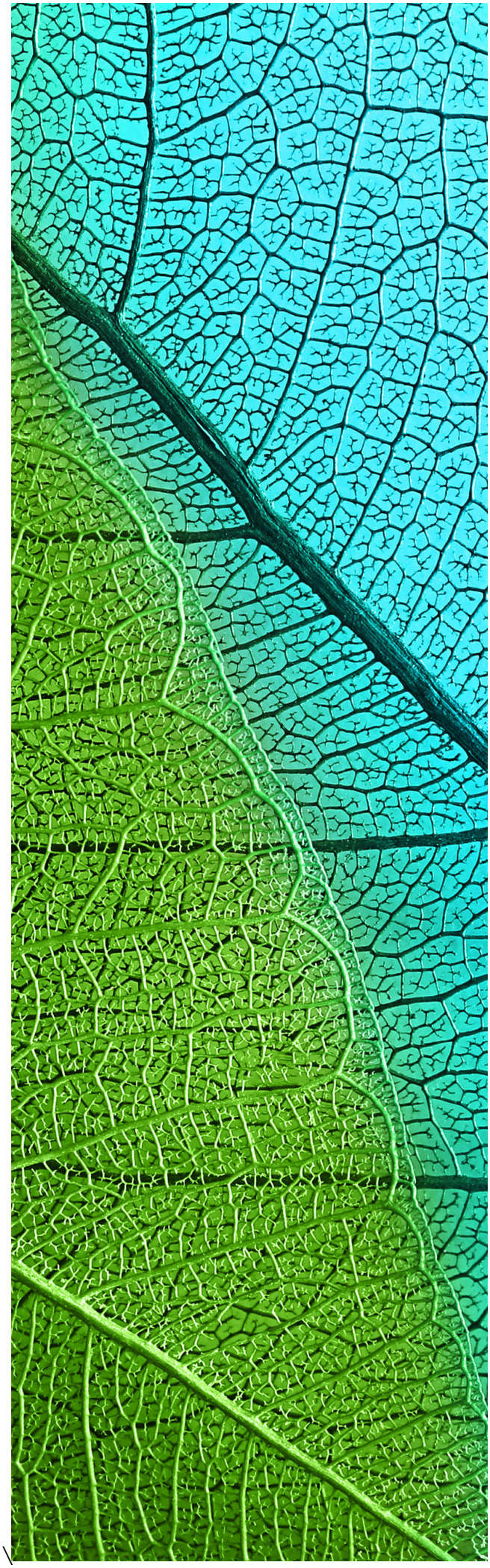
Southern Forest Bat- high frequency call form



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)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

1. Introduction 5
2. Bird Utilisation Survey 8
2.1. Methods 8
2.1.1. Fixed-point bird count 8
2.1.2. Locations of survey points 9
2.1.3. Incidental observations 11
2.1.4. Data preparation and statistical analysis 11
2.1.5. Limitations 11
2.2. Results 11
2.2.1. Survey suitability 11
2.2.1. Species composition 12
2.2.2. Commonly recorded species 15
2.2.3. Flight heights 15
2.3. Listed threatened and migratory species 16
2.3.1. 'At risk' birds. 16
2.3.2. Black Falcon 17
2.3.3. Major Mitchell's Cockatoo 17
2.3.4. Regent Parrot 19
2.3.5. Spotted Harrier 19
2.3.6. White-fronted Chat 20
2.3.7. Raptors 20
2.3.8. Waterbirds 21
3. Bat Survey 22
3.1. Methods 22
3.1.1. Timing of surveys 22
3.1.2. Location of survey points 22
3.1.3. Limitations 24
3.2. Results 25
3.2.1. Bat activity 25
3.2.2. Relative abundance of bats 26
3.2.3. Summer 2021 26
3.2.4. Spring 2021 26

4. Conclusions and recommendations 30
4.1. Bird utilisation summary 30
4.1.1. Black Falcon 30
4.1.2. Major Mitchell's Cockatoo 30
4.1.3. Regent Parrot 31
4.1.4. Spotted Harrier 31
4.1.5. White-fronted Chat 31
4.1.6. Raptors 31
4.2. Bat summary 32
4.3. Recommendations 32
4.3.1. Raptors 32
4.3.2. Major Mitchell's Cockatoo 33
4.3.3. Regent Parrot 33
4.3.4. Bird and Bat Adaptive Management Plan 33
5. References 34

Tables

Table 1: Times when points were counted for each fixed-point bird count survey day 8
Table 2: Habitat description for each bird utilisation survey point* 9
Table 3: Number and height distribution of bird species at survey points during eight seasons surveys at the proposed Junction Rivers Wind Project 13
Table 4: Five most common bird species recorded at impact and reference points at proposed Junction Rivers Wind Project 15
Table 5: Summary of flight heights of all birds recorded over two years of survey 2021 - 2022 16
Table 6: The most abundant species flying at RSA height at the proposed Junction Rivers Wind Project 16
Table 7: Raptor species recorded at impact points during four seasons across two years at the proposed Junction Rivers Wind Project 21
Table 8 Waterbirds species recorded at survey points during four seasons across two years at the proposed Junction Rivers Wind Project 21
Table 9: Habitat description associated with each recording location 22
Table 10: Bat diversity at proposed Junction Rivers Wind Project during summer and spring 2021 25
Table 11: Total bat calls across summer and spring surveys. 26
Table 12: Percentage of detector nights each species was recorded across the six survey locations of recording during summer 2021. 28

Table 13: Percentage of detector nights each species was recorded across five survey locations during spring 2021.....28

Figures

Figure 1: Junction Rivers Wind Project layout and location..... 7

Figure 2: Junction Rivers Wind Project bird utilisation survey (BUS) points.....10

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.....12

Figure 4 Major Mitchell's Cockatoo Occurrences over two years of BUS surveys.....18

Figure 5. Counts of Major Mitchell's Cockatoo during formal BUS surveys.....19

Figure 6: Junction Rivers Wind Project bat recorder locations over two years of survey 23

Figure 7: Percentage of detector nights each species was recorded across the combined summer and spring 2021 surveys 29

Appendices

Appendix 1: Raw data for the two years of BUS survey at impact and reference points at Junction Rivers Wind Project.....35

Appendix 2: Table of results classifying all recorded species into representative categories at Junction Rivers Wind Project.....36

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).

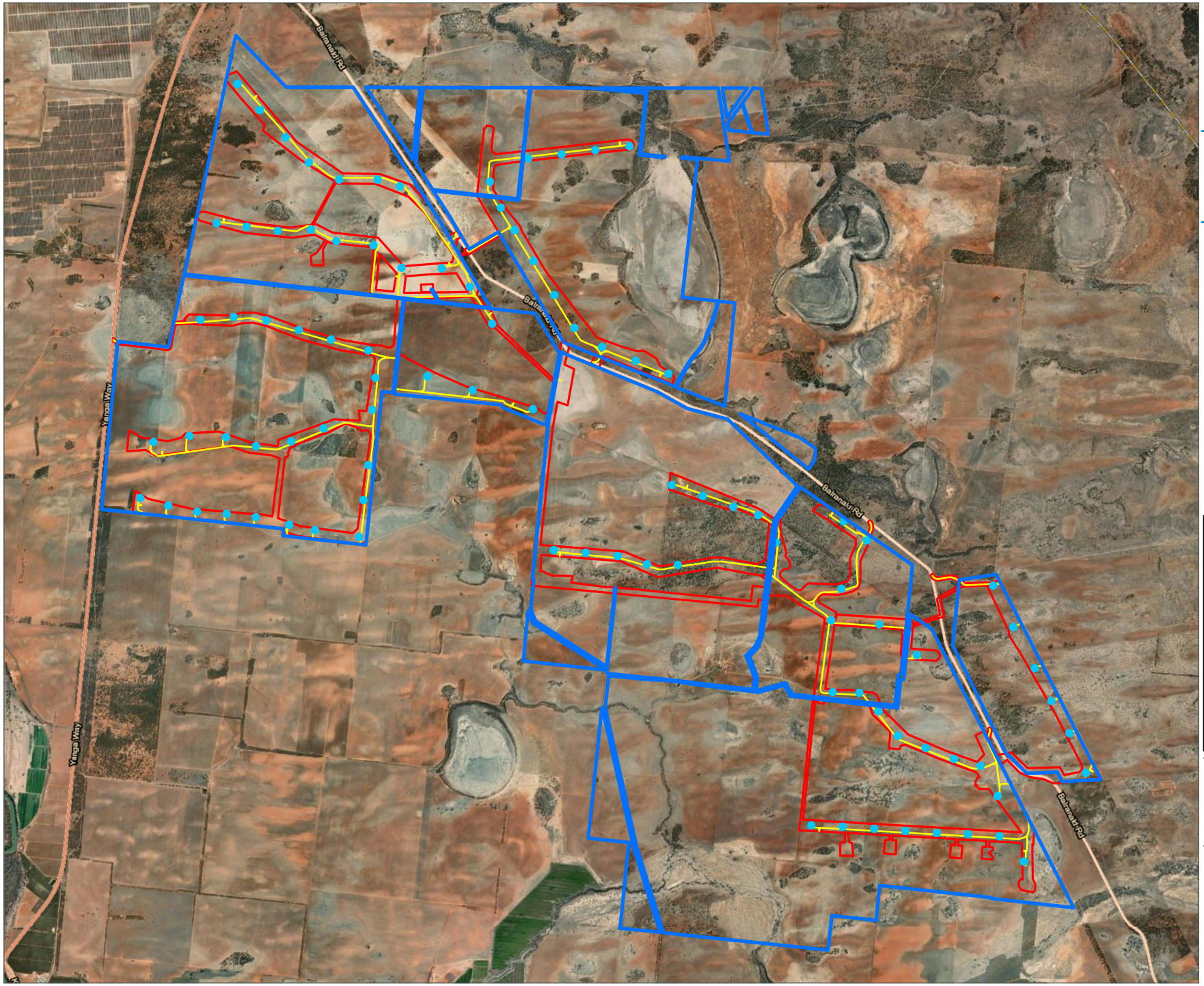


Figure 1: Junction Rivers **Wind** Project
layout and location

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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

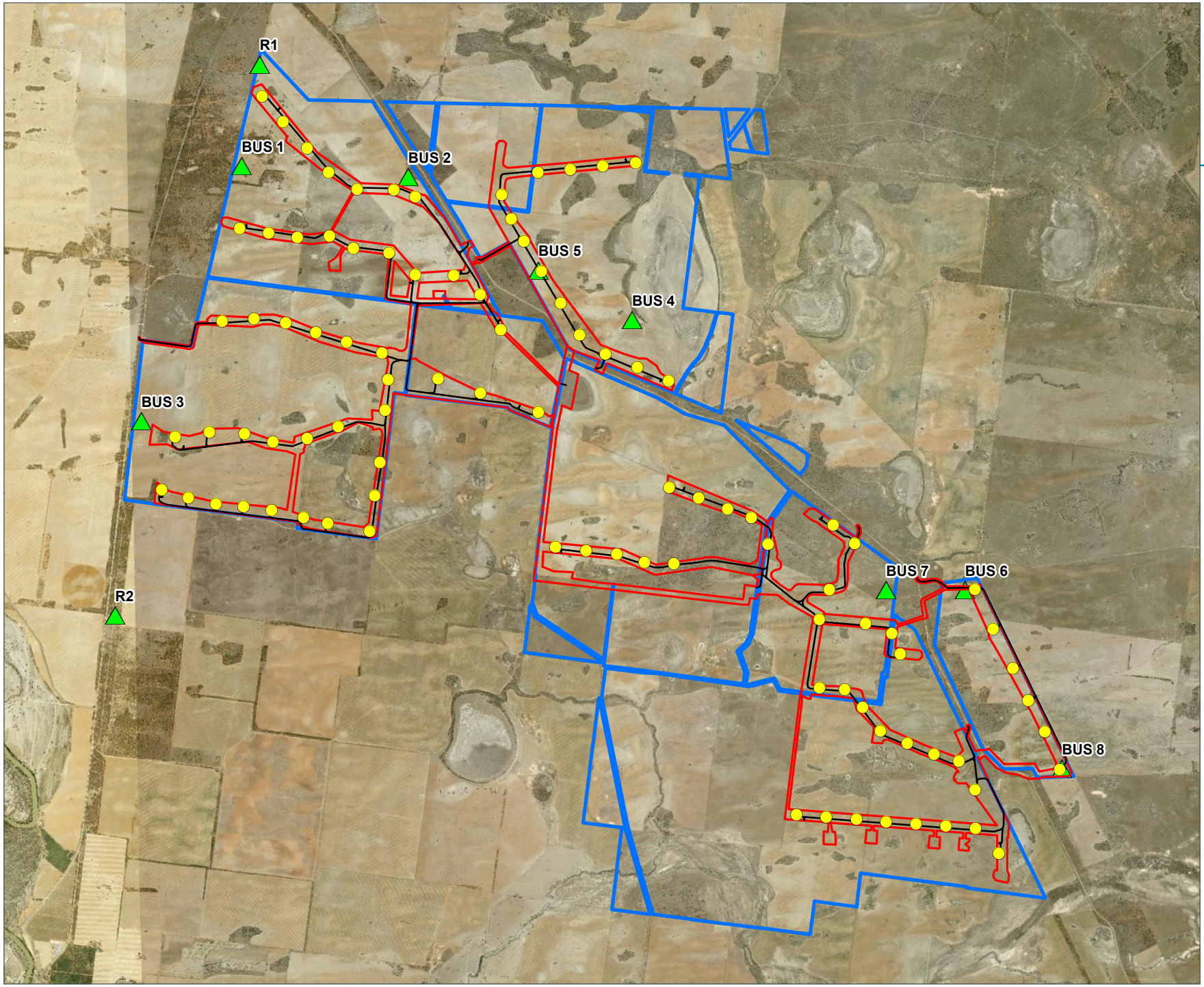


Figure 2: Junction Rivers Wind Project
BUS points

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.

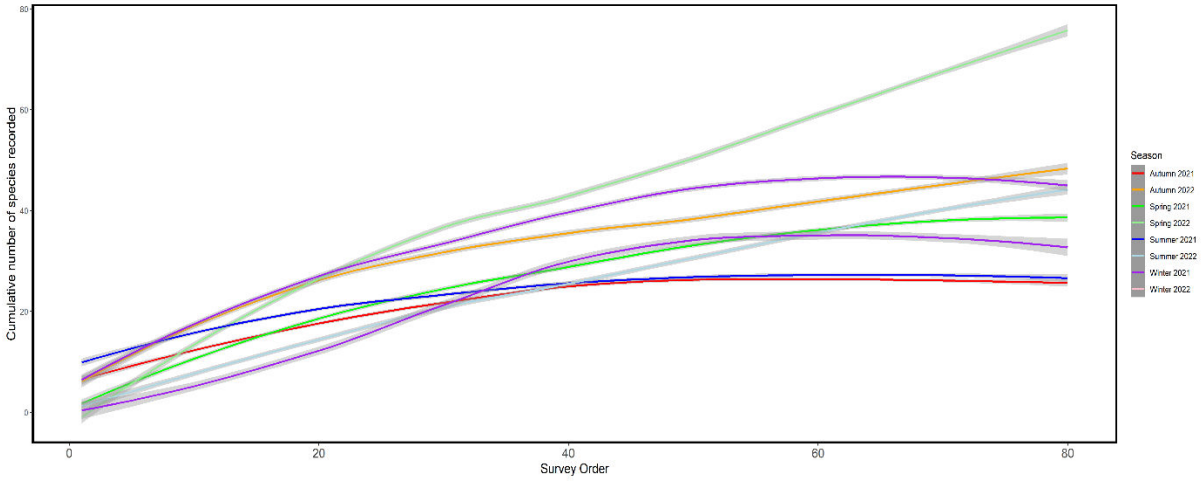


Figure 3: The cumulative number of species of birds recorded during consecutive counts at the impact points on the proposed Junction Rivers Wind Project during 2021 and 2022.

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.

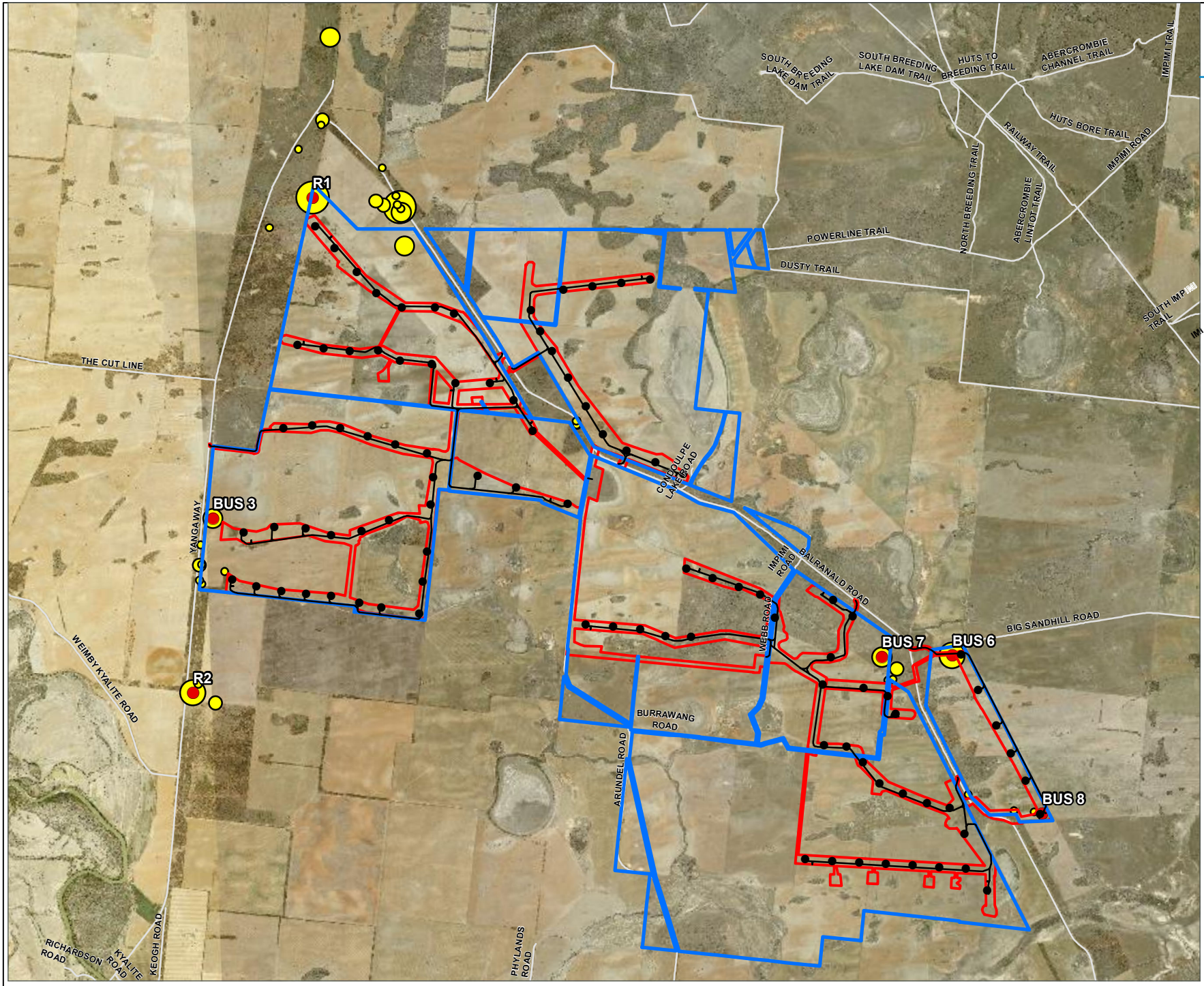


Figure 4: Major Mitchell's Cockatoo Occurrences

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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.

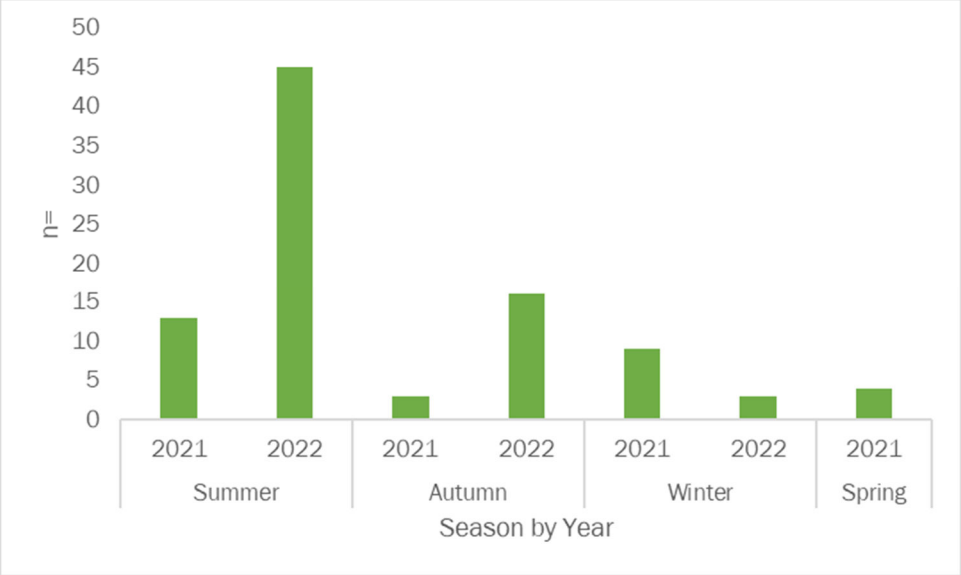


Figure 5. Counts of Major Mitchell's Cockatoo during formal BUS surveys

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

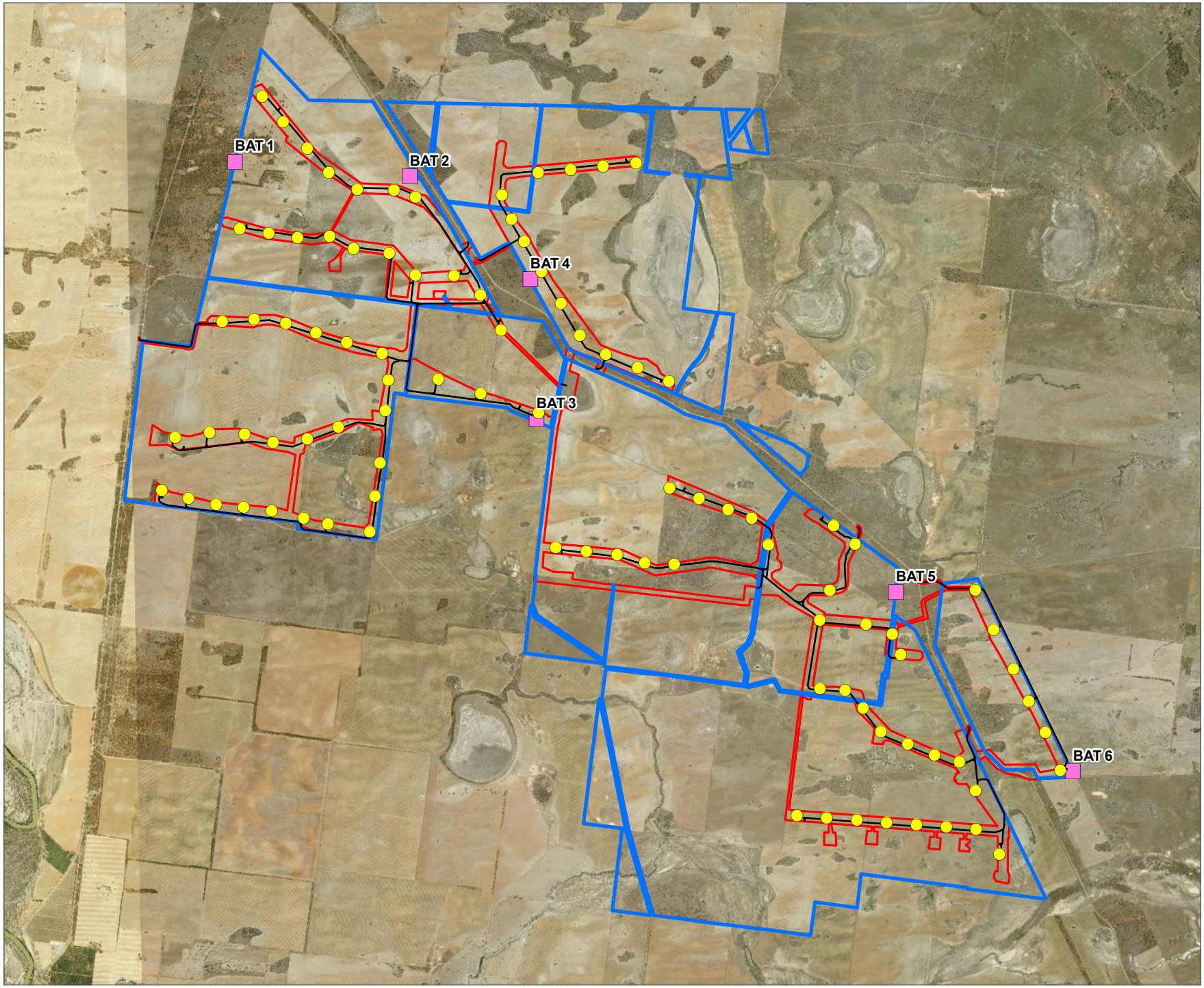


Figure 6: Junction Rivers **Wind** Project
Bat recorder locations

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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.

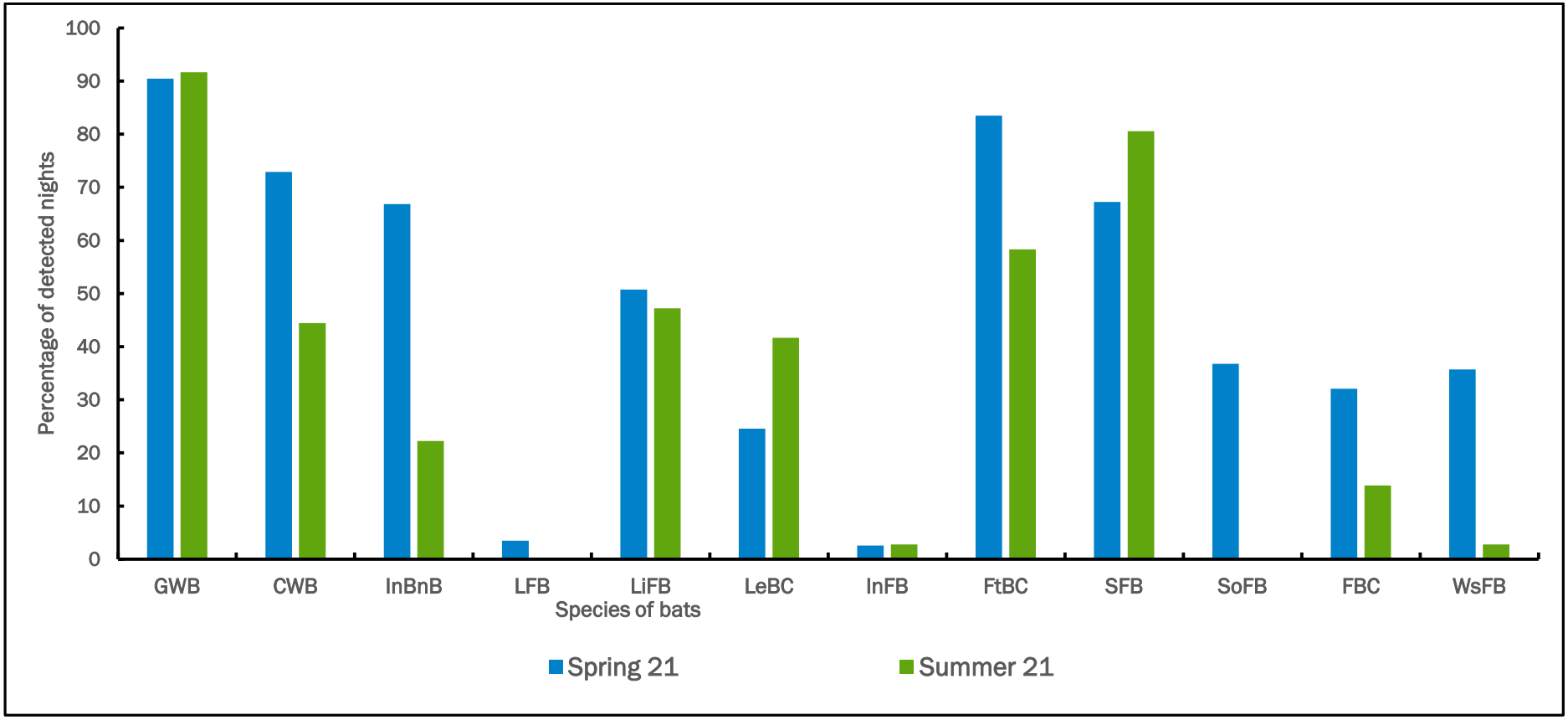


Figure 7: Percentage of detector nights each species was recorded across the combined summer and spring 2021 surveys

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.

5. References

Australasian Bat Society 2022, *BatMap*, accessed 21st December 2022, http://ausbats.org.au/batmap.

AusWEA (Australian Wind Energy Association) 2005, *Wind Farms and Birds: Interim Standards for Risk Assessment,* Report prepared by Brett Lane and Associates and AIRA Professional Services; Report No. 2003.35 (2.2), July 2005.

Clean Energy Council 2018, *Best Practice Guidelines – For Implementation of Wind Energy Projects in Australia*. Clean Energy Council, Melbourne.

DAWE 2022, *Onshore Wind Farms – Interim Advice*, Department of Agriculture, Water and the Environment, Canberra.

Debus, S.J., Bauer, A.L. and Mitchell, G.I., 2017. Breeding biology, behaviour and foraging ecology of the Black Falcon Falco subniger near Tamworth, New South Wales. *Corella*.Marchant, S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds, Volume 2, Raptors to Lapwings*, Oxford University Press, Melbourne.

Menkhorst P, Rogers D, Clarke R, Davies J, Marsack P and Franklin K 2017. *The Australian Bird Guide*. CSIRO Publishing, Clayton, VIC.

OEH 2023a, Corben's Long-eared Bat, threatened species profile, Corben's Long-eared Bat - profile | NSW Environment, Energy and Science

OEH 2023b, Spotted Harrier, threatened species profile, Spotted Harrier - profile | NSW Environment, Energy and Science

R Core Team 2018, *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

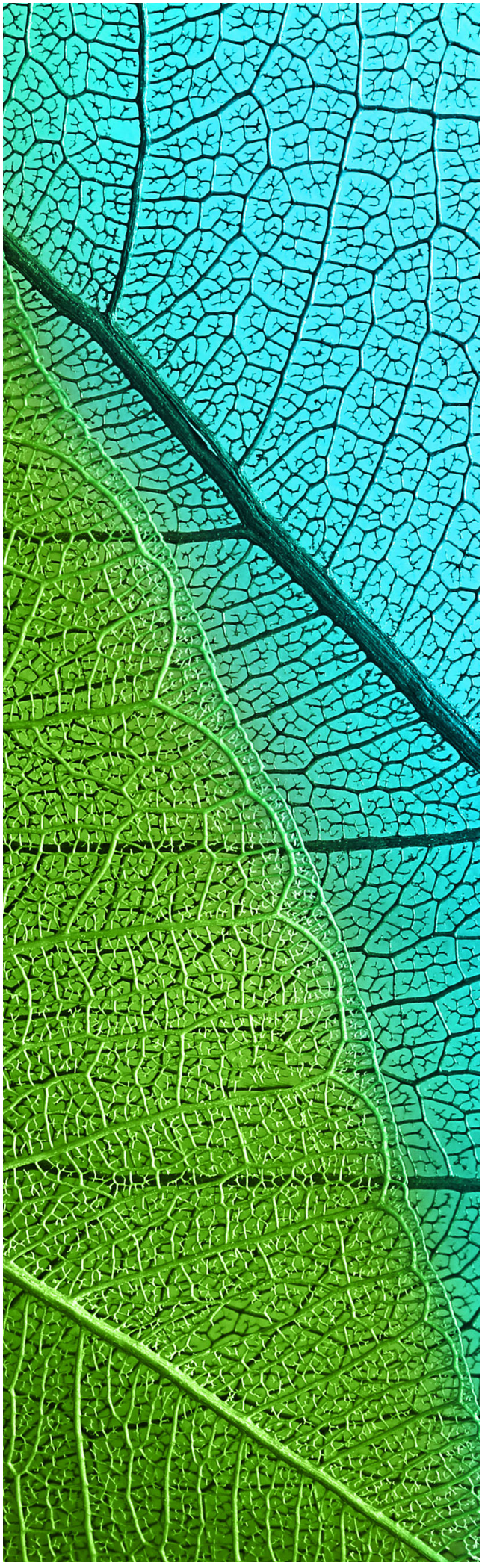
Appendix 1: Raw data for the two years of BUS survey at impact and reference points at Junction Rivers Wind Project

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)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

1. Introduction 1
2. Sources of Information 2
2.1. Sources of information on bird and bats 2
2.2. Proposed models for turbines 2
3. Species and groups of concern 3
4. Risk Assessment Process 6
5. Risk Assessment Results 8
5.1. Threatened bird species 8
5.2. Non-threatened raptor species 9
5.3. Threatened bat species 9
5.4. Non-threatened bat species 10
6. References 17

Tables

Table 1: Proposed turbine specifications for the Junction Rivers Wind Project 2
Table 2: Risk assessment – Short-listed bird and bat species 3
Table 3: Likelihood criteria for a risk event to occur 6
Table 4: Consequence Criteria 7
Table 5: Risk matrix defining risk level based on likelihood and consequence 7
Table 6: Bird and Bat Risk Assessment – Junction Rivers Wind Project 11

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)	31,416m^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 ▪ Common Sandpiper ▪ Fork-tailed Swift ▪ Latham's Snipe ▪ Pectoral Sandpiper ▪ Sharp-tailed Sandpiper ▪ White-throated Needletail ▪ Yellow Wagtail
EPBC Act and BC Act listed threatened birds
▪ Australasian Bittern (Endangered – EPBC & BC Act) ▪ Australian Painted Snipe (Critically Endangered – EPBC Act & Endangered – BC Act) ▪ Curlew Sandpiper (Critically Endangered – EPBC Act & Endangered – BC Act) ▪ Eastern Curlew (Critically Endangered – EPBC Act & Endangered – BC Act) ▪ Grey Falcon (Vulnerable – EPBC Act & Endangered – BC Act) ▪ Malleefowl (Vulnerable – EPBC Act & Endangered – BC Act) ▪ Night Parrot (Endangered – EPBC Act & Extinct – BC Act) ▪ Painted Honeyeater (Vulnerable – EPBC Act & BC Act) ▪ Plains Wanderer (Critically Endangered – EPBC Act & BC Act) ▪ 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 ▪ 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%) 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. 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: Black Kite Brown Falcon Brown Goshawk Nankeen Kestrel 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.

6. References

Atlas of Living Australia (ALA) 2021, ala.org.au.

Churchill, S. 2008. Australia Bats. Jacana Books, New South Wales.

Debus S 2017, Australasian Eagle and Eagle-like Birds, CSIRO Publishing, Clayton South, Victoria.

Department of Agriculture, Water and the Environment (DAWE) 2020, EPBC Act Protected Matters Search Tool, Commonwealth Department of the Environment, 15th November 2021, http://www.environment.gov.au.

Department of Planning Industries & Environment (DPIE) 2021, NSW BioNet: species area search, DPIE, viewed 16th November 2021, http://www.bionet.nsw.gov.au.

Higgins, P.J. and Davies, S.J.J.F., 1996. Handbook of Australian, New Zealand and Antarctic birds; volume 3.

Higgins, PJ (ed) 1999, Handbook of Australian, New Zealand and Antarctic Birds, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, P. J., Peter, J. M., and Steele, W. K. (Eds) 2001. 'Handbook of Australian, New Zealand and Antarctic Birds. Vol. 5. Tyrant-flycatchers to Chats.' Oxford University Press: Melbourne.

Higgins, P.J and Peter, J. M (eds) 2002. Handbook of Australian, New Zealand and Antarctic Birds. Volume 6: Pardalotes to shrike-thrushes, Oxford University Press, Melbourne.

International Organization for Standards (ISO) 2018. Risk Management Guidelines – AS ISO 13000, Standards Australia.

Kennedy, S.J. and Tzaros, C.L., 2005. Foraging ecology of the Swift Parrot Lathamus discolor in the box-ironbark forests and woodlands of Victoria. Pacific Conservation Biology, 11(3), pp.158-173.

Marchant, S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds, Volume 2, Raptors to Lapwing*s, Oxford University Press, Melbourne.

Menkhorst P, Schedvin N, & Geering D, 1999. *Regent Honeyeater Recovery Plan 1999 – 2003.* Department of Natural Resources and Environment, Melbourne.

Menkhorst P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K 2017. *The Australian Bird Guide*. CSIRO Publishing, Melbourne.

Menkhorst, P., Rogers, D., Clarke, R., Davies, J., Marsack, P. & Franklin, K. (2021). The Australian Bird Guide. CSIRO publishing, Melbourne.

Nature Advisory 2021a Bird Utilisation Survey – 1st Annual BUS report- Nature Advisory Report 20195.04 (1.0).

Office of Environment & Heritage, NSW (OEH) 2021, Threatened Species Profile, viewed 15th November 2021, http://www.environment.gov.au.

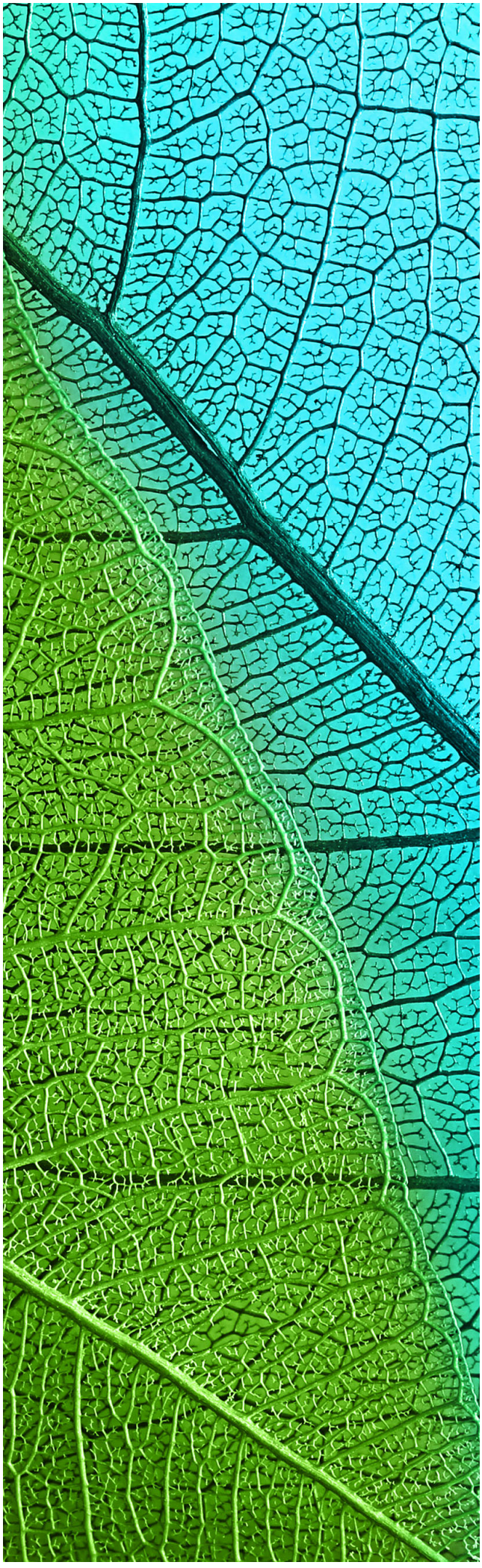
Office of Environment & Heritage, NSW (OEH) 2022a, Threatened Species Profile, viewed 9th November 2022, http://www.environment.gov.au

Office of Environment & Heritage, NSW (OEH) 2022b, Threatened Species Profile, viewed 9th November 2022, http://www.environment.gov.au

Office of Environment & Heritage, NSW (OEH) 2022c, Threatened Species Profile, viewed 9th November 2022, http://www.environment.gov.au

Office of Environment & Heritage, NSW (OEH) 2022d, Threatened Species Profile, viewed 9th November 2022, http://www.environment.gov.au

Office of Environment & Heritage, NSW (OEH) 2022e, Threatened Species Profile, viewed 9th November 2022, http://www.environment.gov.au



Junction Rivers Wind Project

Preliminary Literature Review on Habitat Use of the Australasian Bittern in the Riverina

Prepared for Windlab Pty Ltd

February 2024
Report No. 20195.07 (1.1)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

1. Executive summary 1
2. Introduction 3
2.1. Methods 3
3. Overview of species biology and ecology 4
3.1. Description 4
3.2. Diet 4
3.3. Distribution and Population 4
3.4. Habitat 5
3.5. Breeding 5
3.6. Movements 6
3.7. Conservation Status 6
4. Detailed Spatial Ecology Review 7
4.1. Breeding Period 7
4.2. Habitat Features 7
4.2.1. Permanent Wetlands 7
4.2.2. Rice Crops and Associated Irrigation 9
4.2.3. Other Ephemeral Wetlands 10
4.3. Population Information and Movements 11
4.3.1. Permanent Wetlands 11
4.3.2. Rice Crops and Associated Irrigation 12
4.3.3. Other Ephemeral Wetlands 13
4.3.4. Movements 14
4.4. Flight Behaviour 14
4.4.1. Flight Heights 14
4.4.2. Local Flight Behaviour 14
4.4.3. Long Range Flight Behaviours 15
4.4.4. Risk Flight Behaviours 15
5. Application: Analysis of nearby records 17
5.1. Literature 17
5.2. Analysis of on-site habitat and regional records 17
5.2.1. Flights Between Clusters 20
5.2.2. Flights Between Clusters and Significant Permanent Wetlands 20

5.2.3. Flights Between Clusters and Seasonal Breeding Grounds 20
5.2.4. Worst-case and Likely Scenarios 23
5.3. Limitations of analysis 25
6. References 27

Figures

Figure 1: Image of a mature adult specimen of Australasian Bittern *Botaurus poiciloptilus*. Taken from southern Victoria, 18/09/19. 4
Figure 2: Distribution map for the Australasian Bittern *Botaurus poiciloptilus* within Australia (DCCEEW 2022) 5
Figure 3: Map of Australasian Bittern records in the region surrounding the proposed Junction Rivers Wind Project. 19
Figure 4: Major rice-growing areas in the NSW Riverina, and flight routes between record clusters and other sites 22

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).

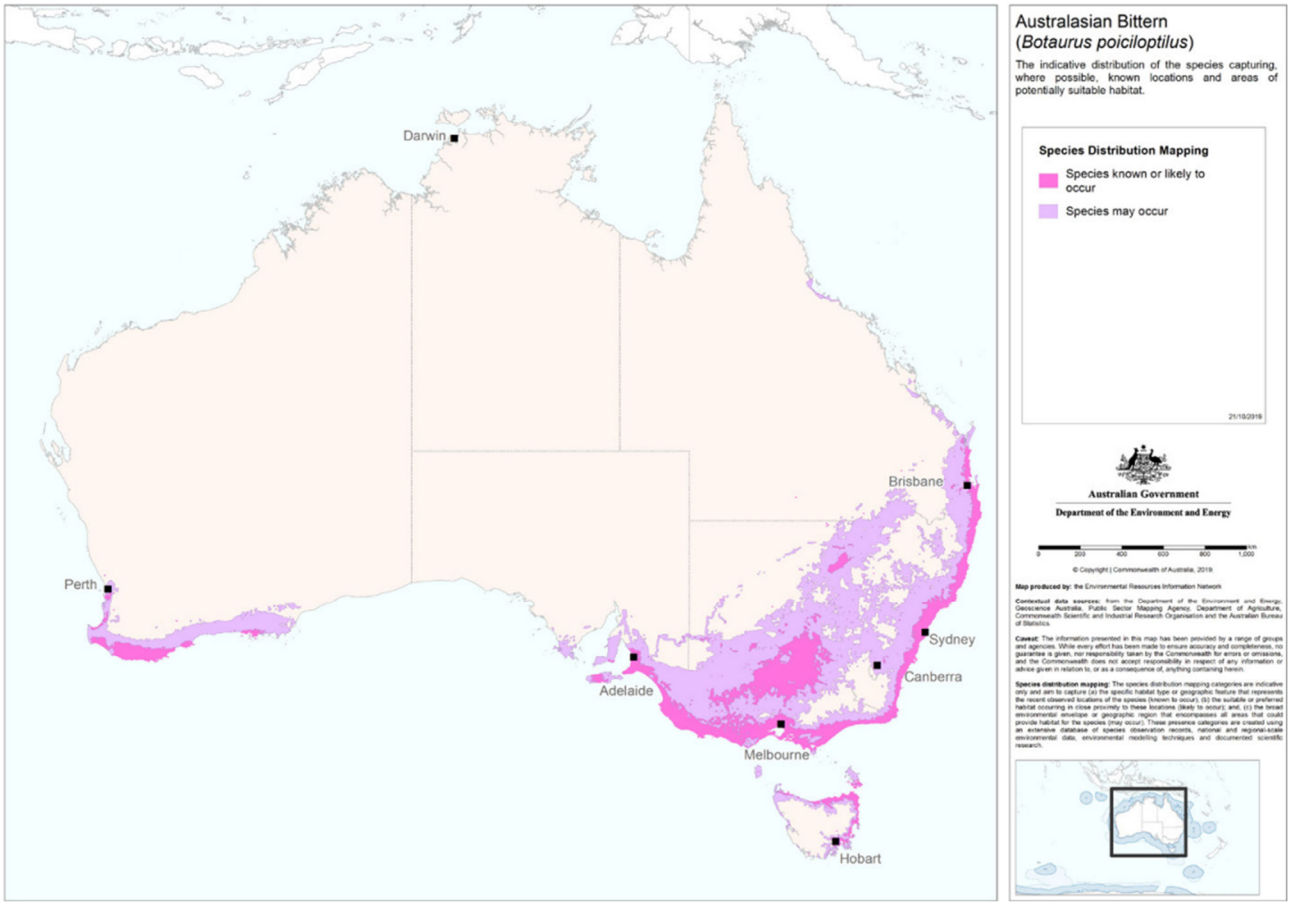


Figure 2: Distribution map for the Australasian Bittern *Botaurus poiciloptilus* within Australia (DCCEEW 2022)

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):

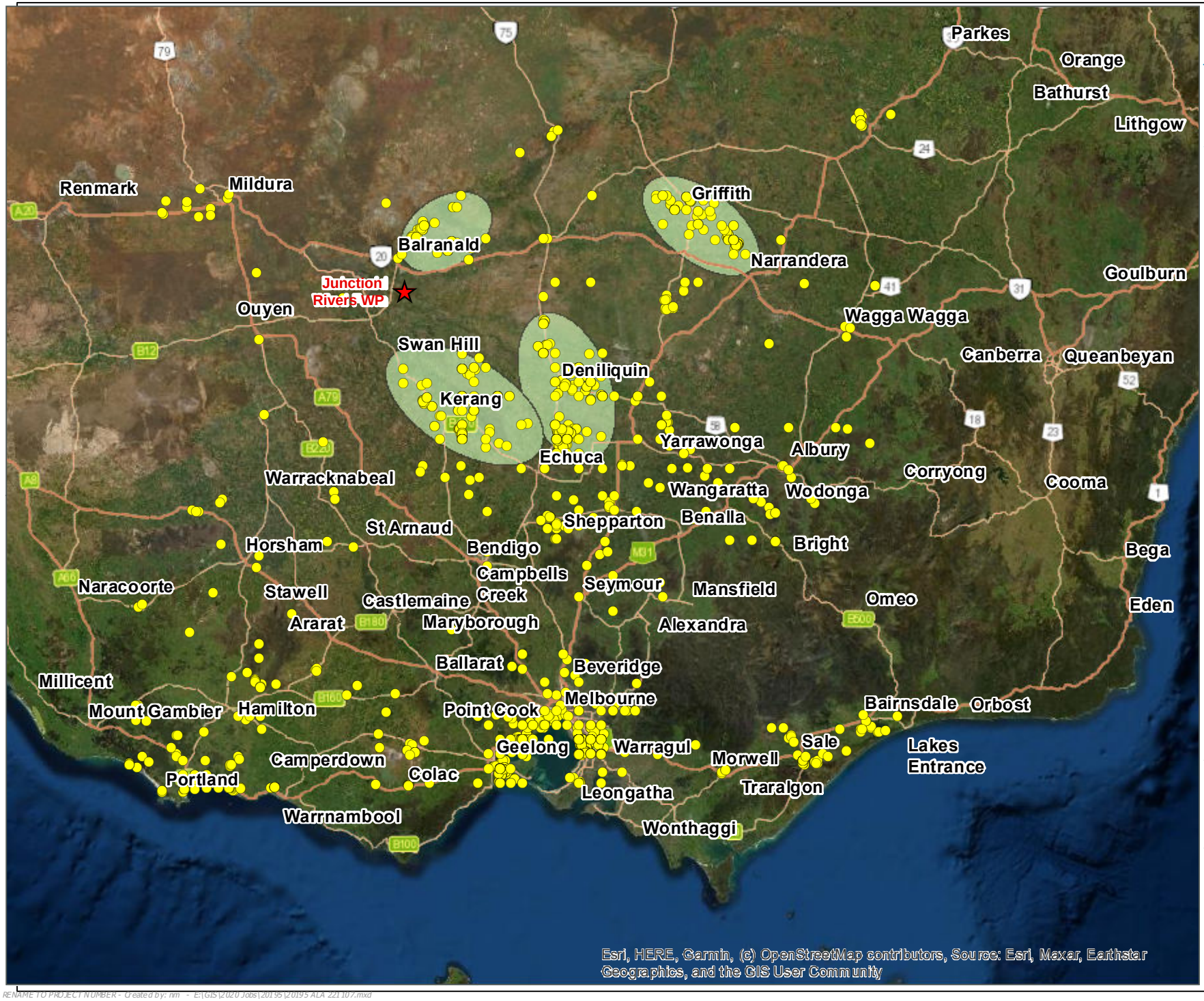


Figure 1: Australian Bittern Records (Scale 1:4,000,000)

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

N

Metres
0 53,000

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

RENAME TO PROJECT NUMBER - Created by: nm - E:\GIS\2020 Jobs\20195\20195 ALA 221107.mxd

- 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.

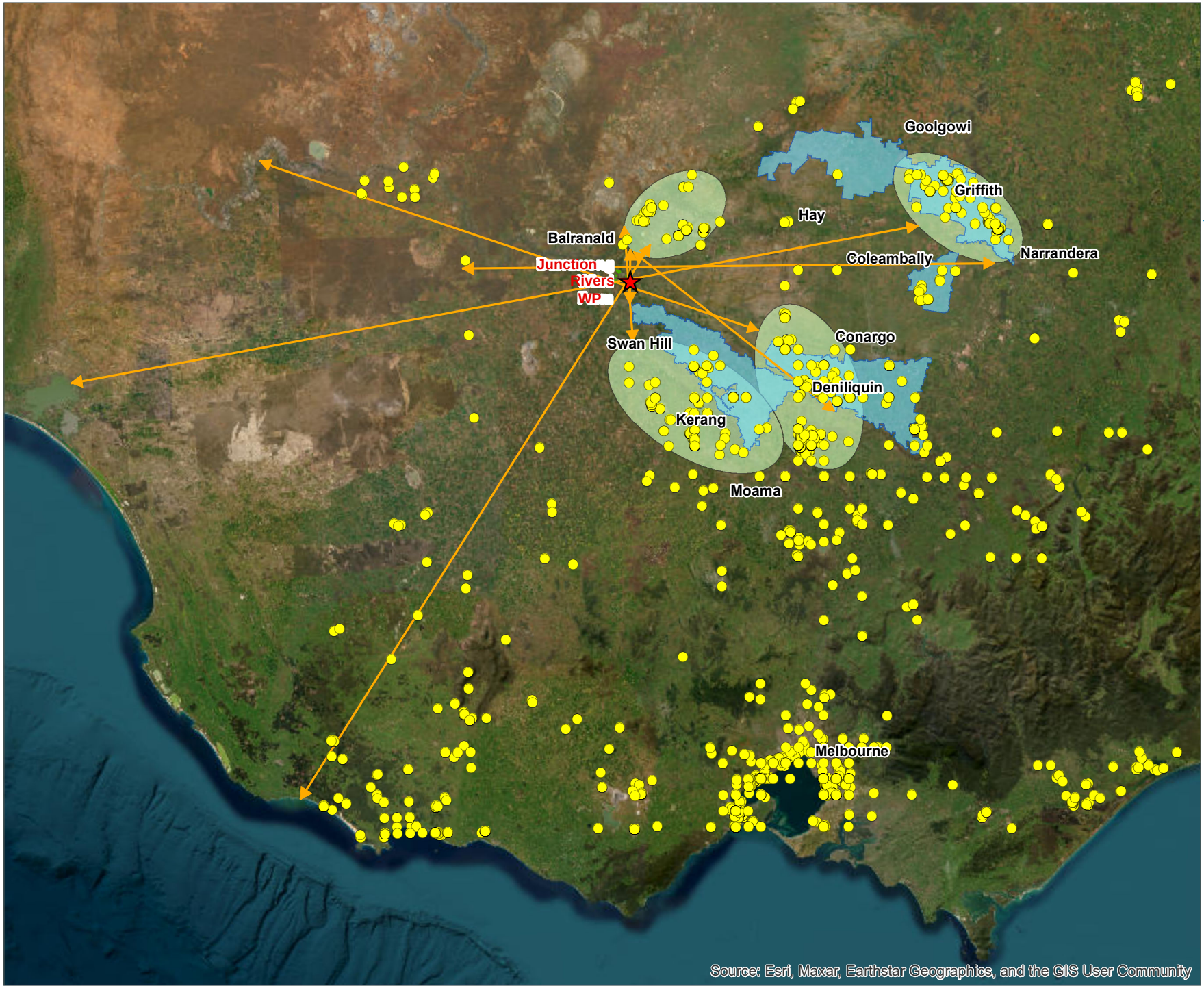


Figure 4: Major rice-growing areas in the NSW Riverina, and flight routes between record clusters and other sites

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

N

Metres
0 57,400

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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).

6. References

Atlas of Living Australia (ALA) website at http://www.ala.org.au. Accessed 23 February 2023.

Australian Research Council (ARC) Centre of Excellence for Climate Extremes 2022, *Briefing Note 20: Multi-year La Nina Events*. Australian Research Council, Australian Government.

BirdLife International 2019, *Botaurus stellaris. The IUCN Red List of Threatened Species* 2016: e.T22697346A86438000. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22697346A86438000.en. Downloaded on 13 September 2019.

Birds Australia 2010, *Australasian Bittern* Botaurus poiciloptilus *National Population Estimates for Spring – Summer 2009–10.* In possession of Birds Australia, Carlton.

Bitterns in Rice Project (2016). The Story So Far: 2012-2016. www.bitternsinrice.com.au/wp-content/uploads/2016/08/Bitterns-in-RiceProject-2012-2016-summary-booklet.pdf. Accessed 13 September 2019.

Bitterns in Rice Project 2019, Tracking Bunyip Birds, www.bitternsinrice.com.au/ tracking-bunyip-birds/ Accessed 23 February 2023.

Bright J 1935, Notes on a few birds of the Rochester District, *Emu* 34: 293-302.

Buller WL 1888, *A History of the Birds of New Zealand*, London.

Butcher R and Hale J 2011, *Ecological Character Description for Hattah-Kulkyne Lakes Ramsar site*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra (DSEWPaC).

Cleland JB, Maiden JH, Froggatt WW, Ferguson EW and Musson CT 1918, The food of Australian birds: An investigation into the character of the stomach and crop contents, *Department of Agriculture NSW Science Bulletin*, 15: 1-112.

Corrick AH and Norman FI 1980, Wetlands of Victoria I: Wetlands and waterbirds of the Snowy River and Gippsland Lakes catchment, *Proceedings of the Royal Society of Victoria* 91: 1-15.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2022, *National Recovery Plan for the Australasian Bittern (*Botaurus poiciloptilus*)*, Commonwealth of Australia.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023, *EPBC Act Protected Matters Search Tool*, Department of Climate Change, Energy, the Environment and Water, Canberra, viewed 28th Feb 2023 , https://www.environment.gov.au/epbc/pmst/index.html.

Department of the Environment and Energy (DoEE) 2016, *Wetlands and changes in water flow*, Fact Sheet, Commonwealth of Australia 2016.

Department of Environment, Water and Natural Resources (DEWNR) 2013, *Information Sheet on Ramsar Wetlands (RIS) – The Coorong, and Lakes Alexandrina and Albert Wetland*, Department of Environment, Water and Natural Resources, Adelaide.

Evans JP, Argueso D, Olson R and Di Luca A 2017, Bias-corrected regional climate projections of extreme rainfall in south-east Australia, *Theoretical and Applied Climatology* 130: 1085-1098.

Everaert J date unknown, Wind turbines and birds in Flanders: preliminary study results and recommendations, Natuur.Oriolus 69(4): 145-155.

Garnett ST, Szabo JK and Dutson G (eds) 2011, *The Action Plan for Australian Birds 2010*, CSIRO Publishing. Melbourne.

Garnett S and Baker GB (eds) 2020, *Action Plan for Australian Birds 2020*, CSIRO Publishing, Melbourne.

Herring MW 2022, *Saving the Endangered Australasian Bittern: A Guide to Wetland Management and Bittern-friendly Rice Farming*. Riverina Local Land Services, Griffith, New South Wales.

Herring MW, Veltheim I and Silcocks A 2016, Robbie's gone a roaming. Australian Birdlife 5 (3): 26-31.

Herring MW, Robinson W, Zander KK and Garnett ST 2019, Rice fields support the global stronghold for an endangered waterbird, *Agriculture, Ecosystems and Environment* 284: 106559.

Hobbs JN 1961, The birds of south-west New South Wales, *Emu* 61: 21-55.

Hobbs JN 1979, An irruptive extension of range of the golden-headed cisticola, *Australian Birds*, 14: 43.

Hodgkin J 1949, High-flying bittern, *NZ Bird Notes (Notornis)* 3(4): 109.

Islam MK, Hassan NMS, Rasul MG, Emami K and Chowdhury AA 2022, Assessment of solar and wind energy potential in far north Queensland, Australia, *Energy Reports* 8: 557-564.

Jaensch R 1982, South-west waterbird project, *Western Australian Bird Notes* 23: 3-8.

Jaensch R 2004, Australasian Bittern, *Wingspan* 14: 4.

Kingsford RT 2000, Ecological impacts of dams, water diversions and river managements on floodplains wetlands in Australia, *Austral Ecology* 25: 109–127.

Marchant S and Higgins PJ (eds) 1990, *Handbook of Australian, New Zealand and Antarctic Birds, Vol. 1. Ratites to Ducks. Part B. Australian Pelican to Ducks*. Oxford University Press, Melbourne.

Marsden Jacobs Associates 2020, *Rice in the Riverina*, Marsden Jacobson Report for the Independent Murray-Darling Basin Social and Economic Assessment Panel.

Moloney PD, Lumsden LF and Smales I 2019, *Investigation of existing post-construction mortality monitoring at Victorian wind farms to assess its utility in estimating mortality rates*, Arthur Rylah Institute for Environmental Research Technical Report Series No. 302, Department of Environment, Land, Water and Planning, Heidelberg, Victoria, Australia.

Nature Advisory 2023, *Bird and Bat Baseline Report.* Report for Windlab Pty Ltd. Authors Schipper C, O'Meara E, Allen P, Thomas G, Doughty C, O'Callaghan B. Nature Advisory Pty Ltd, Melbourne. Project No. 20195.

Newall PR, Lloyd LN, Gell PA and Walker KF 2009, *Ecological Character Description for the Riverland Ramsar Site*. Lloyd Environmental Pty Ltd Report (Project No: LE0739) to Department for Environment and Heritage, South Australia.

Onians G 1933, The Brown Bittern, *Emu* 32(4): 311-312.

Pickering R 2013, Australasian Bittern in Southwest Australia. Perth, WA: BirdLife Australia. Available at http://birdlife.org.au/projects/bittern-project.

Potter SD 1950, Bittern catching eel, *NZ Bird Notes (Notornis)* 3(9): 242.

Rubolini D, Gustin M, Bogliani G and Garavaglia R 2005, Birds and powerlines in Italy: an assessment, *Bird Conservation International* 15: 131-145. < doi:10.1017/S0959270905000109>.

Serventy DL and Whittell HM 1976, *Birds of Western Australia*, Lamb Publications, Perth.

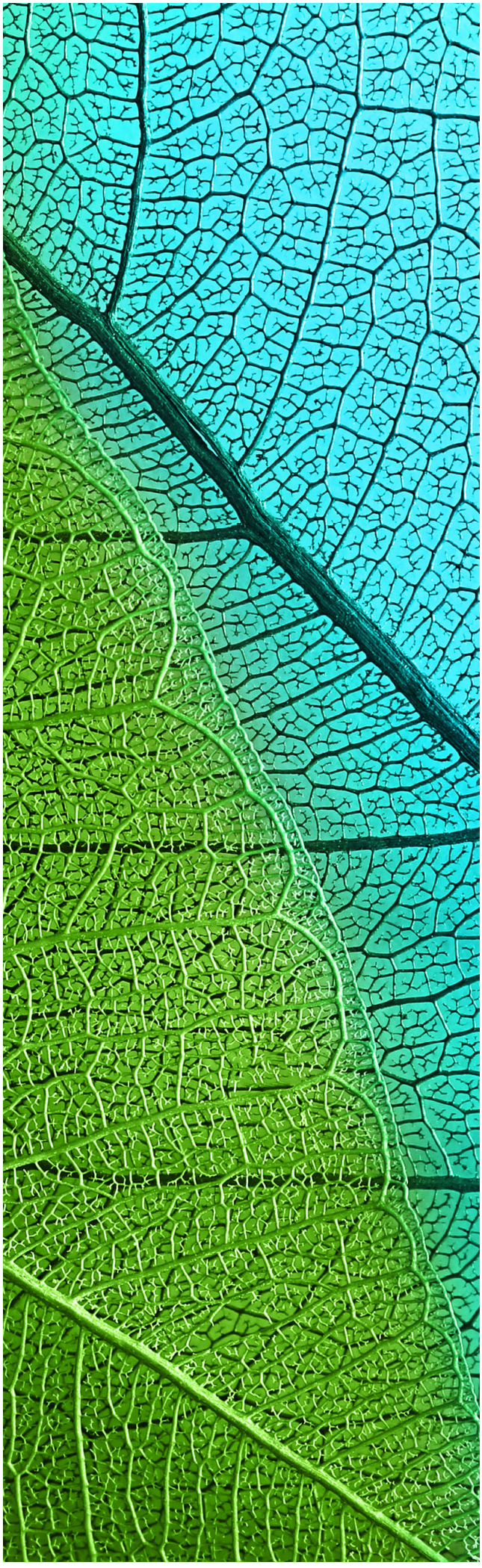
Symbolix 2020, *Post construction bird and bat monitoring at wind farms in Victoria*, Public Report for 13th Wind Wildlife Research Meeting.

Threatened Species Scientific Committee (TSSC) 2019, *Conservation Advice* Botaurus poiciloptilus *Australasian Bittern*, Department of the Environment and Energy, Canberra, ACT.

Wheeler WR 1950, Further observations from Fisherman's Bend, Melbourne, *Emu* 50(2): 73:83.

White G, Purps J and Alsbury S 2006. *The bittern in Europe: a guide to species and habitat management*, The RSPB, Sandy.

Whiteside AJ 1989, The behaviour of bitterns and their use of habitat, *Notornis* 36: 89-95.



Junction Rivers Wind Project

Regent Parrot Targeted Assessment Report

Prepared for Windlab Pty Ltd

February 2024
Report No. 20195.06 (1.2)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

1. Executive summary 1
2. Introduction 2
3. Regent Parrot biology 3
3.1. Description 3
3.2. Habitat 3
3.3. Distribution 3
3.4. Threats 3
3.5. Legislative protection 3
4. Methods 4
4.1. Existing information 4
4.2. Habitat assessment 4
4.3. Field methodology 4
4.4. Limitations of field assessment 4
5. Results 6
5.1. Existing information 6
5.2. Habitat assessment 10
5.3. Survey results 12
6. Assessment of impacts 13
6.1. Proposed development 13
6.2. Design recommendations 13
6.3. Impacts of proposed development 14
7. Regulatory implications 16
7.1. EPBC Act 16
7.2. BC Act 16
8. References 17

Figures

Figure 1: Regent Parrot (eastern subspecies) records from Bionet with 10 km of proposed windfarm boundary 5

Figure 2: Targeted assessment Regent Parrot survey locations and roaming survey transects 7

Figures 3 – A & B: Regent Parrot recorded by Nature Advisory during two years of bird utilisation surveys at the proposed Junction Rivers Wind Project 8

Figure 4: Movement and foraging corridor (Yanga Corridor) for Regent Parrot including flight observations recorded during targeted assessment 11

Figure 5: Percent occurrence of distance (m) Regent Parrots were observed away from suitable habitat. 12

Figure 6: Percent occurrence of observed flight heights of Regent Parrot....12

Figure 7: Proposed Turbine free buffer area along the Yanga Corridor to protect Regent Parrot foraging roosting habitat and flight movements by the species....15

Appendices

Appendix 1: NSW Bionet historical records of Regent Parrot....18

Appendix 2: Weather conditions during the targeted Regent Parrot survey. 20

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).

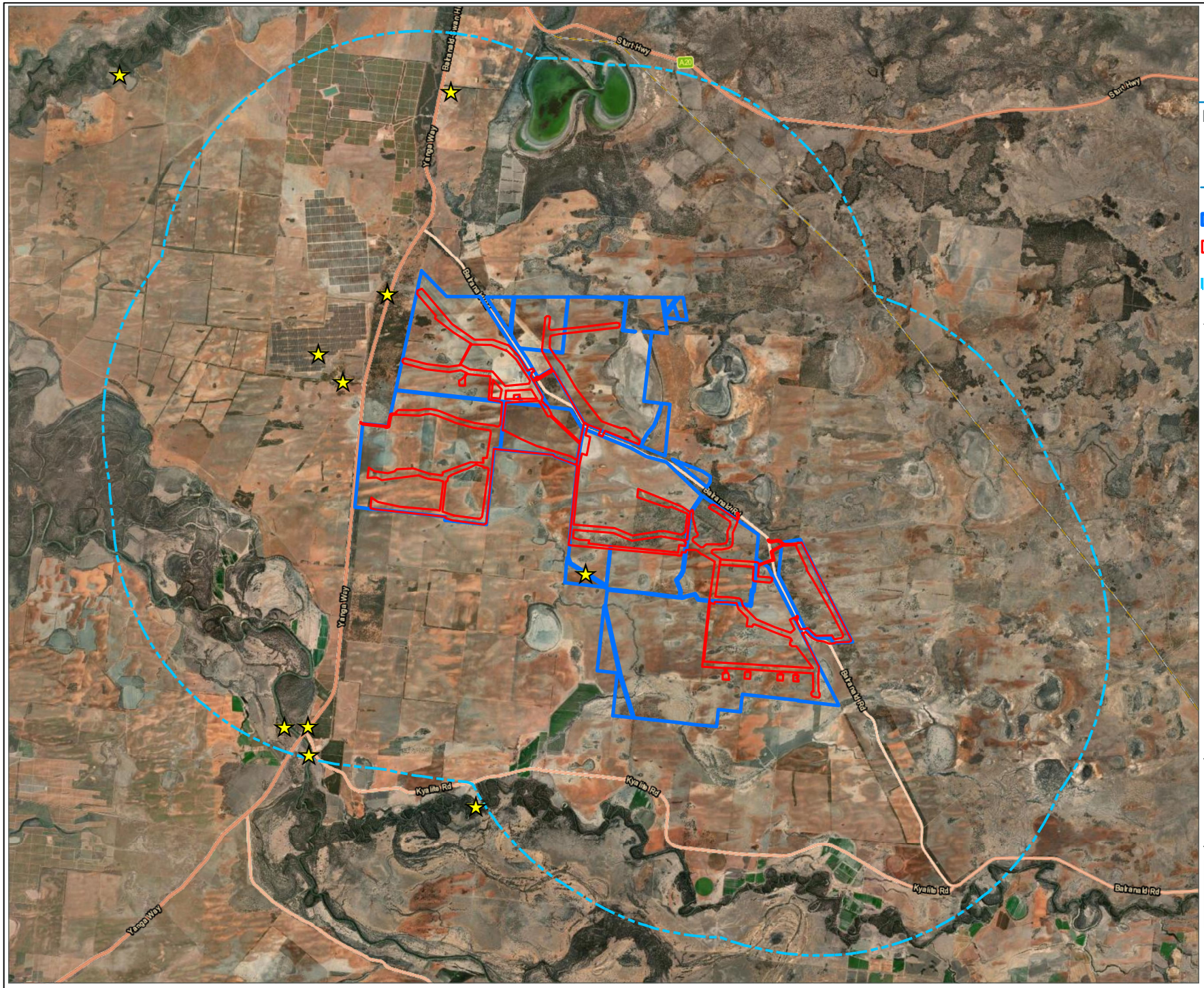


Figure 1: Regent Parrot (eastern subspecies) records from Bionet

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)

N

Metres
0 3,200

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

20195 - Created by: nm - E:\GIS\2020 Jobs\20195\20195 FIG1 RP Bionet 230602.mxd

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.

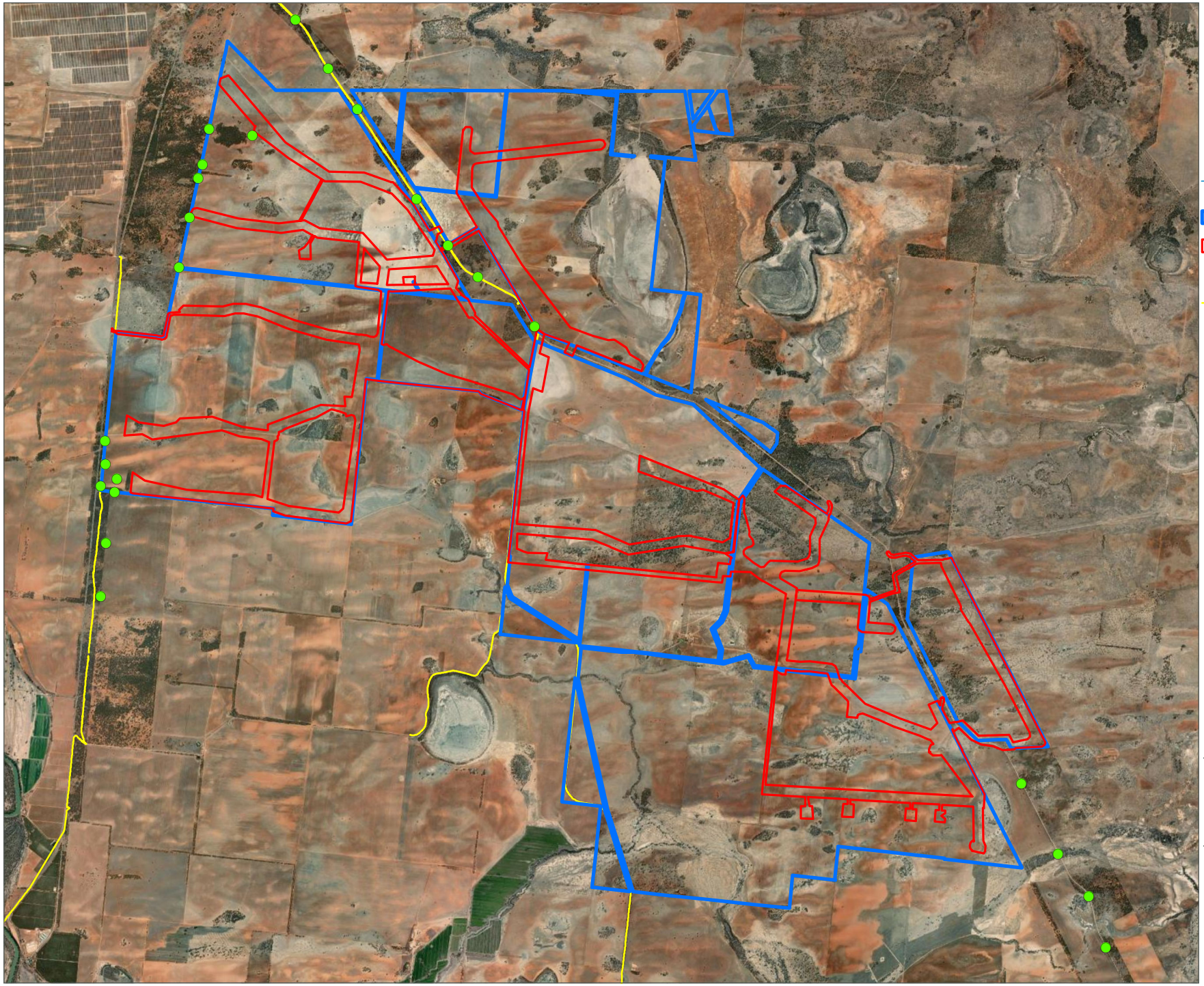


Figure 2: Regent Parrot survey locations and roaming surveys

Project: Junction Rivers Wind Project
Client: Windlab Pty Ltd
Date: 22/02/2024

- Wind Farm Boundary
- Development corridor
- Survey location
- Roaming survey tracks

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

20195 - Created by: nm - E:\GIS\2020 Jobs\20195\20195 FIG2 RP Survey Locations and Roaming Surveys 230602.mxd

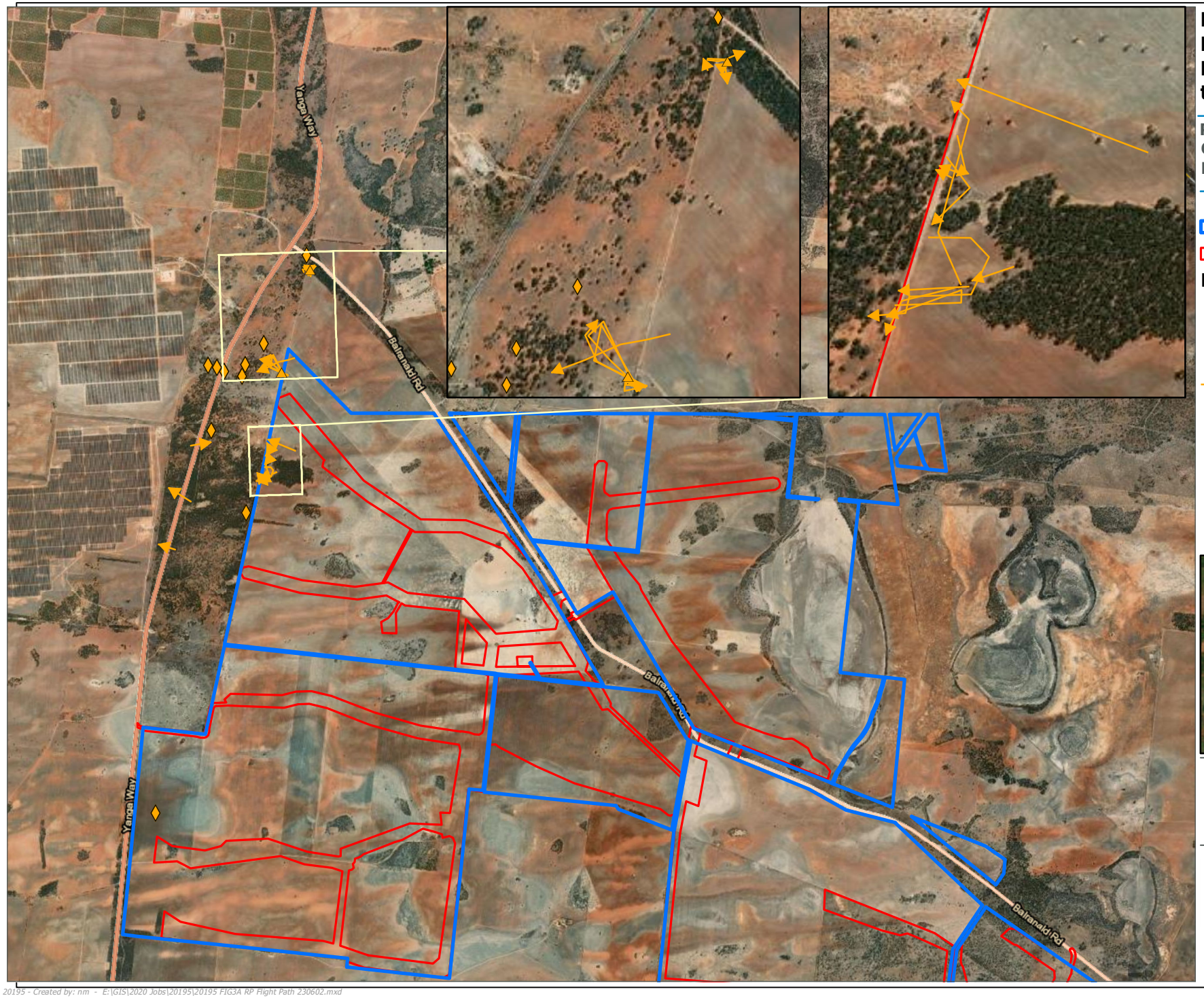


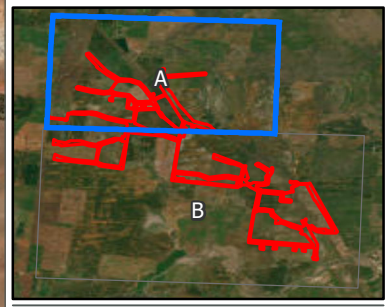
Figure 3-A: Regent Parrot recorded by Nature Advisory during two years of monitoring

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



N

Metres
0 1,200

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

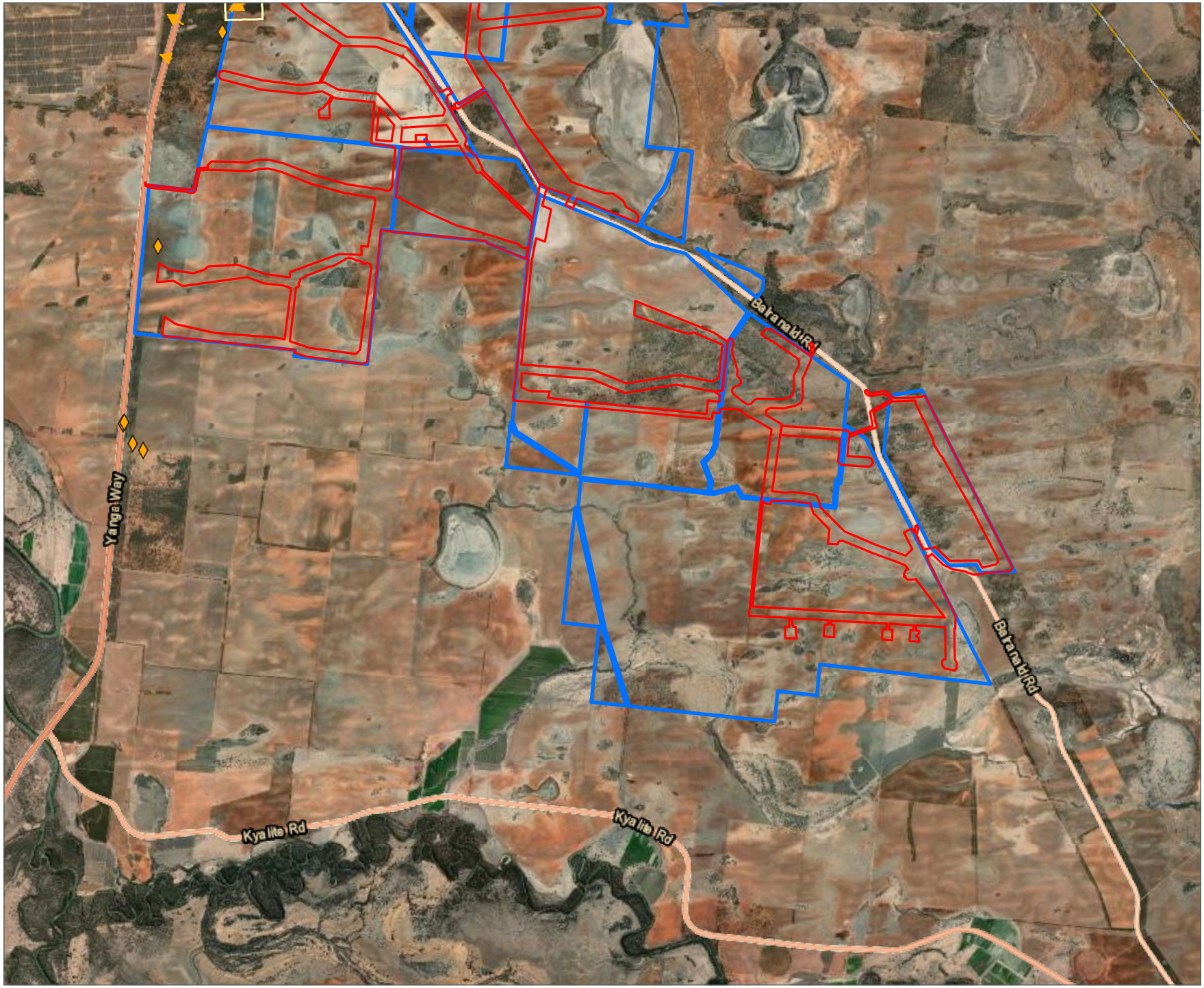


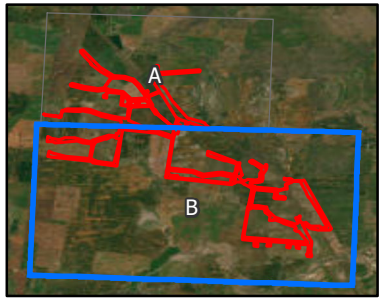
Figure 3-B: Regent Parrot recorded by Nature Advisory during two years of monitoring

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



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

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.

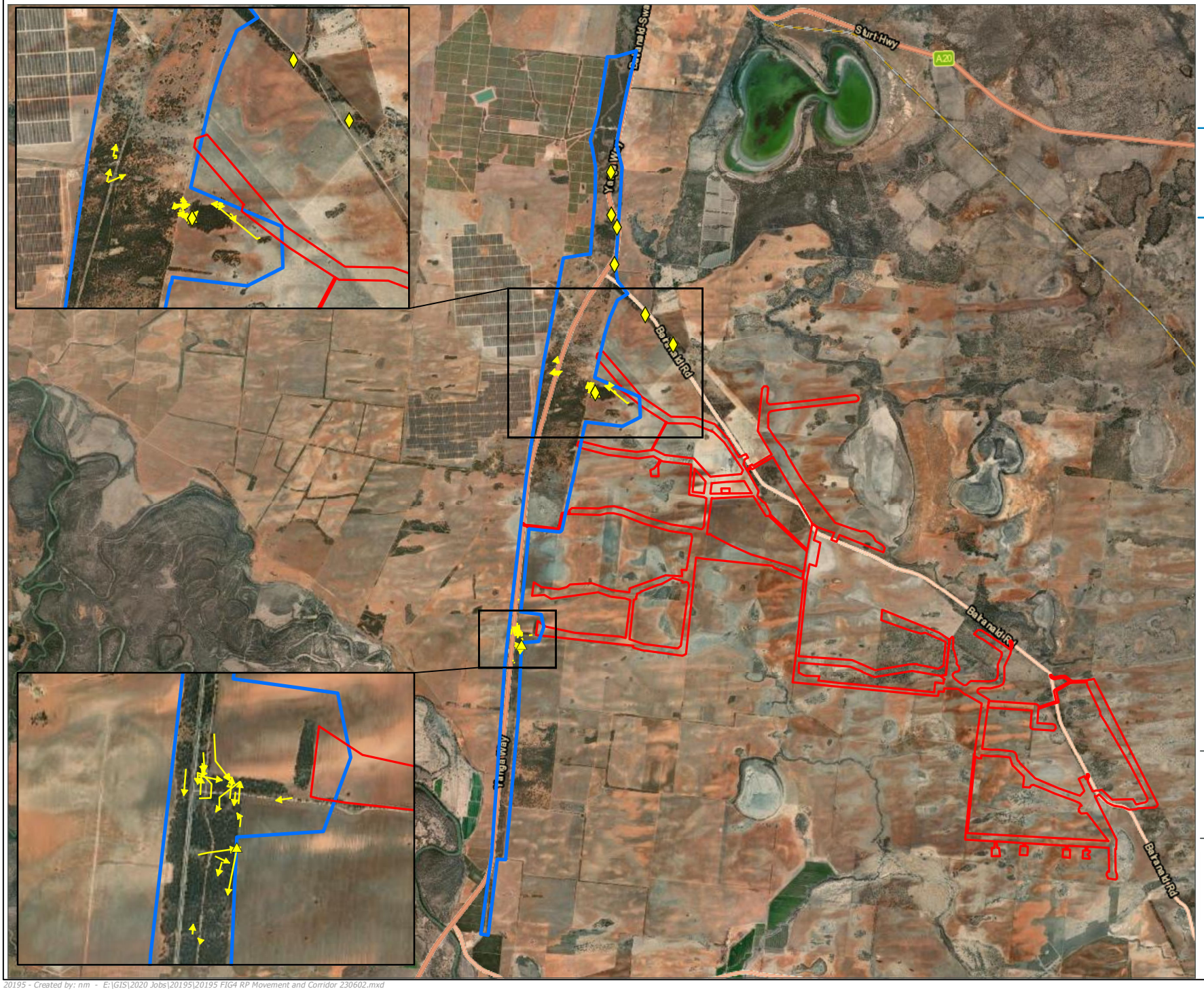


Figure 4: Movement and foraging corridor for Regent Parrot including flight observations at BWF

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

N

Metres
0 2,000

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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.

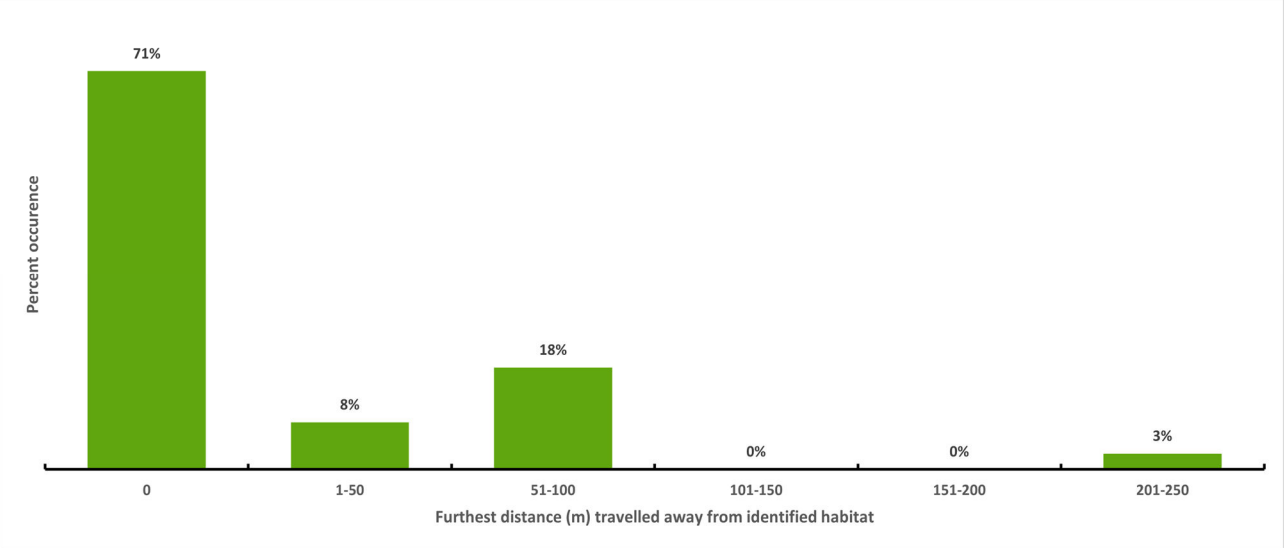


Figure 5: Percent occurrence of distance (m) Regent Parrots were observed away from suitable habitat.

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.

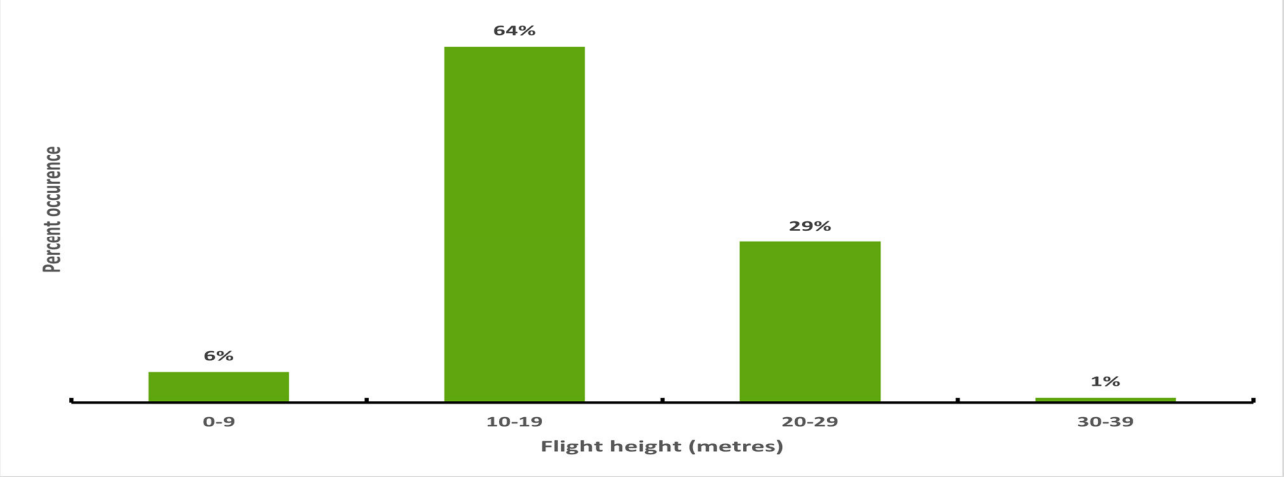


Figure 6: Percent occurrence of observed flight heights of Regent Parrot

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.

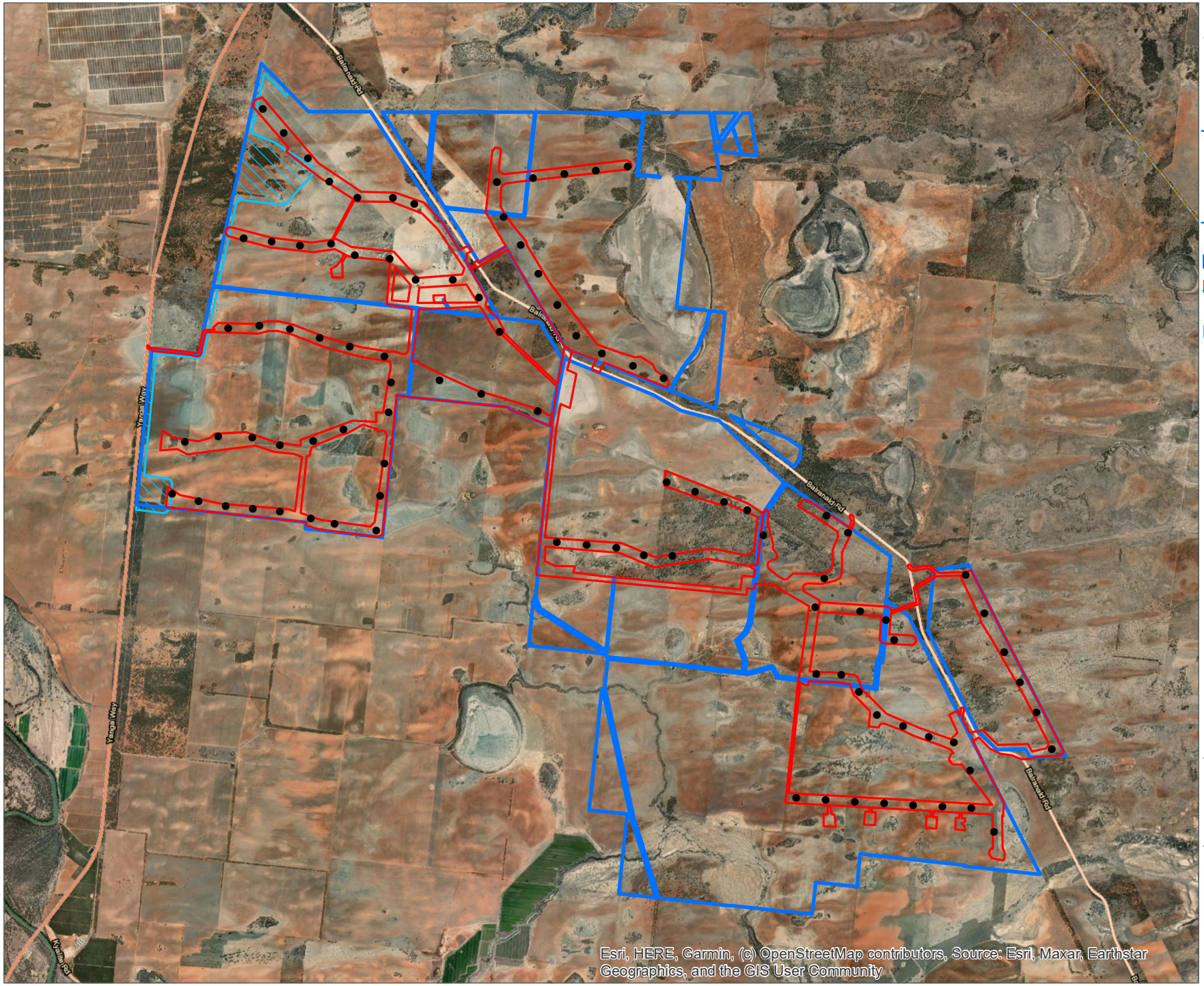


Figure 7: 100m buffer from identified Regent Parrot foraging and roosting habitat

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

Nature Advisory
PO Box 337, Camberwell, VIC 3124, Australia
www.natureadvisory.com.au
03 9815 2111 - info@natureadvisory.com.au

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.

8. References

Baker-Gabb, D. 1997. The Birds Australia Murray Mallee Reserve. A safe home for some of Australia's rarest birds. *Wingspan Supplement* Vol. 7 No. 2.

Baker-Gabb, D. and Hurley, V.G. 2011. *National Recovery Plan for the Regent Parrot (eastern subspecies) Polytelis anthopeplus monarchoides*. Department of Sustainability and Environment, Melbourne.

Burbidge, A.H. 1985. *The Regent Parrot. A report on the breeding distribution and habitat requirements along the Murray River in south-eastern Australia*. Australian National Parks and Wildlife Service, Report Series No. 4

DEE 2017, *NVIS Fact Sheet MVG 14 – Mallee woodlands and shrublands*. Department of Environment and Energy, Canberra.

DEWHA 2010, "Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act".

Higgins, Peter & Davies, Jeff & Dabbagh, Khalid. (1999). Handbook of Australian, New Zealand & Antarctic birds. Volume 4: Parrots to Dollarbird. Hurley, V.G. 2009. *Results of nest site monitoring of active Regent Parrot (Polytelis anthopeplus monarchoides) nests in the Outlet Creek system, Wyperfeld NP, during spring 2008*. Department of Sustainability and Environment, Mildura.

Joseph, L. 1978. Range and movements of the Regent Parrot in South Australia. *South Australian Ornithologist* 28: 26–27

Menkhorst, Peter & Rogers, Danny & Clarke, Rohan & Davies, Jeff & Marsack, Peter & Franklin, Kim. (2017). The Australian Bird Guide.

Nature Advisory 2023, 20195.05 (1.0) Junction Rivers Wind Project Bird and Bat Baseline Report.

DPIE 2022, *NSW BioNet: species area search*, Department of Planning Industries & Environment, accessed 6th December 2022, http://www.bionet.nsw.gov.au.

Robertson, P. and Hurley, V.G. 2010. *Nest site activity patterns of Regent Parrots (Polytelis anthopeplus monarchoides) at Outlet Creek, Wyperfeld National Park, Victoria*. Report to the Mallee Catchment Management Authority. Department of Sustainability and Environment, Mildura.

Sluiter, I.R.K. 2006. *Observations on spring Regent Parrot Movements at Wemen in relation to landscape change between 1998 and 2006*. Ogyris Ecological Report No. 2006/18 to the Mallee Catchment Management Authority. Ogyris Pty. Ltd., Merbein.

Webster, R. 1991. *The biology and management of the Regent Parrot (Polytelis anthopeplus) in NSW. Species Management Report Number 4*. NSW National Parks and Wildlife Service, Hurstville.

Webster, R. and Leslie, D. 1997. *Assessment of Regent Parrot Polytelis anthopeplus breeding habitat in south-western New South Wales*. Report to NSW National Parks and Wildlife Service and State Forests of New South Wales

Webster, R. 2005. *A survey of Regent Parrot Polytelis anthopeplus monarchoides breeding colonies in Victoria*. Report to Mallee Catchment Management Authority. Ecosurveys Pty Ltd., Deniliquin.

Webster, R. and Belcher, C. 2008. *Survey for the foraging habitat of the Regent Parrot Polytelis anthopeplus monarchoides in the non-breeding season in the Lower Murray Darling CMA Area*. Report to Department of Environment and Climate Change and the Lower Murray Darling Catchment Management Authority. Ecosurveys Pty Ltd, Deniliquin.

Appendix 1: NSW Bionet historical records of Regent Parrot

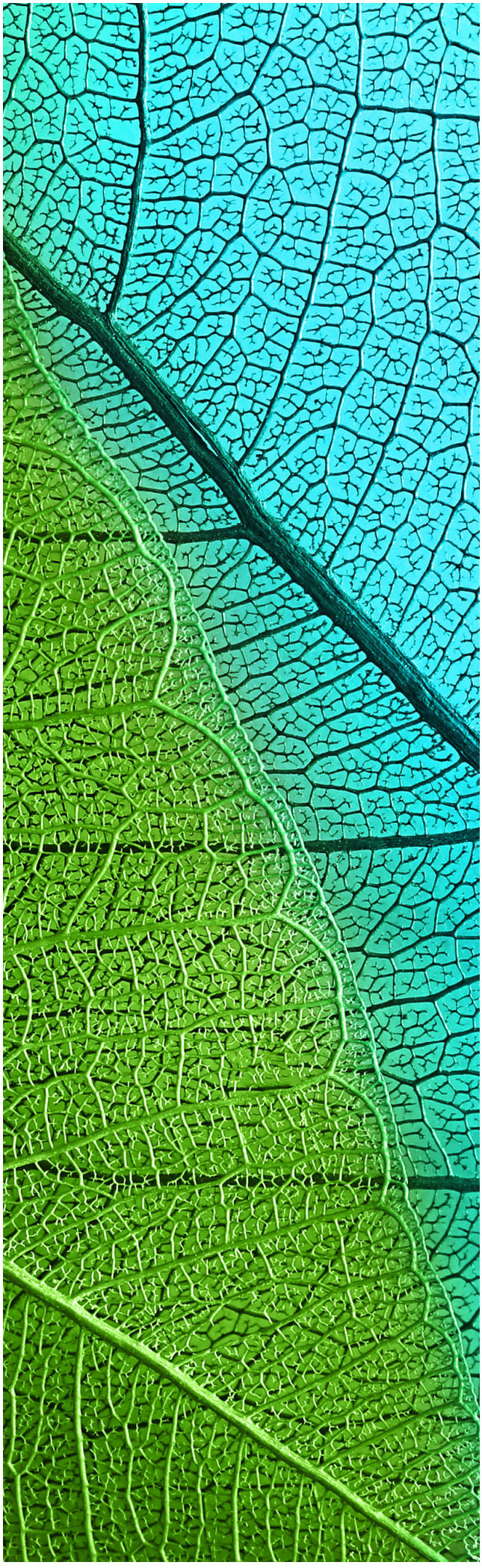
Dataset Name	Sighting Key	Species Code	Scientific Name	NSW Status	Comm Status	Sensitivity Class	Profile ID	Date First	Date Last	Number Individuals	Estimate Type Code	Observation Type	Status	Latitude GDA94	Longitude GDA94	Zone	Accuracy
DPIE Data from Scientific Licences dataset	SJJSI0324405	709	Polytelis 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)

Nature Advisory
(Formerly Brett Lane & Associates Pty Ltd)
5/61-63 Camberwell Road
Hawthorn East, VIC 3123
PO Box 337, Camberwell VIC 3124
(03) 9815 2111
www.natureadvisory.com.au

Contents

1. Executive summary 5
1.1. Cormorants 5
1.2. Waterfowl 5
1.3. Shorebirds 5
1.4. Terns 6
1.5. Large Waterbirds 6
2. Introduction 8
3. Methods 9
3.1. Existing Information 9
3.2. Screening for analysis 9
3.3. Analysis 10
4. Group 1: Cormorants 11
4.1. Overview of species biology and ecology 11
4.1.1. Description 11
4.1.2. Diet 11
4.1.3. Distribution and Population 11
4.1.4. Habitat 12
4.1.5. Breeding 12
4.1.6. Movements 12
4.1.7. Social Behaviour 13
4.1.8. Conservation Status 13
4.2. Local abundance analysis 13
4.2.1. Great Cormorant 13
4.2.2. Black-and-white Shag 14
4.2.3. Little Black Cormorant 14
4.2.4. Little Pied Cormorant 15
4.3. Flight height analysis/review 16
5. Group 2: Waterfowl (Ducks, Geese and Swans) 18
5.1. Species biology and ecology 18
5.1.1. Description 18
5.1.2. Diet 18
5.1.3. Distribution and Population 18

5.1.4. Habitat 19
5.1.5. Breeding 19
5.1.6. Movements 20
5.1.7. Social Behaviour 20
5.1.8. Conservation Status 21
5.2. Local Abundance Analysis 21
5.2.1. Grey Teal 21
5.2.2. Maned Duck 22
5.2.3. Pink-eared Duck 23
5.2.4. Australasian Shoveler 25
5.2.5. Freckled Duck 25
5.2.6. Magpie Goose 26
5.2.7. Blue-billed Duck 26
5.3. Flight height analysis/review 27
6. Group 3: Shorebirds (Migratory and Non-Migratory) 29
6.1. Species biology and ecology 29
6.1.1. Description 29
6.1.2. Diet 29
6.1.3. Distribution and Population 29
6.1.4. Habitat 30
6.1.5. Breeding 30
6.1.6. Movements 31
6.1.7. Social Behaviour 32
6.1.8. Conservation Status 32
6.2. Local Abundance Analysis 32
6.2.1. Sharp-tailed Sandpiper 32
6.2.2. Common Greenshank 33
6.2.3. Common Sandpiper 33
6.2.4. Pectoral Sandpiper 34
6.2.5. Marsh Sandpiper 34
6.2.6. Curlew Sandpiper 34
6.2.7. Eastern Curlew 35
6.2.8. Great Knot 35
6.2.9. Black-tailed Godwit 35

6.2.10. Latham's Snipe 36
6.2.11. Australian Painted-Snipe 36
6.2.12. Red-necked Avocet 37
6.2.13. Pied Stilt 37
6.3. Flight height analysis/review 39
7. Group 4: Terns 40
7.1. Overview of species biology and ecology 40
7.1.1. Description 40
7.1.2. Diet 40
7.1.3. Distribution and Population 40
7.1.4. Habitat 40
7.1.5. Breeding 41
7.1.6. Movements 41
7.1.7. Social Behaviour 42
7.1.8. Conservation Status 42
7.2. Local abundance analysis 42
7.2.1. Caspian Tern 42
7.2.2. Gull-billed Tern 42
7.2.3. Whiskered Tern 43
7.3. Flight height analysis/review 44
8. Group 5: Very large waterbirds 45
8.1. Overview of species biology and ecology 45
8.1.1. Description 45
8.1.2. Diet 45
8.1.3. Distribution and Population 46
8.1.4. Habitat 46
8.1.5. Breeding 47
8.1.6. Movements 47
8.1.7. Social Behaviour 48
8.1.8. Conservation Status 48
8.2. Local abundance analysis 48
8.2.1. Brolga 48
8.2.2. White-bellied Sea-eagle 49
8.2.3. Australian Pelican 50

8.2.4. Straw-necked Ibis ..... **Error! Bookmark not defined.**
8.3. Flight height analysis/review 52
9. References 55

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.

9. References

Alberta Environment and Sustainable Resource Development Agency (AB ESRD) 2011, *Wildlife Guidelines for Alberta wind energy projects*, Alberta Environment and Sustainable Resource Development Agency, Edmonton, Alberta, Canada.

Atlas of Living Australia (ALA) website at http://www.ala.org.au. Accessed 23 February 2023.

Australian Research Council (ARC) Centre of Excellence for Climate Extremes 2022, *Briefing Note 20: Multi-year La Nina Events*. Australian Research Council, Australian Government.

Beauchamp AJ, Hansen K and Pilon G 2009, Canopy and above canopy movements of birds on Whatupuke Island, New Zealand, *Notornis* 56: 213-16.

BirdLife Australia 2012, Pied Cormorant. <https://birdlife.org.au/bird-profiles/pied-cormorant/.> Accessed 16/03/2023.

BirdLife International 2023, IUCN Red List for Birds, <http://www.birdlife.org>. Accessed 15/02/2023.

Birds in Backyards 2023, Bird Finder: All species, <https://www.birdsinbackyards.net/finder/all-species>. Accessed 16/03/2023.

Birds of the World 2023, Great Cormorant, <https://birdsoftheworld.org/bow/species/grecor/cur/introduction>. Accessed 15/02/2023.

Commonwealth of Australia 2020, *Wildlife Conservation Plan for Seabirds*, Department of Agriculture, Water and the Environment, Canberra.

DCCEEW 2023a, *Limosa limosa* - Black-tailed Godwit, <http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?showprofile=Y&taxon_id=845>. Accessed 12/03/2023.

DCCEEW 2023b, *Hydroprogne caspia* – Caspian Tern, <http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=808>.

DCCEEW 2023c, *Haliaeetus leucogaster* – White-bellied Sea-Eagle, <https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=943> . Accessed 15/03/2023.

Department of the Environment and Energy (DoEE) 2017, *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed shorebird species*, EPBC Act Policy Statement 3.21, Department of the Environment and Energy, Commonwealth of Australia.

Everaert J date unknown, Wind turbines and birds in Flanders: preliminary study results and recommendations, Natuur.Oriolus 69(4): 145-55.

Finn J, Carlsson J, Kelly T and Davenport J 2012, Avoidance of headwinds or exploitation of ground effect – why do birds fly low?, *Journal of Field Ornithology* 83(2): 192-202.

Furness RW, Wade HM and Masden EA 2013, Assessing vulnerability of marine bird populations to offshore wind farms, *Journal of Environmental Management* 119: 56-66.

Herring MW 2022, *Saving the Endangered Australasian Bittern: A Guide to Wetland Management and Bittern-friendly Rice Farming*. Riverina Local Land Services, Griffith, New South Wales.

Islam MK, Hassan NMS, Rasul MG, Emami K and Chowdhury AA 2022, Assessment of solar and wind energy potential in far north Queensland, Australia, *Energy Reports* 8: 557-64.

Llewellyn LC 1983, Movements of cormorants in south eastern Australia and the influence of flood on breeding, *Australian Wildlife Research* 10(1): 149-67.

Lyons M, Brandis K, Callaghan C, McCann J, Mills C, Ryall S and Kingsford R 2018, Bird interactions with drones, from individuals to large colonies, *Australian Field Ornithology* 35: 51-56.

MacGillivray W 1923, The nesting of the Australian pelican (*Pelicanus conspicillatus*), *Emu* 22(3): 162-74.

Marchant S and Higgins PJ (eds) 1990, *Handbook of Australian, New Zealand and Antarctic Birds, Vol. 1. Ratites to Ducks.* Oxford University Press, Melbourne.

Matthews CW 1984, Aspects of the biology of the little shag (Phalacrocorax melanoleucous brevirostris Veillot 1817), MSc (Zoology) Thesis, Massey University.

Moloney PD, Lumsden LF and Smales I 2019, *Investigation of existing post-construction mortality monitoring at Victorian wind farms to assess its utility in estimating mortality rates*, Arthur Rylah Institute for Environmental Research Technical Report Series No. 302, Department of Environment, Land, Water and Planning, Heidelberg, Victoria, Australia.

Morcombe M 2021, *Morcombe & Stewart Guide to Birds of Australia* (Version 1.5) [Mobile App]. Apple App Store.

Nature Advisory 2023, *Junction Rivers Wind Project - Bird and Bat Baseline Report*. Report for Windlab Pty Ltd. Authors Schipper C., O'Meara E., Allen P., Thomas G., Doughty C., O'Callaghan B., Nature Advisory Pty Ltd, Project No. 20195.

Office of Environment and Heritage (OEH) 2018, Magpie Goose - profile, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10056>. Accessed 16/02/2023.

Office of Environment and Heritage (OEH) 2021a, Great Knot - profile, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10128>. Accessed 16/02/2023.

Office of Environment and Heritage (OEH) 2018, Black-tailed Godwit - profile, <https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10479>. Accessed 16/02/2023.

Pizzey G and Knight F 2013, *Birds of Australia – Digital Edition* (Version 1.3) [Mobile App]. Apple App Store.

Rueda-Uribe C, Lotberg U and Akesson S 2022, Foraging on the wing for fish while migrating over changing landscapes: travelling behaviours vary with available aquatic habitat for Caspian terns, *Movement Ecology* 10: 9. DOI: <https://doi.org/10.1186/s40462-022-00307-8>.

Smales I 2005, *Modelled cumulative impacts on the White-bellied Sea-eagle of wind farms across the species' Australian range*, Report for Department of Environment and Heritage. Author Smales I., Biosis Research Pty Ltd, Project No. 5238.

Smales I date unknown, *Expert Witness Statement of Ian John Smales*, prepared for Stockyard Hill Wind Farm Pty Ltd. Author Smales I. Biosis Research Pty Ltd, Project No. unknown.

Straw J 2013, Chapter 2.9: Waterbirds: identification, rehabilitation and management, in (book unknown). Found at NSW Government website "Sydney Olympic Park" – <http://www.sopa.gov.au> .

Swift JJ 1960, Notes on the behaviour of whiskered terns, *British Birds* 53: 557-72.

Symbolix 2020, *Post construction bird and bat monitoring at wind farms in Victoria*, Public Report for 13th Wind Wildlife Research Meeting.

Xu F and Si Y 2019, The frost wave hypothesis: How the environment drives autumn departure of migratory waterfowl, *Ecological Indicators* 101: 1018-25.

Appendix 10. Biosis microbat technical report

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

Junction Rivers Wind Project
Bat call analysis results

TECHNICAL REPORT

2 July 2025

Contents

1. Introduction 1
1.1. Project background 1
1.2. Reporting standard 1
2. Methods 2
2.1. Survey method and effort 2
2.2. Defining microbat habitat types 4
2.3. Reference library 4
2.4. Call identification 5
2.5. Limitations and assumptions 6
2.6. Qualifications 7
3. Results 8
3.1. Data collection and analysis 8
3.2. Microbat species identification 9
3.3. Threatened species summary 9
3.4. Species with increased risk of blade strike 14
3.5. Bat activity 14
4. Conclusion and recommendations 17
References 18
Appendices 20
Appendix A. Example time versus frequency graphs for species identification 21

Tables

Table 1 Total survey effort (ground-based detectors only) summary 3
Table 2 Survey effort for paired met mast detectors 3
Table 3 List of sampling sites and associated habitat unit and type. 4
Table 4 Call identification confidence ratings 5
Table 5 Bat call analysis results 9

Graphs

Graph 1 Bat activity at height versus ground level per sampling date 15
Graph 2 Maximum, minimum and average nightly temperatures recorded by bat detectors. 16
Graph 3 Total bat activity per site 16

Plates

Plate 1 Current accepted distribution range (green polygon) of the Inland Forest Bat in proximity to the subject land. 10
Plate 2 Location of Sheepwash wetlands where Southern Myotis was recorded in 2021-22 monitoring by the Murrumbidgee MER 12
Plate 3 Sheepwash wetland where Southern Myotis were recorded in monitoring by the Murrumbidgee MER. 12
Plate 4 White-striped Free-tailed Bat *Austronomus australis* 22
Plate 5 Gould's Wattled Bat *Chalinolobus gouldii* 23
Plate 6 Chocolate Wattled Bat *Chalinolobus morio* 24
Plate 7 Long-eared Bat (*Nyctophilus spp.*) 25
Plate 8 Inland Free-tailed Bat *Ozimops petersi* 26
Plate 9 South-eastern Free-tailed Bat *Ozimops planiceps* 27
Plate 10 Ride's Free-tailed Bat *Ozimops ridei* 28
Plate 11 Inland Broad-nosed Bat *Scotorepens balstoni* 29
Plate 12 Little Broad-nosed Bat *Scotorepens greyii* 30
Plate 13 Inland Forest Bat *Vespadelus baverstocki* 31
Plate 14 Large Forest Bat *Vespadelus darlingtoni* 32
Plate 15 Southern Forest Bat *Vespadelus regulus* (Riverina high frequency form) 33
Plate 16 Little Forest Bat *Vespadelus vulturnus* (Riverina form) 34

1. Introduction

1.1. Project background

Biosis Pty Ltd (Biosis) was engaged 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 (the Project) located around 15 kilometres south of Balranald, and 12 kilometres north of Kyalite, New South Wales (NSW).

The Project includes the construction, operation and decommissioning of a wind farm and associated infrastructure within the Balranald and Edwards River Local Government Areas.

A detailed description of the ecological values of each site can be found in the BDAR for the project prepared by Biosis (Biosis 2025).

The scope of this microbat assessment is to broadly identify the microbat fauna at the site, allowing for recommendations around avoidance, mitigation and (if required) further detailed microbat assessment to inform detailed design of the project. The primary objectives are:

- Describe the microbat fauna within the proposed wind farm project area (the subject land).
- Undertake bat utilisation surveys to compare bat activity in various habitats within the site.
- Identify potential constraints for the development in relation to threatened microbat species or in the case of the wind farm, at-risk bat species.
- Provide recommendations regarding future survey effort to inform impact assessment and a project specific Bird And Bat Adaptive Management Plan (BBAMP).

1.2. Reporting standard

The content of this report follows the standards for the interpretation and reporting of bat call data described by the Australasian Bat Society, available on-line at http://www.ausbats.org.au/.

2. Methods

2.1. Survey method and effort

Survey was undertaken with reference to the following guidelines:

- *'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method* (NSW Office of Environment and Heritage, 2021).
- *Survey guidelines for Australia's threatened bats* (Department of the Environment, Water, Heritage and the Arts, 2010).

2.1.1. Year 1 and 2 (Nature Advisory)

Nature Advisory completed two surveys in 2021 and three surveys in 2022 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 subject land and located near proposed turbines was analysed. Survey timeframes and data analysed for the assessment is summarised below:

- Summer 2021: 22 February 2021 – 27 February 2021
- Spring 2021: 2 November 2021 - 30 November 2021
- Autumn 2022: 27 April 2022 – 1 May 2022
- Winter 2022: 11 July – 15 July 2022
- Spring 2022: 3 October – 9 October

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. Survey locations in 2022 replicated existing locations surveyed within 2021 (refer to BDAR Figure 10 [Biosis 2025] for survey locations).

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. Files were recorded in Zero Crossing (ZC) format.

Data was not recorded from one of the devices within spring 2022. Data was not recorded from three of the devices within autumn 2022.

All units were at ground level, there was no data collected at height during 2021 or 2022.

2.1.2. Year 3 (Biosis)

Thirteen Anabat Swift ultrasonic bat detectors (full spectrum) were deployed at ground-level from 20-21/1/2025 – 2-3-2/2025. Calls were recorded from dusk until dawn using ultrasonic recorders fitted with omnidirectional microphones. Default settings for trigger, sensitivity, sampling rate and minimum / maximum

frequency were used. Each time a bat flies past the detector, its call is recorded as a digital file (defined here as a 'pass') that is saved directly onto a memory card in the detector unit. Units were set on trigger mode to record at night. Files were recorded in full spectrum format (.wav).

Table 1 Total survey effort (ground-based detectors only) summary

Season	Dates	No. nights	Detector nights	Detector model
Nature Advisory				
Summer 2021	22 Feb – 27 Feb 2021	6 consecutive nights	36	Songmeter (ZC)
Spring 2021	2 Nov – 30 Nov 2021	24-29 consecutive nights (location dependent)	130	Songmeter (ZC)
Autumn 2022	27 Apr – 02 Mar 2022	6 consecutive nights	11	Songmeter (ZC)
Winter 2022	11 Jul – 16 Jul 2022	6 consecutive nights	24	Songmeter (ZC)
Spring 2022	3 Oct – 6 Oct	3 consecutive nights	17	Songmeter (ZC)
Biosis				
Summer 2025	20/21 Jan – 03 Feb 2025	13/14 consecutive nights (location dependent)	186	Anabat Swift (FS)
Autumn 2025	TBC	-	-	
Winter 2025	TBC	-	-	

Units were located to allow space in front and around the microphone to minimise echoes from hard surfaces, call attenuation from surrounding vegetation, and ensure adequate flight space around the microphone.

Data was also collected at height (~70metres above ground level) by using an ultrasonic detector mounted securely to a pulley system installed on a met mast. A unit was also placed at ground level at the met mast, resulting in paired detectors sampling call data at ground level and at height simultaneously.

Table 2 Survey effort for paired met mast detectors

Deployment	Start date	End date	Number of nights
Spring 2024	15/10/2024	30/10/2024	15
Summer 2025	21/01/2025	2/02/2025	13
Autumn 2025	TBC		
Winter 2025	TBC		
TOTAL			**TBC**

2.2. Defining microbat habitat types

The site was stratified into habitat types likely to be relevant to bats using desktop analysis to allocate survey points across the site in representative habitats. Stratification was associated with vegetation structure and diversity, with modified land assumed to provide little structural or floristic (and insect) diversity and woodland habitats likely to contain the highest structural and floristic diversity and therefore be more highly utilised by bats. The habitat was broadly stratified into three habitat types:

- Open (cropped)
- Open (DNG)
- Semi-cluttered (open woodland)

Habitat of each sampling point is shown in Table 3 2021 (refer to BDAR Figure 10 [Biosis 2025] for survey locations).

Table 3 List of sampling sites and associated habitat unit and type.

Microbat survey point	Habitat type
MM_Ground	Open (cropped)
MM_Height	Open (cropped)
Bat_1	Open (DNG)
Bat_2	Semi cluttered (open woodland)
Bat_3	Open (cropped)
Bat_4	Open (cropped)
Bat_5	Open (DNG)
Bat_6	Open (DNG)
Bat_7	Semi cluttered (open woodland)
Bat_8	Open (cropped)
Bat_9	Semi cluttered (open woodland)
Bat_10	Open (DNG)
Bat_11	Semi cluttered (open woodland)
Bat_12	Semi cluttered (open woodland)

2.3. Reference library

No reference calls were collected during the survey. Call identification was assisted by the following resources:

- *Bat calls of NSW* (Pennay, Law, & Reinhold 2004) including sample call files downloaded from https://www.environment.nsw.gov.au/topics/animals-and-plants/surveys-monitoring-and-records/bat-calls-of-nsw.
- *Key to the bat calls of south-east Queensland and north-east New South Wales* (Reinhold et al. 2001).
- Unpublished course materials from the Advanced Bat Call Analysis Workshop (May 2023) – Titley Scientific and Balance! Environmental (Greg Ford and Julie Broken-Brow).

Species nomenclature used in this report follows the *Australian Faunal Directory* (Australian Biological Resources Study 2024) unless otherwise stated.

2.4. Call identification

Data was viewed using Anabat Insight (version 2.0.8, licensed), Titley Scientific.

Known species geographic distributions (Churchill 2008, Australasian Bat Society 2022) were used to generate a list of species with potential to occur at the site. Species identification was guided by the probability of occurrence at the site based on distribution, database records obtained from NSW BioNet and known habitat values at each detector point and across the site more broadly. Species at the edge of their distribution range were included as potential species at the site given that bats are likely under surveyed in the region and records may not reflect true distribution.

Files not containing bat calls (noise files) were filtered out using a standard "allbats" filter in Anabat Insight and not included in further analysis (trash files).

Custom decision trees were used to sort remaining files into likely species and species groups based on call parameters such as characteristic frequency, slope, duration and time between calls. Calls were then identified by visually comparing the spectrogram and call characteristics (e.g. characteristic frequency and call shape) with reference calls, descriptions from available reference materials (Reinhold et al. 2001, Pennay, Law, & Reinhold 2004), calls validated by other experts and other site data.

A call (pass) was defined as a sequence of five or more consecutive pulses of similar frequency and shape. Identification was not attempted for sequences with less than five defined consecutive pulses (unless for readily identifiable species such as the White-striped Freetail-bat *Austronomus australis*). Similarly, sequences containing multiple bats or pulses with irregular frequency and / or shape (non search-phase calls) were not identified to species. Calls with less than five pulses were excluded from further analysis and not included in metrics of bat activity.

The focus of call analysis was to generate a list of species present, particularly threatened species. Analysis of individual species activity was beyond the scope of the assessment, given the number of files recorded. Once a species was positively identified, it was marked as present. Species identification was therefore not attempted for all files recorded. Files that were manually reviewed were tagged so that the proportion of files reviewed could be tracked.

Where a threatened species was not recorded through the decision tree, additional checks were used to improve confidence that a false negative was not recorded including target frequency filters and manual review. If the volume of data was considered too great for manual review, threatened species were conservatively included as a species group at the site.

Due to variability in the quality of calls and difficulty in distinguishing some species a conservative approach was taken when analysing calls and assigning an identification. The identification of each call was assigned a confidence rating (Duffy et al. 2000) as summarized in Table 4 below.

Table 4 Call identification confidence ratings

Identification	Description
Almost certain	Diagnostic call characteristics present, consistent with descriptions in reference material and / or reference calls.
Probable	Highly likely the call represents a particular species, but call lacks enough detail (e.g. call quality) to be definite, or similarities with other species of similar call type or frequency limits identification certainty, and/or there is

Identification	Description
	a limited number of sequences to be confident in species presence.
Species Group	Call characteristics (e.g frequency, shape) are indicative of a number of species, or call lacks sufficient detail (e.g. call quality, diagnostic features) that would allow identification to species level.
Not Detected	Of the data analysed, no calls were attributable to this species.

2.5. Limitations and assumptions

Ultrasonic sampling is associated with a number of limitations. Detectability of bats relates to the intensity of their calls, their flight characteristics and the structure of the surrounding vegetation, all of which influence the distance over which a bat can be detected. Differences in the probability of detection may result in reduced likelihood of recording and therefore positively identifying some species as present within a site. It was assumed that detectability for each species was equal at each site allowing valid comparisons between different sites, however, calls for each species have unequal probability of detection and identification which prevents comparisons between species within sites.

A recorded call constitutes a measure of relative bat activity, but does not reflect species abundance. The number of calls provides a comparable index of activity to estimate the foraging selectivity of individual species between sampling sites. Due to the inability to review every call in such large datasets, it is assumed that each file found to contain a bat call, represents a single 'pass'. This is likely to underestimate bat activity in some instances, as files may contain two or more bat passes. However, there is no reliable way to consistently find files with multiple bats calling across a data set of this size.

Manual call analysis is also associated with limitations including the sometimes arbitrary selection of useable calls and subjectivity of the observer. Examples of identified calls have been provided (Appendix A) to improve the transparency of how calls were attributed to a species. All data was analysed by the same observer where possible.

Files with less than five pulses were excluded from activity estimates and species identification on the assumption they were either not bat calls, or were very poor quality bat calls however, due to the volume of data it was not possible to review all these files to determine which. Similarly, it was not possible to manually review all files to remove false triggers/noise consistently on all units. Repetitive ultrasonic noise (such as insect calls), may have been mistaken for bat calls and could result in an overestimate of activity at some units, at some times of the year. Although it was not possible to completely remove these files, where noise files were encountered during manual review, they were flagged and removed from further analysis. If noise was a particular issue at a unit, extra effort was made to remove these files. This was particularly relevant to low frequency sounds, which are commonly mistaken for low-frequency calling bats (aerial foraging species), so all attempts were made to ensure calls attributed to these species were true bat calls rather than false triggers.

It has been assumed that comparison between ground-based detectors and detectors at height remain valid. It should be noted however that detection distances may vary between these units due to variation in environmental conditions at height compared to ground level (such as increased wind shear resulting in higher call attenuation). The ground-based unit is also limited to sampling bats flying above it only, whereas

the unit at height can sample bats flying both above and below the detector resulting in different sampling volumes.

2.6. Qualifications

Call analysis was undertaken by Felicity Williams. Felicity is experienced in ultrasonic call analysis having used it to complete her Honours thesis titled "The influence of fire on the foraging activity of insectivorous bats in the Victorian Mallee" in 2009 under the supervision of Lindy Lumsden (Arthur Rylah Institute for Environmental Research, Victorian Government Department of Land, Environment, Water and Planning). Felicity has over eight years' experience using ultrasonic call detection and analysis for impact assessments on microbats in both Victoria and NSW.

Felicity has completed the following training courses with regard to ultrasonic call recording and analysis:

- Advanced Bat Call Analysis Workshop (May 2023) – Titley Scientific and Balance! Environmental (Greg Ford and Julie Broken-Brow).
- Anabat Insight Advanced Skills Workshop (March 2022) – Titley Scientific (Kristen Thompson).
- Micro-workshop: Deployment Techniques for Bat Detectors (March 2022) – Titley Scientific.
- Micro-workshop: Basics of Bat Calls (February 2022) – Titley Scientific.
- Bats of Gluepot Reserve (2011) – Survey techniques and identification (Terry Reardon, Dennis Matthews).
- Anabat system training course (December 2010) – Titley Scientific (Chris Corben).

Threatened species identification was confirmed by bat expert Greg Ford, Balance! Environmental.

3. Results

3.1. Data collection and analysis

3.1.1. Nature Advisory

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 *Scotorepens 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.

Activity data has not been quantified for the 2021-2022 surveys. Given these were completed using zero crossing data files and less sensitive microphones, the results will not be directly comparable with full spectrum data (collected in 2025 by Biosis).

3.1.2. Biosis data

A total of 14,073 files were recorded during the paired met mast detector deployment in spring 2024. Of these, 4075 (29%) were valid bat calls with the remainder discarded by the allbats filter or containing less than five pulses.

A total of 101,505 files were recorded across the summer 2025 paired met mast, and ground-based detector deployments. Of these, 74,979 files were valid bat calls, with the remainder discarded by the allbats filter as noise/false triggers and not used in further analysis. Files containing less than five pulses were also removed using a custom decision tree. These were not used for species identification or metrics of bat activity.

A total of 15 paired detector nights were analysed in spring 2024, with 173 detector nights in summer from ground-based detectors plus 13 paired detector nights from the met mast units in summer 2025. Comparisons of bat activity across the site were only made for nights where adequate replication was achieved across the survey (at least 90% of units working on a given night). This resulted in omission of data from two nights (20/1/2025 and 2/2/2025) from activity comparisons at ground level. A total of 154 detector nights were included for activity comparisons for ground level data.

For the paired detectors at the met mast, both units stopped correct functioning on 30 October 2024, resulting in a total of 15 nights of paired recording in spring 2024. In summer 2025, both units worked successfully for the full deployment period resulting in 13 nights of paired recording. This resulted in a combined total of 28 nights of paired recording at ground level and height.

3.2. Microbat species identification

Twelve species were positively identified (Almost certain or Possible) of the 18 species that are known or predicted to occur within 10 kilometres of the subject land (Australasian Bat Society 2022). Up to four additional species may also have been recorded however reliable identification to species level was not possible due to poor data quality and/or similarity of call characteristics between species.

Table 5 provides a list of all species known or predicted to occur in the subject land, their conservation status, and identification following call analysis.

Table 5 Bat call analysis results

Species name	Common name	BC Act status	EPBC Act status	Identification	Recorded at height
Austronomus australis	White-striped Free-tailed Bat	-	-	Almost certain	Yes
Chalinolobus gouldii	Gould's Wattled Bat	-	-	Almost certain	Yes
Chalinolobus morio	Chocolate Wattled Bat	-	-	Almost certain	Possible
Ozimops petersi	Inland Free-tailed Bat	-	-	Almost certain	Yes
Ozimops planiceps	South-eastern Free-tailed Bat	-	-	Almost certain	Yes
Ozimops ridei	Ride's Free-tailed Bat	-	-	Almost certain	Yes
Scotorepens balstoni	Inland Broad-nosed Bat	-	-	Almost certain	Yes
Scotorepens greyii	Little Broad-nosed Bat	-	-	Almost certain	No
Vespadelus baverstocki	Inland Forest Bat	V	-	Almost certain	Possible
Vespadelus darlingtoni	Large Forest Bat	-	-	Almost certain	No
Vespadelus vulturnus	Little Forest Bat	-	-	Almost certain	Possible
Vespadelus regulus	Southern Forest Bat	-	-	Probable	Possible
Myotis macropus	Southern Myotis	V	-	Species Group	No
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Species Group	No
Nyctophilus geoffroyi	Lesser Long-eared Bat	-	-	Species Group	No
Nyctophilus gouldi	Gould's Long-eared Bat	-	-	Species Group	No
Chalinolobus picatus	Little Pied Bat	V	-	Not recorded	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Not recorded	No

3.3. Threatened species summary

Reliable identification to species level of two threatened species with potential to occur at the site was not possible due to similarity of call characteristics between species. These species include:

- Southern Myotis *Myotis Macropus.*
- Corben's Long-eared Bat *Nyctophilus corbeni*.

Inland Forest Bat

Inland Forest Bat has been confidential recorded with the subject land ('almost certain' by Biosis) and inhabits grassland, chenopod shrublands, stony deserts, mallee, creeks and open and closed woodlands, plains and hilly terrain. It is thought that River Red Gum lined watercourses and other eucalypts are likely to be critical in providing adequate shelter and foraging resources in arid areas for this species, which relies on tree hollow roosts. Stock dams, tanks and waterholes are likely to be important for both foraging and drinking. The southern extent of the species distribution runs north-west of the site (Plate 1).

Calls from the site were positively identified as Inland Forest Bat by bat call expert Greg Ford (Balance! Environmental). As the Inland Forest Bat is known to inhabit grasslands and chenopod shrublands, it is possible that the species may be roosting within woodland habitats and foraging within the subject land. Although outside the current range, Inland Forest Bat has been considered present and included as an ecosystem credit species. As the calls of this species can overlap with the more common Little Forest Bat, to verify the species is present trapping data would need to be collected.

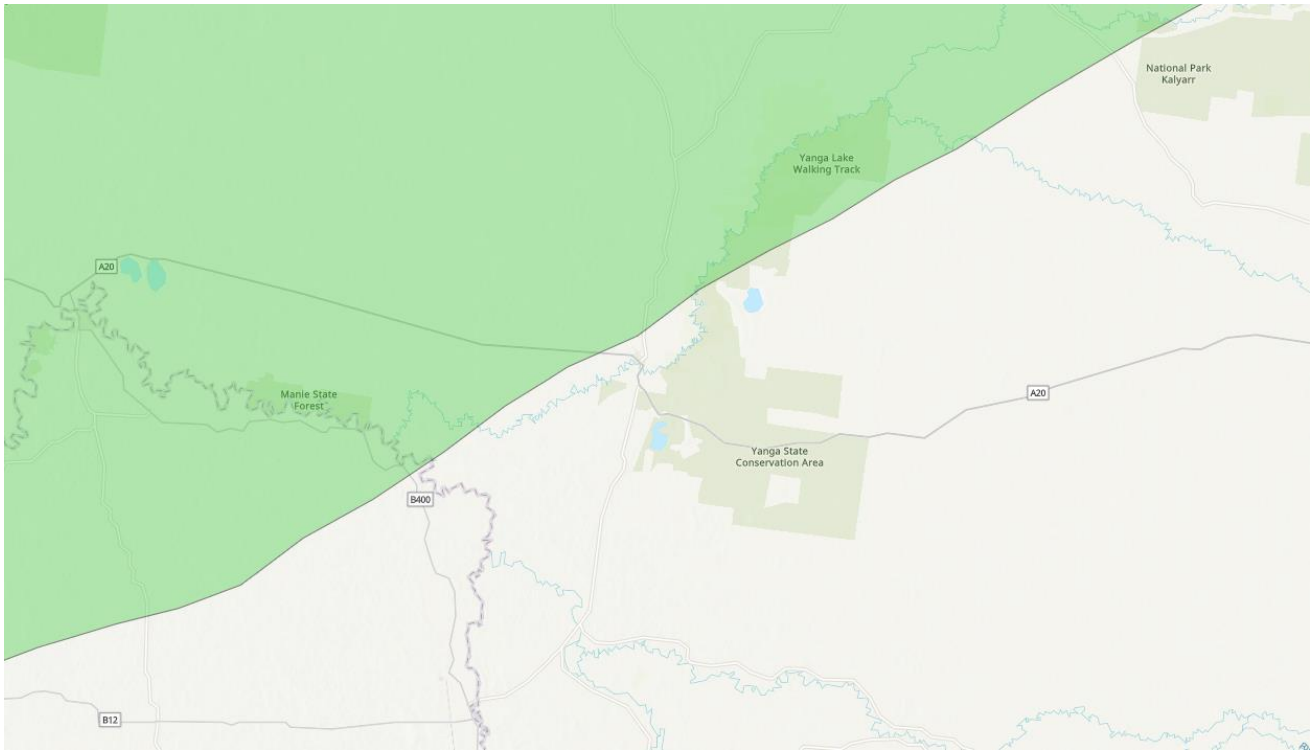


Plate 1 **Current accepted distribution range (green polygon) of the Inland Forest Bat in proximity to the subject land.**

Southern Myotis

Southern Myotis is included in the *Nyctophilus/Myotis* species group of calls following analysis by Biosis however, this does not mean the species has been recorded as present at the site. Identification of Southern Myotis to species level is difficult, and only possible in sequences containing particular features that allow it to be differentiated from other species that produce similar, near vertical, high-bandwidth linear call types where these species overlap in distribution (such as Gould's Long-eared Bat *Nyctophilus gouldii,* Lesser Long-

eared Bat *Nyctophilus geoffroyi* and Corben's Long-eared Bat *Nyctophilus corbeni*). Good quality sequences of Southern Myotis can be differentiated from *Nyctophilus spp* where a feeding buzz is present (a rapid increase in pulse repetition rate, slope, frequency and speed) (Gonsalves & Law 2017). Reinhold et al. (2001) also report that Southern Myotis calls generally have a pulse interval of less than 75 milliseconds, an initial slope of greater than 400 Octaves Per Second but that between these values the species cannot be distinguished. No calls containing the listed diagnostic features were found in the data analysed for the project that would allow the species to be confirmed as present however, intermediate type calls were observed, that meant the species also couldn't be ruled out from call analysis alone.

It is difficult to identify linear type bat calls to species level from ultrasonic analysis, and it is particularly difficult to positively identify Southern Myotis based on calls without the presence of diagnostic features. As a result, during the analysis process all linear type calls were assigned to a species complex, that for the project includes Southern Myotis, Gould's Long-eared Bat, Lesser Long-eared Bat and Corben's Long-eared Bat. Assigning a call to the *Myotis/Nyctophilus* species complex is not confirmation that Southern Myotis is present, rather a reflection of the fact that the call could theoretically belong to either of these species, and it cannot be confirmed which one from the call alone.

This approach is common in bat call analysis, and an accepted limitation of the methodology. It is also more conservative than ruling the species as not present, where no calls with distinguishing features are observed despite many sequences being present in the range of values that are indistinguishable. Continuing to include Southern Myotis as possibly present (by assigning it to a species complex) during the call analysis means that additional consideration of the site context and available habitat for the species must be given to inform an assessment of likely presence and impact. The results from the ultrasonic analysis therefore, must be viewed in the context of the broader landscape and habitat values within the site.

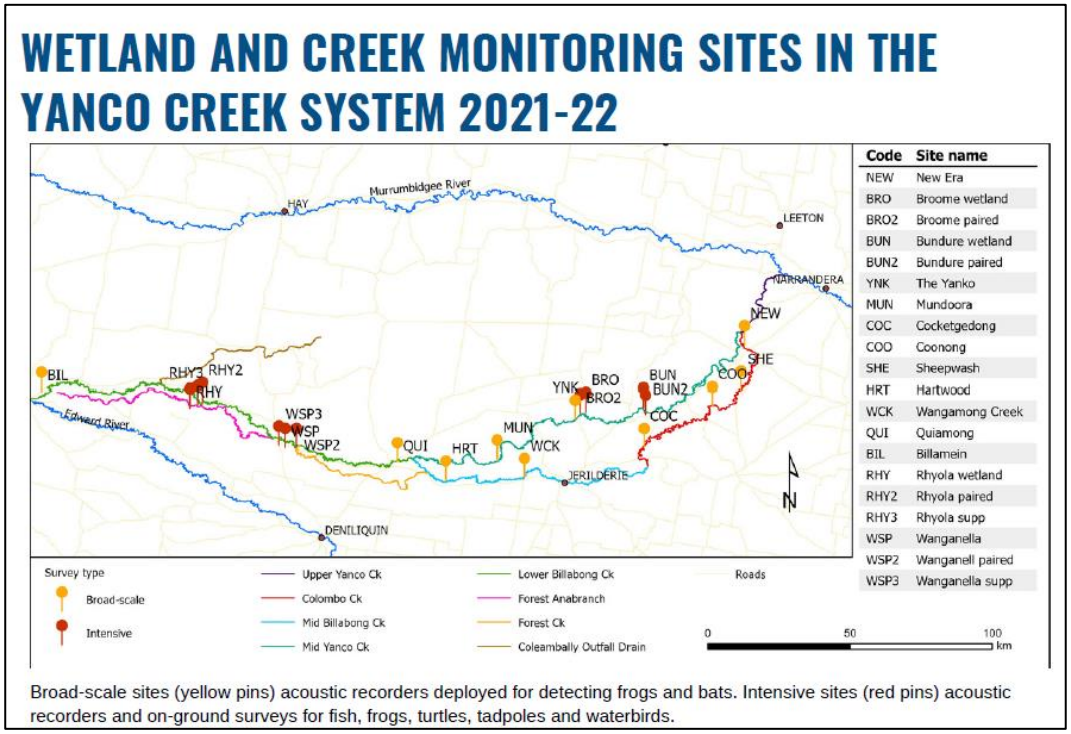
Southern Myotis, also known as the 'fishing bat', forages in and around dams, streams and waterways with large pools or stretches. The TBDC lists the habitat constraints for the species as "waterbodies with permanent pools/stretches 3m or wider…", due to the reliance of this species on permanent water for foraging where it scoops prey from the water with its feet (Campbell 2009). The species also roosts in close proximity to its foraging habitat (within 200 metres) utilising both tree hollows or human structures including bridges, culverts, caves and tunnels etc. (Campbell 2009, Gorecki 2020).

The species is primarily coastal, occurring in a narrow coastal band from the Kimberly to North Queensland and along the east coast of Queensland, NSW and Victoria to South Australia. Although its distribution does extend inland, this is predominantly along major inland rivers (such as the Murray River and the Murrumbidgee River), reflecting its close association with water (Gonsalves & Law 2017). Bionet records for Southern Myotis strongly reflect the known habitat preferences for the species, being concentrated on the coast and extending inland via major inland river corridors.

Despite inland rivers representing apparently suitable habitat, the species is still seemingly rare. Law and Anderson (1999) surveyed 18 sites in the State Forests of the Millewa and Koondrook/Perricoota area (about 40 to 50 kilometres south-west of Deniliquin, NSW), targeting Southern Myotis and found it present at only two locations within 7 kilometres of each other, near the Barmah Bridge. This was consistent with previous surveys in the region that recorded the species in a similar location. The authors concluded that the species is "extremely rare" in the study region despite the presence of apparently suitable foraging habitat and abundant roost hollows in River Red Gums. Surveys further downstream on the Victorian side of the border by Lumsden and Bennet (1995) also failed to detect the species.

The most recent data from the vicinity of the project is from the Monitoring, Evaluation and Research program (MER) that has been in place in the Murrumbidgee Catchment area since 2014 overseen by the Commonwealth Environmental Water Office. 2021-22 surveys within the Yanco Creek System monitored ten

wetlands and recorded Southern Myotis from only one site, known as Sheepwash wetlands Plate 2, located approximately 50 kilometres south-west of Narrandera (Turner et al. 2022). This more recent study similarly demonstrates the rarity of the species in the region, such that even targeted surveys, in permanent, vegetated waterbodies may fail to detect the species. The habitat where the species recorded is also considerably different to what is found on site (Plate 3).



Broad-scale sites (yellow pins) acoustic recorders deployed for detecting frogs and bats. Intensive sites (red pins) acoustic recorders and on-ground surveys for fish, frogs, turtles, tadpoles and waterbirds.

Plate 2 **Location of Sheepwash wetlands where Southern Myotis was recorded in 2021-22 monitoring by the Murrumbidgee MER**

Plate 3 **Sheepwash wetland where Southern Myotis were recorded in monitoring by the Murrumbidgee MER.**

A study by Law, Chidel and Towerton (2001)) found that *Myotis macropus* 'can persist in some agricultural settings if suitable roosts are present' and that 'rural creeks with intact riparian vegetation have a good chance of supporting' the species. However, their study was in a vastly different part of the species range, in Northern NSW near Urbenville. Southern Myotis were found roosting beneath an old log bridge on Boomi Creek, well within the coastal distribution of the species and a very typical roost structure. Law, Chidel and Towerton (2001) go on to emphasise that the species is 'clearly uncommon in certain areas, such as along the Murray River' and that 'intensive agricultural practices, such as cropping with irrigation, could be more detrimental to *M.macropus* because of increased fertiliser, herbicide and insecticide run-off'.

As described in Section 2.1.3 of the BDAR, permanent rivers in proximity to the site include the Wakool River and the Edward River (approximately 10 kilometres south) and the Murrumbidgee River 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. The seasonal watercourse The Forest Creek flows from Nyangay Creek, into the subject land, and into the Edward River.

Although calls of the Myotis/Nyctophilus species complex were recorded across the subject land, the broader distribution and habitat constraints of the species were assessed to determine the likelihood of calls in the species complex being those of Southern Myotis. This approach is consistent with Section 5.2 of the BAM where the assessor is able to eliminate a species if "none of the habitat constraints for the species are present in a vegetation zone". Based on the absence of suitable permanent water, connected vegetation and suitable roost sites, it was concluded that Southern Myotis is unlikely to be present in the subject land.

As the species was not recorded present at the subject land, it was not assessed in accordance with steps 2-6 in BAM Subsections 5.2.2 to 5.2.6. As none of the habitat constraints for the species are present, the species was considered unlikely to occur in accordance with Section 5.2.2 (2) of the BAM.

Corben's Long-eared Bat

Corben's Long-eared Bat has also been recorded as part of a 'species group' by Biosis within the subject land, and is a clutter adapted species that forages in and around vegetation, usually at canopy height (4-5 metres) or below (Churchill 2008). Thought capable of foraging sometimes in open space, they are considered forest-dependent and sensitive to vegetation loss and fragmentation (Law et al. 2018, Lumsden, Lindeman, & Nelson 2007). The species is largely associated with old growth woodland, where it relies on hollows for roosting. It is likely they choose areas in the landscape that have an abundance of hollows to enable them to have multiple roosting options (Lumsden, Lindeman, & Nelson 2007). Lumsden et al (2007) also state that research in NSW has indicated that Corben's Long-eared Bat is found in considerably higher densities in large intact blocks of vegetation than in small remnants in fragmented landscapes.

The species is sparsely distributed in the landscape, primarily associated with communities dominated or co-dominated by mallee, Buloke, box, Brigalow and Belah. Dead or senescent Buloke is a common roost tree, as well as the hollows of dead mallee (Gonsalves et al. 2022). Larger, intact remnants are likely to be preferred by this species, in contrast to other long-eared bats such as the Lesser Long-eared Bat which are more tolerant to fragmentation (Lumsden, Lindeman, & Nelson 2007). Areas of high stem density, especially those containing dead trees, provide key roosting habitat for Corben's Long-eared Bat, and this is likely to be a significant factor in explaining the species rarity (Law et al. 2016). Corben's Long-eared Bat and Gould's Long-eared Bat have been found to avoid roosting in open, thinned areas in contrast to Lesser Long-eared Bat which although morphologically similar, commonly roosts where it is more open (Law et al. 2018).

Calls for the Corben's Long-eared Bat overlap entirely with more common species such as Gould's Long-eared Bat *Nyctophilus gouldi* and Lesser Long-eared Bat *Nyctophilus geoffroyi*. *Nyctophilus spp* calls were recorded

from all detectors across the site. However, based on the habitat preferences of Corben's Long-eared Bat, it is likely that this species would mostly occur in proximity to large patches of vegetation containing suitable roosting habitat, rather than in open areas.

A conservative approach has been taken to assume presence for this species, based on the presence of suitable habitat within the species' known range (different to the situation for Southern Myotis), as an ecosystem credit species and assess impacts in accordance with BAM and EPBC Act requirements.

3.4. Species with increased risk of blade strike

Turbine strike risk for microbats at wind energy facilities can be inferred from a species' flight characteristics and foraging preferences. Bats with long, narrow wings are generally suited to fast, direct flight and therefore forage in open spaces above the canopy capturing prey on the wing (such as freetail bats). In contrast, bats with broader, shorter wings that are suited to increased manoeuvrability are generally found to forage in and around vegetation where they glean insects from foliage (such as long-eared bats *Nyctophilus* spp.). In general, bats that fly in open spaces and above the tree canopy are more likely to occur in the vicinity of wind turbines (and turbine blades) and therefor at a greater risk of blade strike compared to those that forage in and around vegetation. Species recorded at the subject land considered likely to have an increased blade strike risk include:

- White-striped Free-tailed Bat
- Gould's Wattled Bat
- Inland Free-tailed Bat
- South-eastern Free-tailed Bat
- Ride's Free-tailed Bat

These species tend to fly in open areas and at height, and are considered most likely to be subject to collisions with turbines. All of these species are known to occur at height (>50m above ground level).

3.5. Bat activity

Bat activity at height

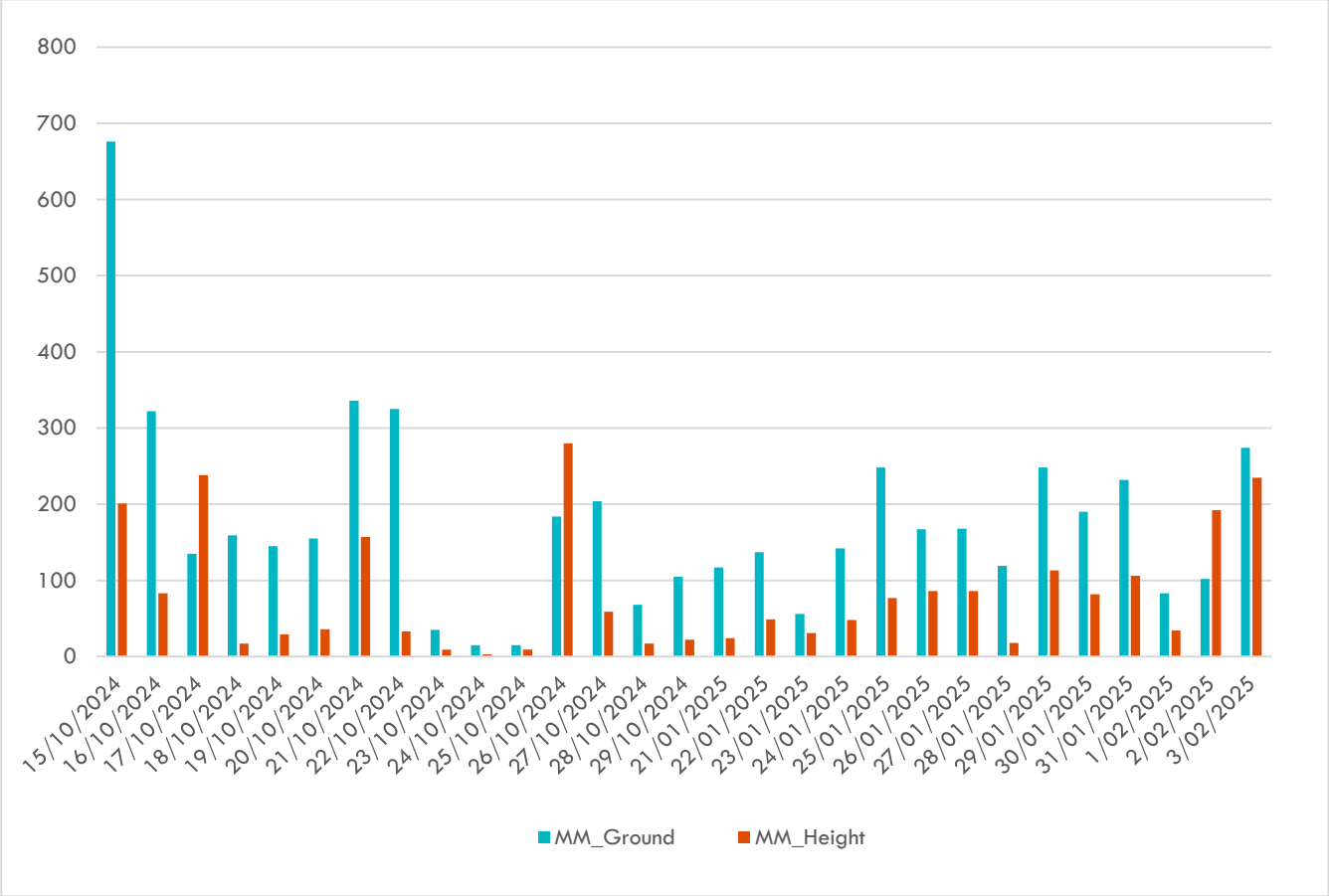
Bat activity at height was compared to activity at ground level using the paired detectors located at the met mast (ground level and approximately 70 metres above ground level). There is one met mast on within the subject land, which was installed not long prior to spring 2024.

In spring 2024, activity at ground level was higher than that recorded at height on 13 nights out of 15. In summer 2025, activity at ground level was higher than that recorded at height on all nights except the final night (2 February 2025).

Overall, activity on the ground-level detector had an average of 154 passes per night while the detector at height had an average of 73 passes per night across the recording period. The maximum number of passes recorded at height was 192 passes 2 February 2025. The highest number of passes recorded at ground level was 248 the night of 25 January 2025.

Bat activity recorded was overwhelmingly concentrated in frequencies between 25-34 khz. At height, there was also minimal recorded activity of high-frequency species. Although it is acknowledged that high-

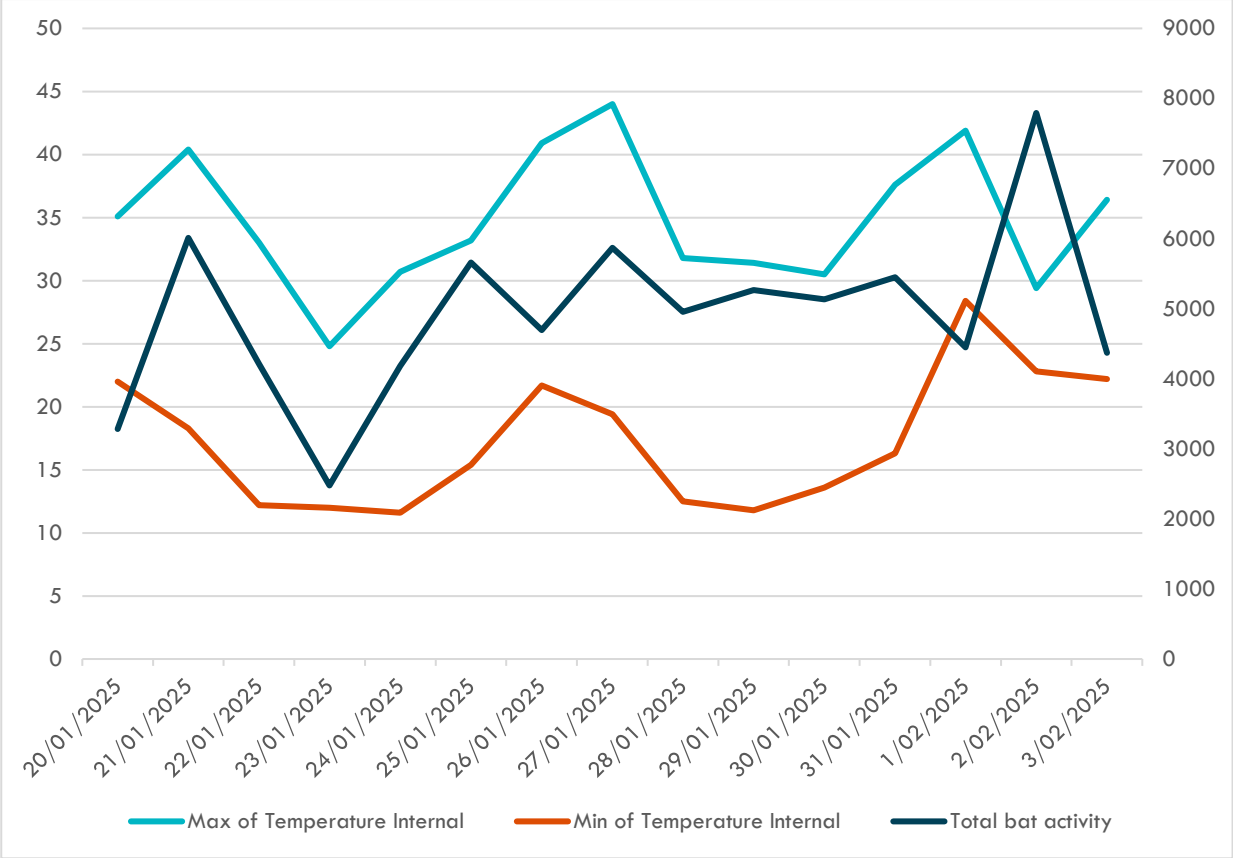
frequency bat species can and do likely fly at height, the data suggests that this activity is much less than lower frequency species, and it is reasonable to assume that collision risk is therefore also lower.



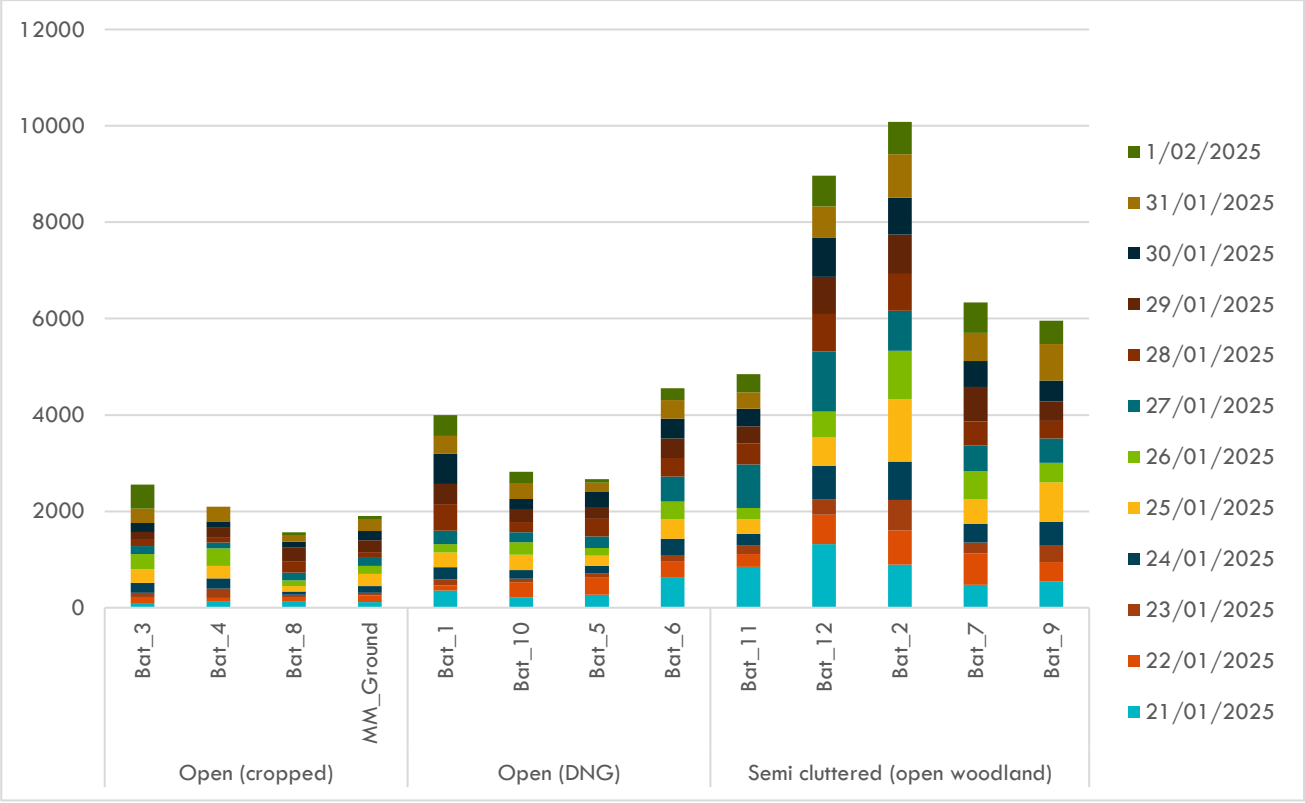
Graph 1 Bat activity at height versus ground level per sampling date

Bat activity

Bat activity was compared per night across all sites. When compared with temperature recorded from detectors, there is a general trend towards higher activity during warmer temperatures, and reduced activity when temperatures are lower (Graph 2). When looking at activity per habitat unit, there is a trend towards lower activity at open sites compared to treed sites (Graph 3), with DNG sites showing slightly higher activity compared to cropped sites.



Graph 2 **Maximum, minimum and average nightly temperatures recorded by bat detectors.**



Graph 3 **Total bat activity per site**

4. Conclusion and recommendations

One threatened bat species, Inland Forest Bat, was positively recorded as occurring within the project site. Corben's Long-eared Bat has been assessed as likely or possibly occurring within the project site, with potential calls identified and suitable habitat occurring.

Southern Myotis is considered unlikely to occur within the subject land based on the results of the ultrasonic analysis combined with known distribution, habitat constraints, Bionet records, and the habitat values present within the site.

Although calls of the Myotis/*Nyctophilus* species complex were recorded across the site, the broader distribution and habitat constraints of Southern Myotis were considered to determine the likelihood of calls in the species complex representing that species. This approach is consistent with section 5.2 of the BAM where the assessor is able to eliminate a species if "none of the habitat constraints for the species are present in a vegetation zone". Based on its foraging strategy, distribution and known habitat associations, it is considered highly unlikely that Southern Myotis extends into the subject land. Suitable habitat for this species across the wind farm site is very limited. The site does not contain permanent rivers or streams, with the only available free water present associated with a number of ground tanks across the site that are isolated from areas of core riparian woodland along permanent watercourses.

Species identified at the site and considered most at risk of collisions with turbines are high-flying species, recorded at height and widely distributed across the site. These include:

- White-striped Free-tailed Bat
- Gould's Wattled Bat
- Inland Free-tailed Bat
- South-eastern Free-tailed Bat
- Ride's Free-tailed Bat

These higher risk species were commonly recorded across all habitat types at the site, including at height. Activity at height was on average lower than activity recorded at ground level. This provides some evidence that bat activity is lower at height in this landscape. High-flying species of bats are also thought to forage closer to the ground in more open landscapes compared to taller eucalypt forests (Baker & Gynther 2023). It is reasonable to assume that where less passes are recorded for bats, there is less risk of collision. The data recorded on detectors placed at ground level and at height demonstrates that bat activity is lower at height. Collision risk for bats is likely to be highest on nights when activity at height is also high, and there are increased likelihood of interactions with turbines.

All of the species considered at higher risk of blade strike produce low frequency calls that are readily identifiable from call analysis. These types of calls would be suitable for real-time call analysis informing smart curtailment approaches if implemented as part of a mitigation strategy at the site under the future Bird and Bat Adaptive Management Plan (BBAMP). Inland Forest bat and Corben's Long-eared Bat have not been included as higher risk species given that they are considered to be 'below canopy' foraging species. Even where recorded on the detector at height, does not necessarily mean they would also occur within rotor swept area.

References

Australasian Bat Society 2022. *BatMap*, *Australasian Bat Society*, http://ausbats.org.au/batmap.

Australian Biological Resources Study 2024. *Australian Faunal Directory*, *Environment home*, accessed 29 March 2022, https://biodiversity.org.au/afd/home.

Baker A & Gynther I (eds.) 2023. *Strahan's Mammals of Australia*, 4th edn, Reed New Holland, Wahroonga, NSW.

Campbell S 2009. 'So long as it's near water: variable roosting behaviour of the large-footed myotis (Myotis macropus)', *Australian Journal of Zoology*, 57: 89–98.

Churchill S 2008. *Australian Bats*, 2nd edn, Allen & Unwin, Sydney, NSW.

Cth DCCEEW 2023. Onshore Wind Farm Guidance.

Duffy AM, Lumsden LF, Caddle CR, Chick RR, & Newell GR 2000. 'The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in south-eastern Australia', *Acta Chiropterologica*, 2, 2: 127–144.

Fenton M 1990. 'The foraging behaviour and ecology of animal-eating bats.', *Canadian Journal of Zoology*, 68, 3: 411–422.

Gonsalves L & Law B 2017. 'Distribution and key foraging habitat of the Large-footed Myotis Myotis macropus in the highly modified Port Jackson estuary, Sydney, Australia: an overlooked, but vulnerable bat', *Australian Zoologist*, 38, 4: 629.

Gonsalves L, Law B, Brassil T, Kerr I, & O'Loughlin C 2022. 'Roost Selection in Relation to a Patchy, Mosaic Management Burn by a Threatened Clutter-Adapted Bat', *Forests*, 13: 1327.

Gorecki V 2020. *The ecology and conservation of the Large-footed Myotis (Myotis macropus) in an urban environment*, Queensland University of Technology.

Law B & Anderson J 1999. 'A survey for the Southern Myotis Myotis macropus (Vespertilionidae) and other bat species in River Red Gum Eucalyptus camaldulensis forests of the Murray River, New South Wales', *Australian Zoologist*, 31, 1.

Law B, Chidel M, & Towerton A 2001. 'A maternity roost of the Southern Myotis Myotis macropus in a rural landscape', *The Australasian Bat Society Newsletter*17: 13–15.

Law B, Gonsalves L, Brassil T, & Chidel M 2016. 'Subtle use of a disturbance mosaic by the south-eastern long-eared bat (Nyctophilus corbeni): an extinction-prone, narrow-space bat.', , 43, 2: 153–168.

Law B, Gonsalves L, Brassil T, & Hill D 2018. 'Does Thinning Homogenous and Dense Regrowth Benefit Bats? Radio-Tracking, Ultrasonic Detection and Trapping', *Diversity*, 10, 2: 45.

Lumsden L, Lindeman M, & Nelson J 2007. *Preliminary investigations into the status and ecology of the Eastern Long-eared Bat Nyctophilus timoriensis (south-eastern form)*, Report to the Mallee Catchment Management Authority. Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment,

Victoria. National Herbarium of Victoria, Royal Botanic Gardens, Melbourne. Department of Sustainability and Environment, Heidelberg, Victoria.

Lumsden LF & Bennet AF 1995. 'Bats of a Semi-arid Environment in South-eastern Australia: Biogeography, Ecology and Conservation', *Wildlife Research*, 22: 217–40.

Pennay M & Freeman J 2005. 'Day roost of Little Pied Bat Chalinolobus picatus (Gould) (Microchiroptera:Vespertilionidae) in north inland New South Wales, Australia', *Australian Zoologist*, 33, 2: 166.

Pennay M, Law B, & Reinhold L 2004. Bat calls of New South Wales, https://www.environment.nsw.gov.au/resources/nature/batcallsofnsw.pdf.

Reinhold L, Law B, Ford G, & Pennay M 2001. *Key to the bat calls of south-east Queensland and north-east New South Wales*, Queensland Department of Natural Resources and Mines, State Forests of New South Wales, University of Southern Queensland, and New South Wales National Parks and Wildlife Service, https://www.researchgate.net/publication/303821240_Key_to_the_bat_calls_of_south-east_Queensland_and_north-east_New_South_Wales.

Turner A, Sanders E, Talbot S, Moore E, & Wassens S 2022. 2021-22 Water Year Yanco Creek System Community Report: Murrumbidgee Monitoring, Evaluation and Research program.

Appendices

Appendix A. Example time versus frequency graphs for species identification

All time versus frequency graphs are shown in F7 (10 ms), compressed mode, unless otherwise stated. Sequences are shown in both full spectrum and zero crossing formats, on a scale of 10 – 90 kHz.

Plate 4 **White-striped Free-tailed Bat *Austronomus australis***

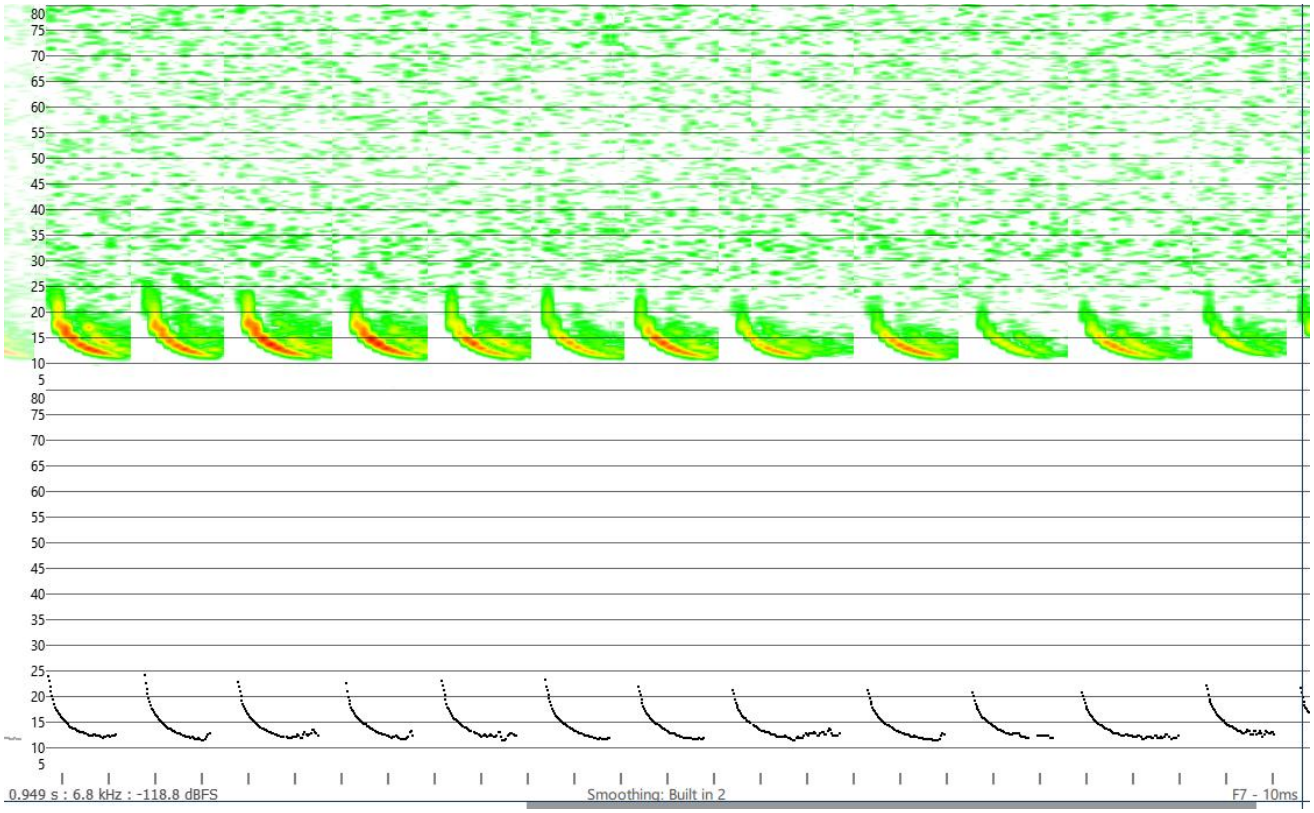


Plate 5 **Gould's Wattled Bat *Chalinolobus gouldii***

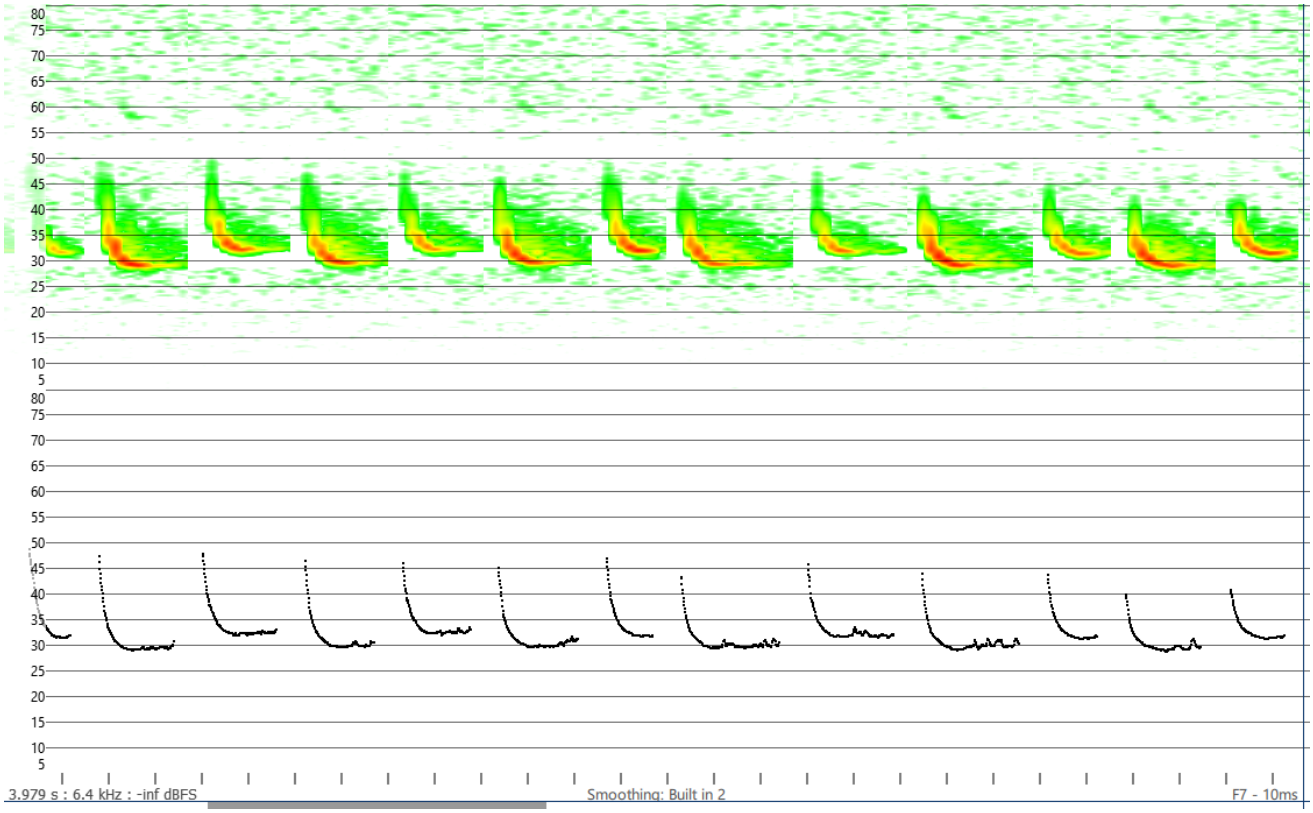


Plate 6 **Chocolate Wattled Bat *Chalinolobus morio***

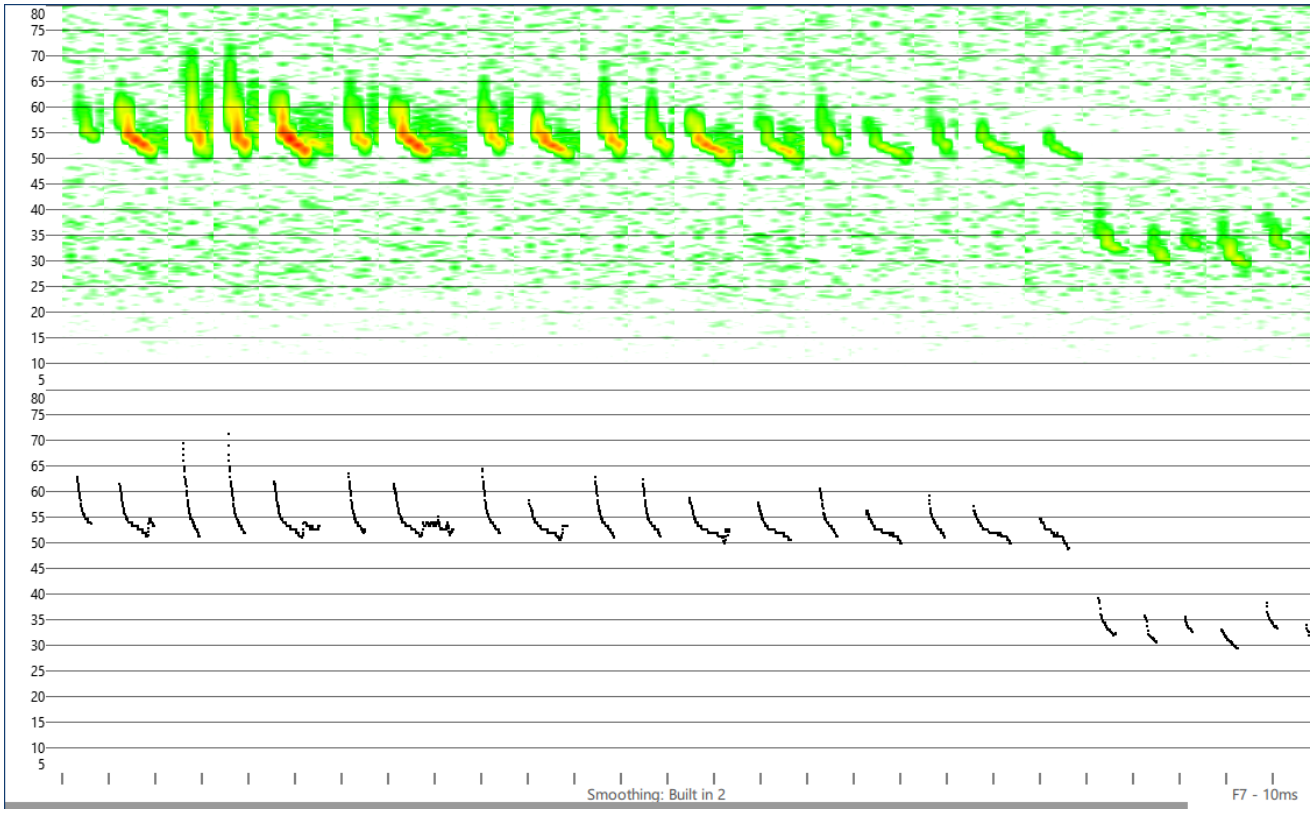


Plate 7 Long-eared Bat (*Nyctophilus spp.*)

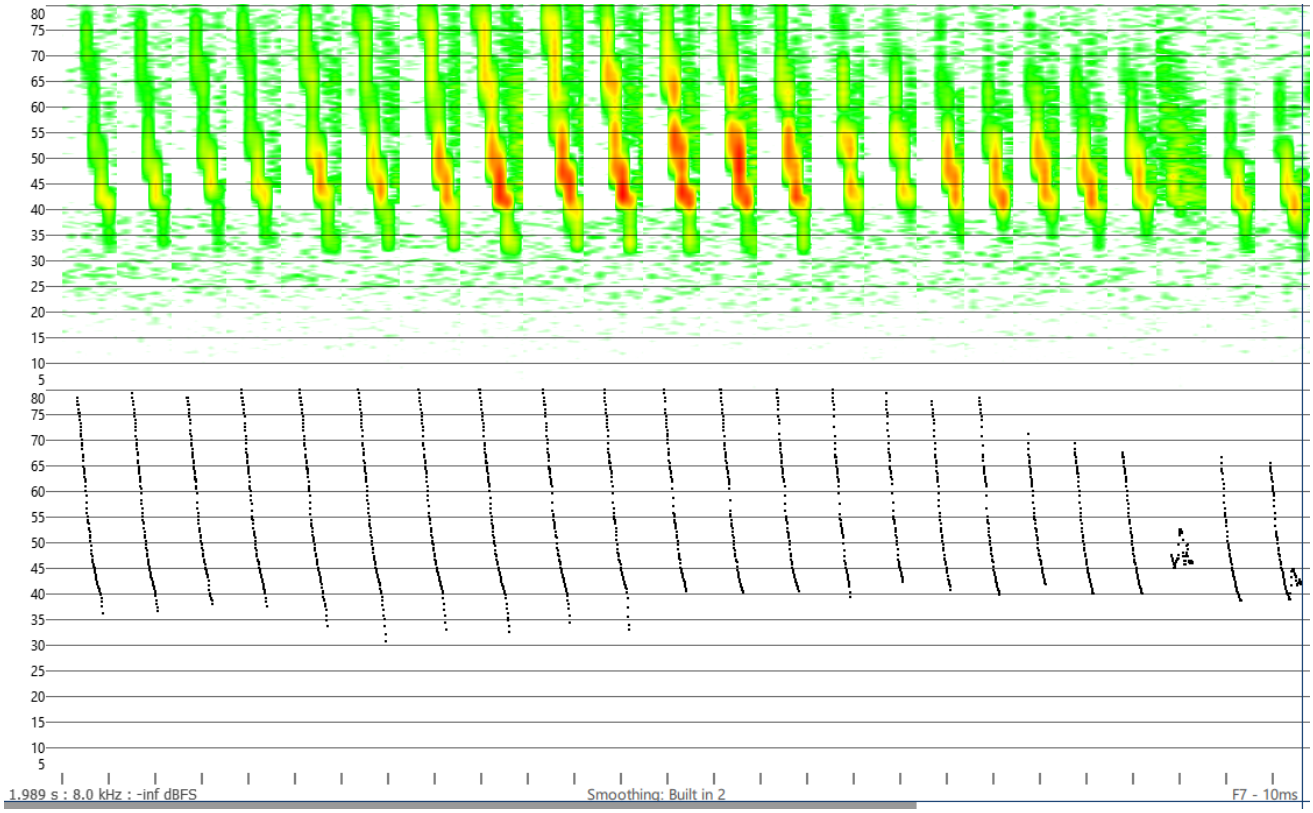


Plate 8 **Inland Free-tailed Bat *Ozimops petersi***

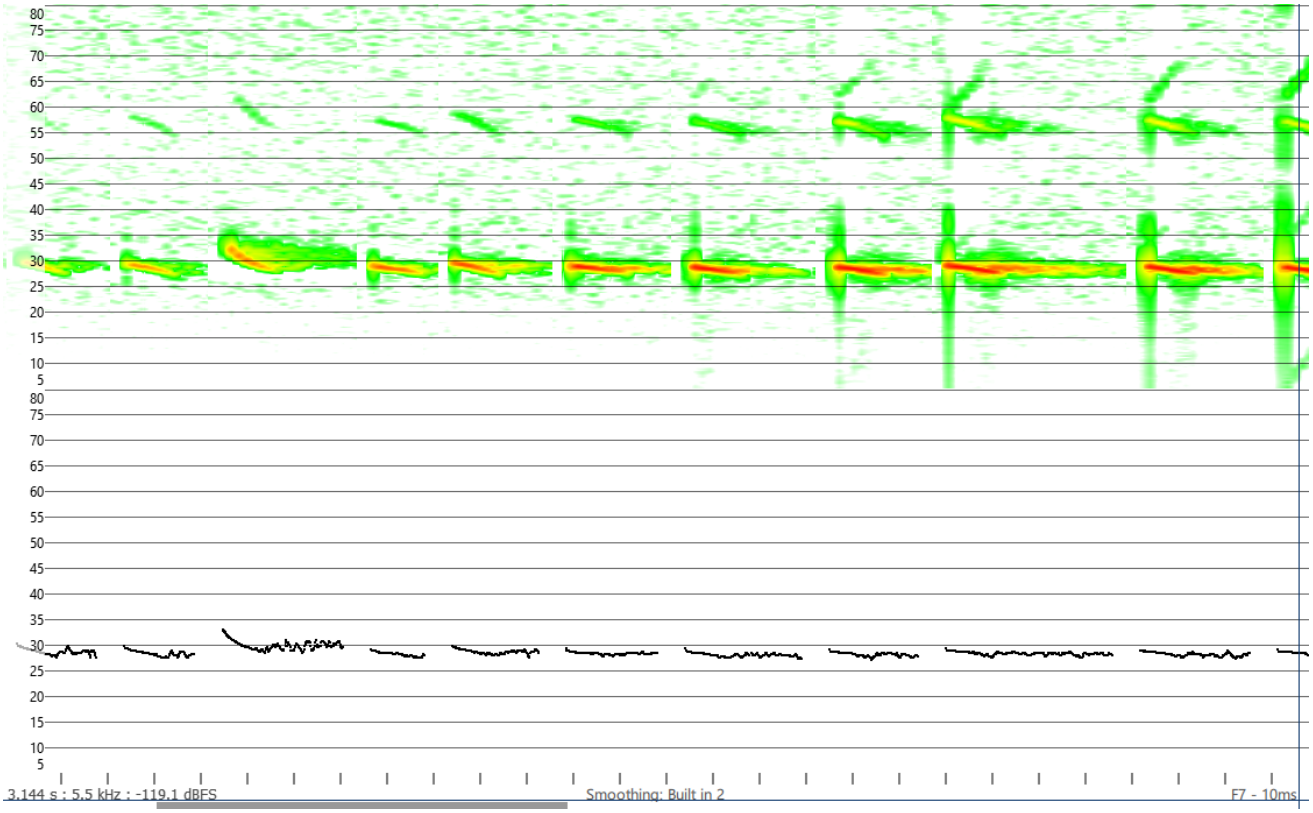


Plate 9 South-eastern Free-tailed Bat *Ozimops planiceps*

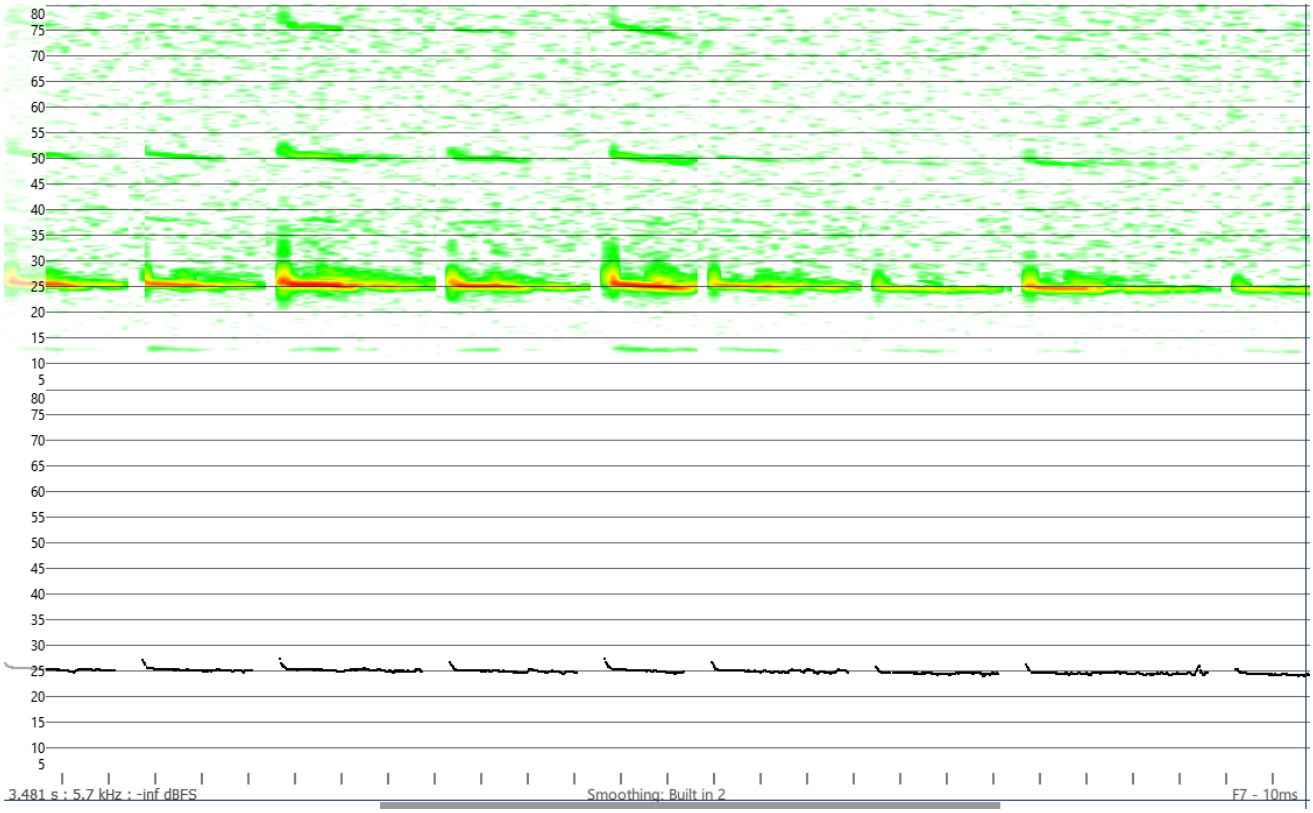


Plate 10 **Ride's Free-tailed Bat *Ozimops ridei***

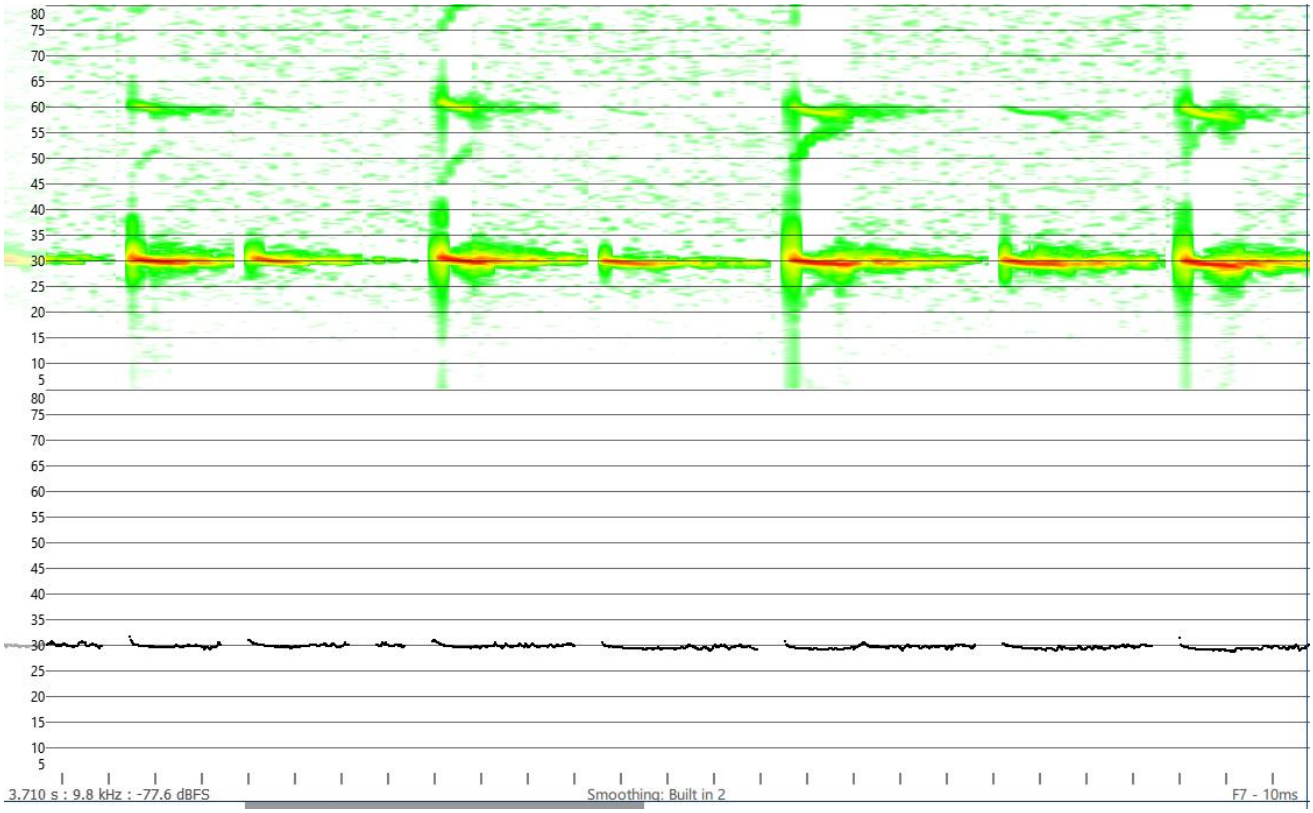


Plate 11 Inland Broad-nosed Bat *Scotorepens balstoni*

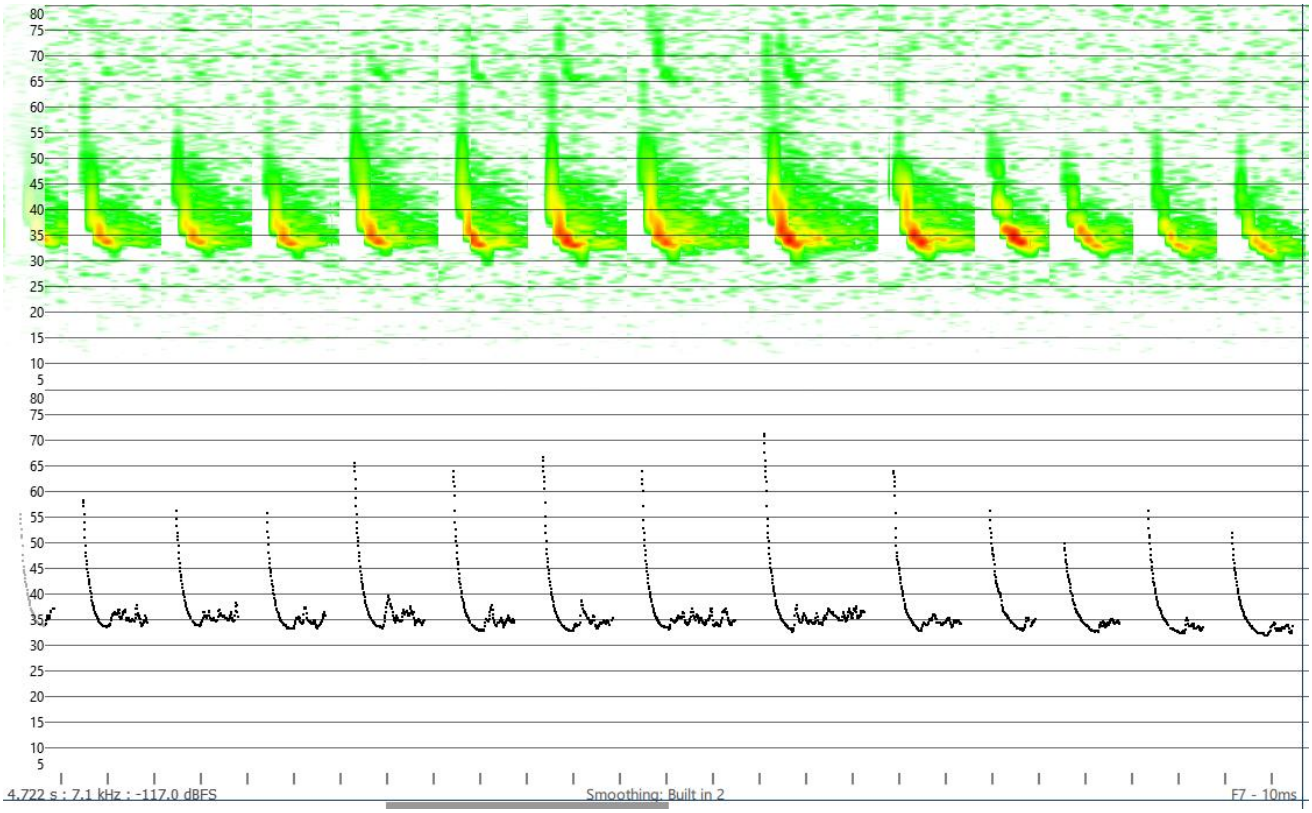


Plate 12 Little Broad-nosed Bat *Scotorepens greyii*

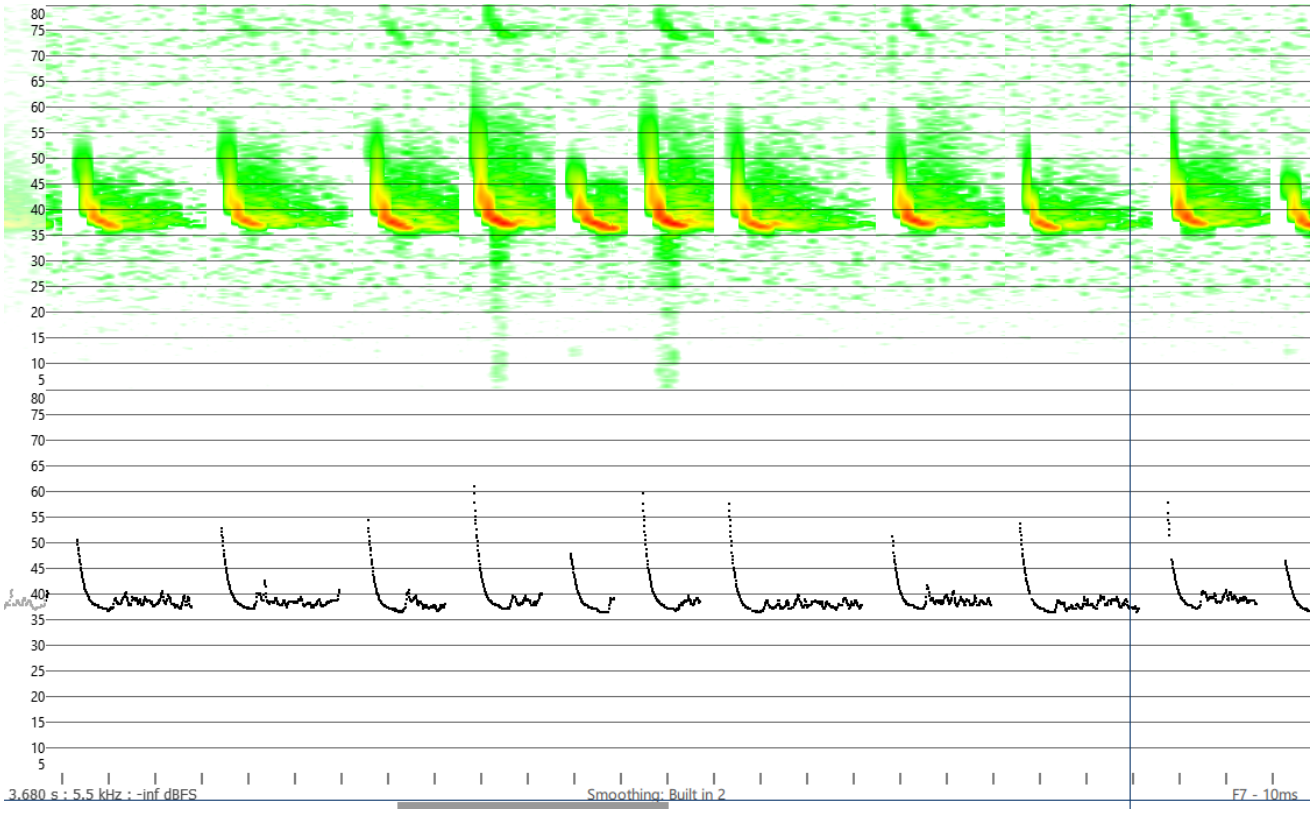


Plate 13 **Inland Forest Bat *Vespadelus baverstocki***

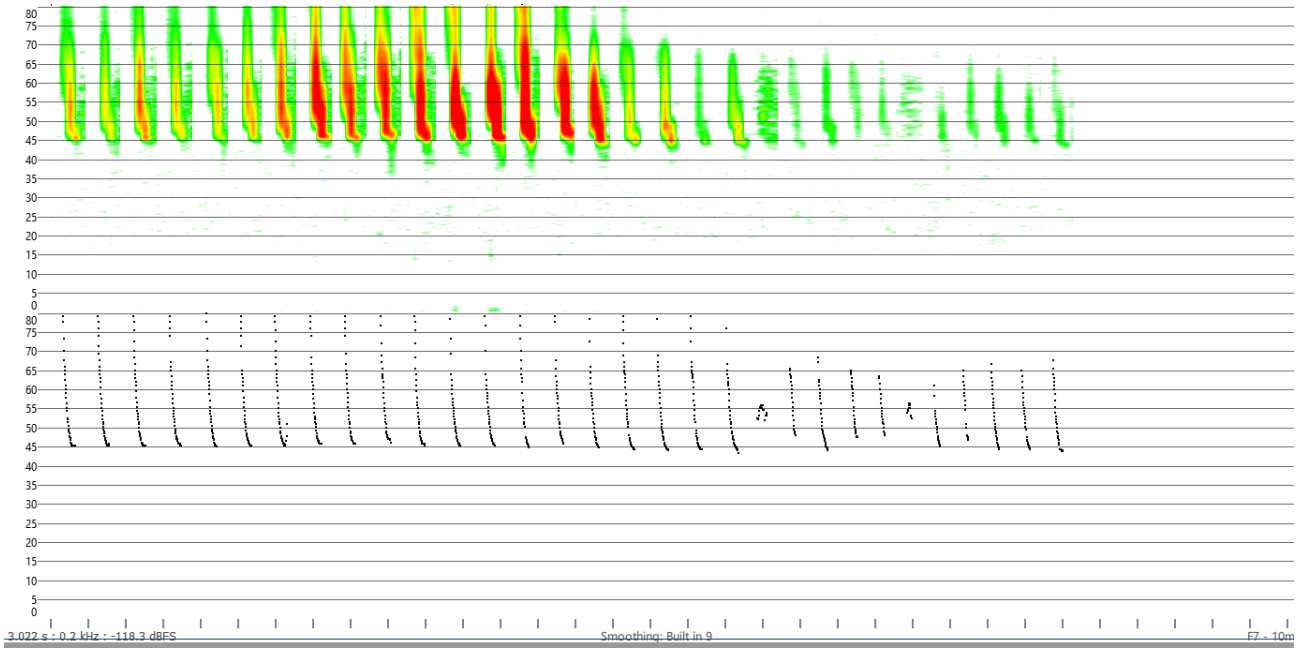


Plate 14 **Large Forest Bat *Vespadelus darlingtoni***

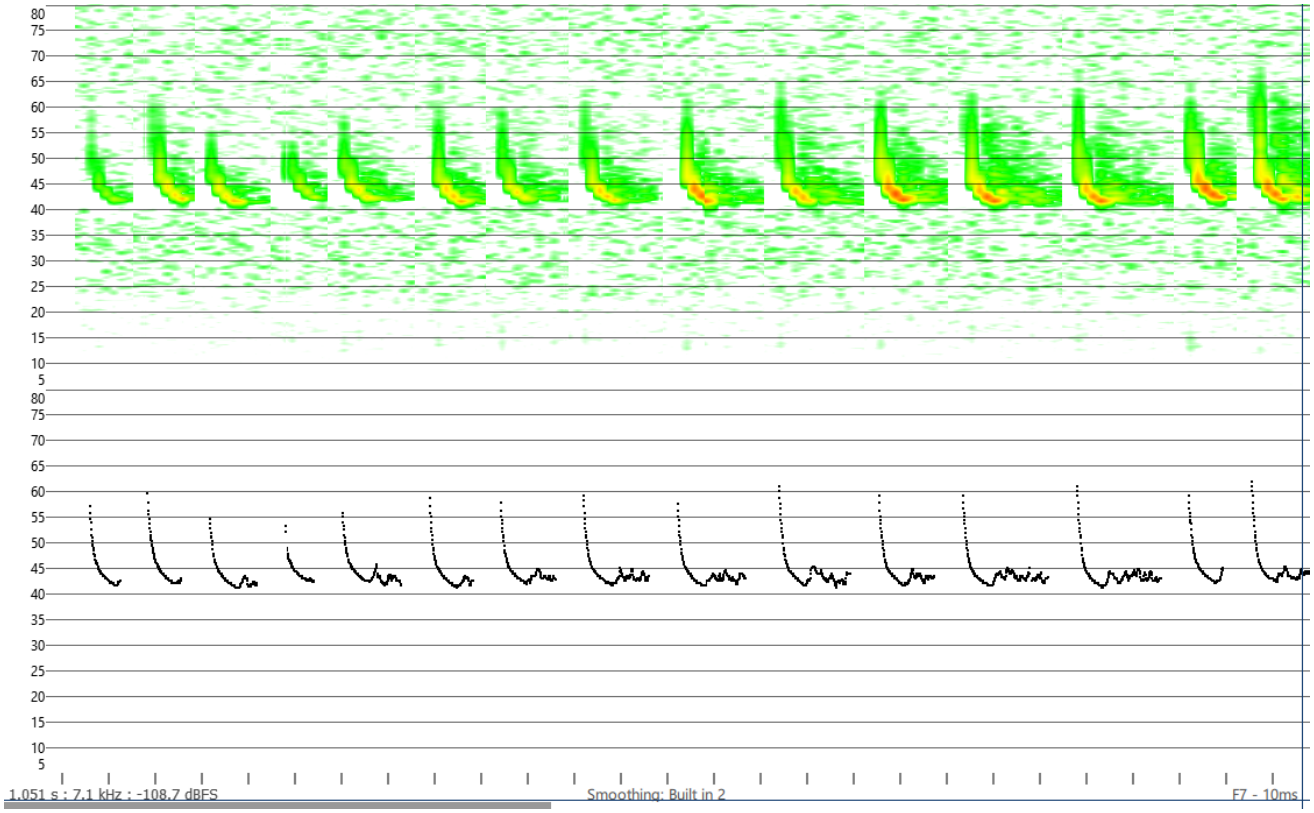


Plate 15 Southern Forest Bat *Vespadelus regulus* (Riverina high frequency form)

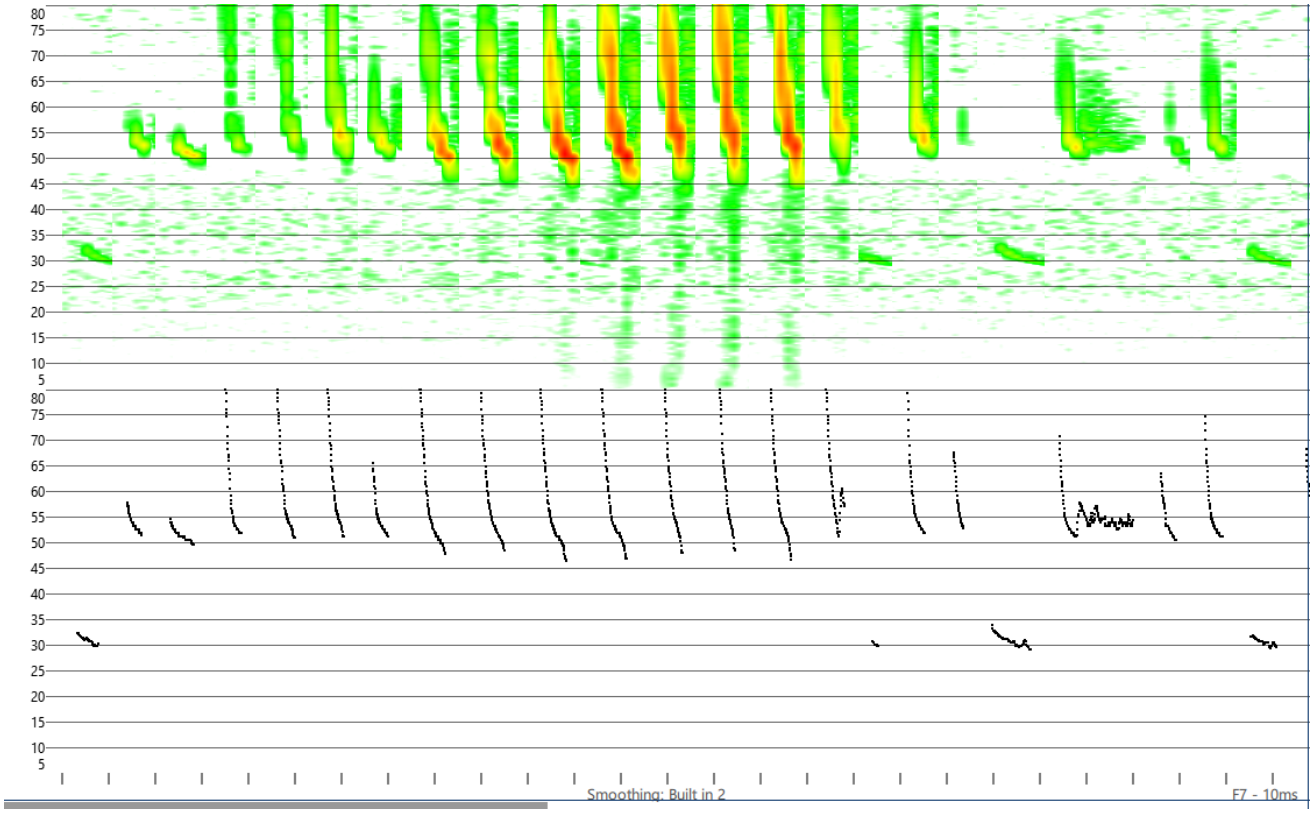
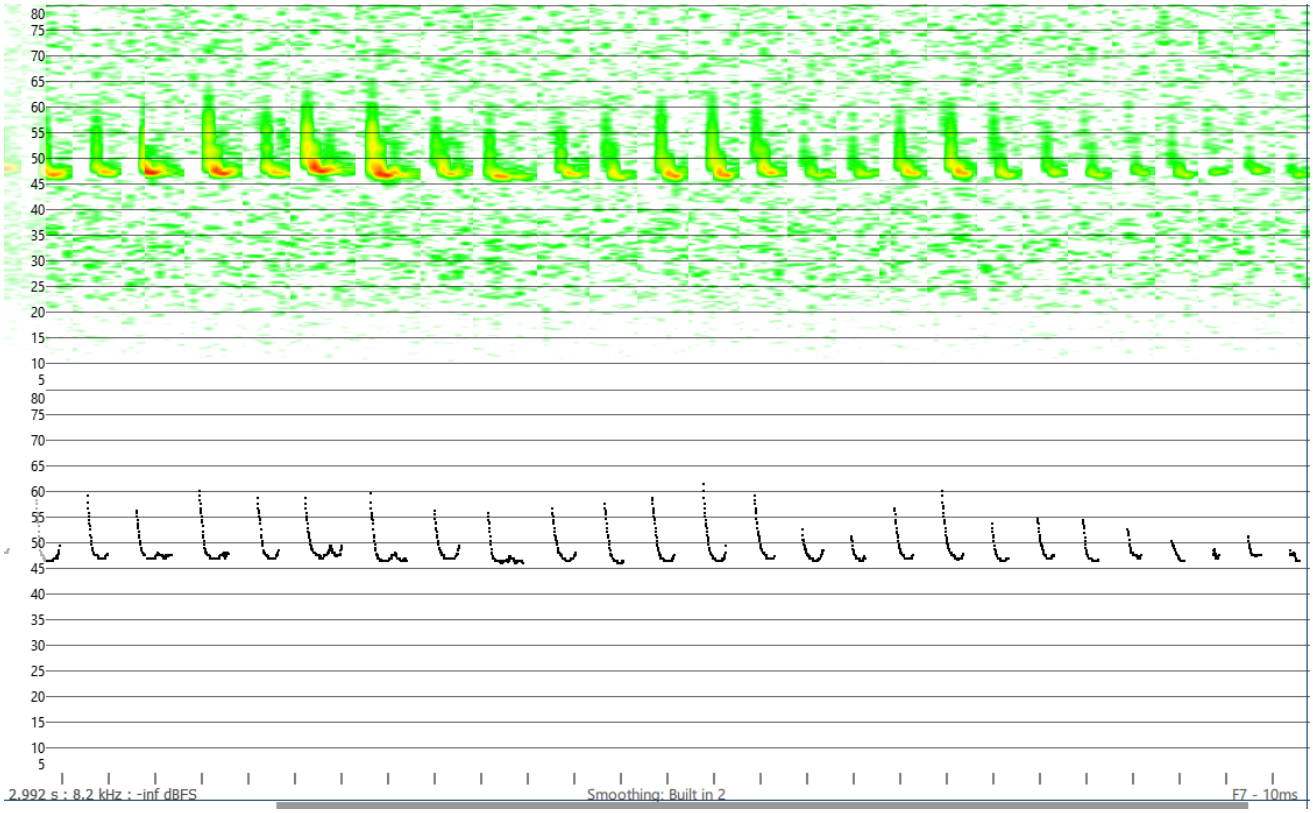


Plate 16 Little Forest Bat *Vespadelus vulturnus* (Riverina form)



Appendix 11. Desert Mouse BAM Species Expert Report

© Biosis 2025 — Leaders in Ecology and Heritage Consulting

ABN: 59 096 030 385

PO Box 207, Kimba, SA 5641

Ecological67@gmail.com

Phone (08) 86481878

Junction Rivers Wind Farm Desert Mouse Expert Advice

Desert Mouse showing distinctive orange eye-ring

Limitations Statement

In preparing this document Ecological Horizons Pty Ltd makes no warranty or guarantee, whether expressed or implied, with respect to the information reported or to the findings, observations or conclusions expressed in this document. Further, such information, findings, observations and conclusions are based solely on observations made and information available to Ecological Horizons Pty Ltd at the time of this study.

Credentials of Expert

Dr Read was recognised as an authority on *Pseudomys desertor* (SF23/131992) by the Director South West, Biodiversity and Conservation Division, Department of Planning and Environment on 17 November 2023 (Appendix 1).

Dr John Read 'rediscovered' *Pseudomys desertor* in South Australia (Read et al.1999) and has trapped the species at numerous sites in arid and semi arid zone. Dr Read also co-authored the Mammals of Australia section on *P. desertor* (Kerle et al 2008).

Dr Read has had 32 years experience of mammals surveys in chenopod sandplain vegetation associations including many of the dominant plant species found at Junction Rivers Wind Farm (Rosewood (*Alectryon oleifolius*), White Cypress Pine (*Callitris glaucophylla*), Sugarwood (*Myoporum platycarpum*), Belah (*Casuarina cristata*), nitre bush (*Nitraria billardierei*).

In addition Dr Read has had 20 years experience trapping in each of 3 additional study areas that either support *P. desertor* (APY Lands) or are in mallee triodia dunefields (Middleback and Immarna) similar to the Junction Rivers landscape. Dr Read has also trapped the Wild Deserts sites in Sturt National Park for the past 10 years, where the only record of *P desertor* was recorded in NSW for the past decade

Methods

This expert report has been prepared for Biosis Pty Limited to determine whether *Pseudomys desertor* are likely to occur within the Junction Rivers Wind Farm Development Footprint. This expert report has been prepared in accordance with the requirements of Box 3 of the Biodiversity Assessment Method ('BAM'; DPIE 2020).

Ecological Horizons arranged for Alex Holmes of GHD to compile regional records (including through use of BioNet database and regional ecological connections) and conduct field inspections of the Junction Rivers Wind Farm for suitable habitat for *Pseudomys desertor* (Appendix 2). Ecological Horizons have worked with Alex and trust and value his ecological skills, local knowledge and thoroughness and discussed with Alex optimum times and habitats for surveying both species. The GHD report is included in Appendix 2 of this report.

This assessment was aided by the extensive vertebrate surveys conducted within the Mallee Cliffs National Park (within the same region) primarily completed by the Australian Wildlife Conservancy (AWC) since 2016, which failed to detect either species. Across the AWC-NSW Parks Partnership Projects there have been 34,087 records of 171 fauna species. Prior to this, records within the national park go back to 1965 producing an additional 12,419 records and 84 species.

Results

Resident populations of *Pseudomys desertor* are considered to be unlikely to occur on the Junction Rivers wind farm site (Figure 1) for three reasons:

1) Scarcity of nearby records (including from the intensively surveyed Mallee Cliffs National Park) suggest that the Project lies just beyond the periphery of the consistently occupied range of *P. desertor*, even though animal distributions are inherently dynamic.
2) The habitat of the project area is 'heavily disturbed' (GHD 2025), without the extensive tracts of *Triodia* hummockland or sedges or good condition chenopod shrubland that typify *P. desertor* habitat.
3) The site appraisal failed to locate likely habitat for *P. desertor* within the study site (GHD 2024)

Figure 1 Junction Rivers wind farm Development footprint

Discussion

The desert mouse, unlike other small rodents is unlikely to be overlooked, even by many members of the public, due to its combination of long fur and especially distinctive orange eye ring. Hence the lack of records from the region are unlikely to be attributed to confusion with other rodents.

Pseudomys desertor is susceptible to predation by feral cats and probably foxes. Because they are a folivore, *P. desertor* are active for longer periods, including before dark and hence potentially more vulnerable to predators, including birds of prey than truly nocturnal rodents. The susceptibility of medium sized rodents to feral cats (Read *et al*. 2024) means that it is highly unlikely that a population of *P. desertor* could be sustained at the largely cleared and heavily grazed Junction Rivers site.

Pseudomys desertor can be sampled through pitfalling, indeed the author had pitfall trapped this species at two widely separated study sites in South Australia in the previous month. However, they are seldom abundant and considerable trap effort, sometimes over several years, is typically required to confirm their presence. Alternative techniques to assess *P. desertor* presence include analyses of owl pellets that should ideally be collected from the proposed wind farm site and also through analysing the stomach contents of feral cats and foxes, which should also optimally be controlled at Junction Rivers.

Conclusions

The expert opinion provided here of resident or important populations of *P. desertor* being unlikely at the Junction Rivers Wind Farm is supported by the conclusions from the GHD site report and the lack of records from the comprehensive, long term local data from the adjacent Mallee Cliffs National Park.

However, expert opinion also suggests that should the Junction Rivers Wind Farm proposal progress to development, there are still tangible benefits that can be provided to the local biodiversity. Infrastructure projects can make a positive contribution to conservation by addressing, as well as not exacerbating, key threats (e.g. Read 2003). For example, reduction in regional feral cat densities through proactive management can lead to profound improvements in small mammal diversity and abundance, both within (Moseby et al. 2019) and beyond (Pedler et al. 2016) conservation management areas. Other opportunities for positive biodiversity benefits could arise from revegetating with endemic plant species, including rare species, and assisting with regional control of overabundant herbivores, potentially including feral species and kangaroos. Striving to provide positive biodiversity benefits may offset inevitable localised impacts from infrastructure developments.

References

Department of Planning, Industry and Environment (DPIE) (2020), Biodiversity Assessment Method. Junction Rivers

GHD (2025) Junction Rivers Wind Farm Desert Mouse habitat assessment

Kerle, J.A., Kutt, A.S. and Read, J.L. (2008). Desert Mouse *Pseudomys desertor* pp 625-626 in : **The Mammals of Australia 3rd edition** eds S. VanDyck and R. Strahan. Reed New Holland, Sydney.

Moseby, K.E., McGregor, H. Hill, B.M. and Read, J.L. (2019) Exploring the internal and external wildlife gradients created by conservation fences **Conservation Biology** DOI: 10.1111/cobi.13389

Pedler, R.D., Brandle, R., Read, J.L., Southgate, R., Bird, P. & Moseby, K.E. (2016). Bio-control triggers landscape-scale recovery of threatened desert mammals **Conservation Biology 30**: 774-782

Read, J., Copley, P. and Bird, P. (1999). The distribution, ecology and current status of *Pseudomys desertor* in South Australia **Wildl. Res. 26**: 453-462.

Read, J.L. (2003). Are miners the bunnies or the bilbies of the rangelands? **Rangeland Journal 25**: 172-182.

Read, J.L., Moseby , K.E. and McGregor, H.W. (2024) Better to bluff than run: conservation implications of feral-cat prey selectivity **Wildlife Research** 51 https://doi.org/10.1071/WR23138

Appendix 1 Expert status verification

Department of Planning and Environment

Dr John Read
ecological67@gmail.com

Our ref: SF23/131992
Sender's ref: BE 23 10

17 November 2023

Dear Dr Read

Approval of Name as an expert for Desert Mouse (*Pseudomys desertor*)

Thank you for your application dated 23 September 2023 to the Biodiversity and Conservation Division (BCD) of the Department of Planning and Environment.

BCD has reviewed the information provided in support of this request and is satisfied that you meet the definition of a species expert for Desert Mouse (*Pseudomys desertor*) in accordance with section 5.3 (Box 3) of the Biodiversity Assessment Method.

Please note that this formal recognition of you as an expert only applies to the Mallee Wind Farm project within the Wentworth Local Government Area.

If you require any further information regarding this matter, please contact Andrew Fisher, Senior Team Leader Planning, via rog.southwest@environment.nsw.gov.au or 02 6022 6023.

Yours sincerely

Adam Vey
Director South West
Biodiversity and Conservation Division
Department of Planning and Environment

Appendix 2. GHD 2025 report

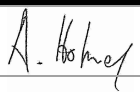
Junction Rivers Wind Farm Desert Mouse

Habitat Assessment

Biosis Pty Ltd

02 April 2025

→ The Power of Commitment

Project name		Junction Rivers Desert Mouse Habitat Assessment						
Document title		Junction Rivers Wind Farm Desert Mouse | Habitat Assessment						
Project number		12665887						
File name		12665887_REP_Junction Rivers Desert Mouse Habitat Assessment.docx						
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**			
			Name	**Signature**	**Name**	**Signature**	**Date**	
S3	0	E. Pacholli	A. Holmes		A. Holmes		02/04/25	

GHD Pty Ltd | ABN 39 008 488 373
Contact: Alex Holmes, Office Manager - Mildura | GHD
57 Orange Avenue,
Mildura, Victoria 3500, Australia
T +61 3 5018 5200 | **F** +61 3 5018 5201 | **E** mdamail@ghd.com | **ghd.com**

© GHD 2025
This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Contents

1. Introduction **1**
1.1 Purpose of this report 1
1.2 Scope and limitations 1
1.3 Assumptions 1
2. Species Information **2**
2.1 Desert Mouse (*Pseudomys desertor*) 2
2.1.1 Species description 2
2.1.2 Life cycle 2
2.1.3 Distribution 2
2.1.4 Habitat requirements 3
3. Description of area **3**
3.1 Landscape context 3
3.2 Native vegetation 4
4. Assessment of species presence and habitat suitability **8**
4.1 Species records and habitat assessments 8
4.1.1 Desert Mouse (*Pseudomys desertor*) 10
4.2 Recent surveys in the region 10
4.2.1 2021 GHD site visit 11
5. Conclusion **15**
6. References **16**

Table index

Table 1 Plant community types, status and area mapped within development footprint 4
Table 2 Annual Rainfall Data from Mildura and Pooncarie 10
Table 3 Threatened Species detected within Mallee Cliffs National Park 11
Table 4 Likelihood of occurrence table for target species 15

Figure index

Figure 1 Desert Mouse observed during a trapping program in the Tanami Desert, NT. 2
Figure 2 PCTs recorded within the study area 7
Figure 3 Historical records of Desert Mouse in western New South Wales 9

1. Introduction

1.1 Purpose of this report

GHD Pty Ltd (GHD) has been engaged by Biosis for ecological services to support the assessment of the proposed Junction Windfarm project in the Kyalite region, southeast of Balranald NSW. Biosis require local ecological knowledge to assess the likelihood of occurrence of the Desert Mouse (*Pseudomys desertor*), listed as threatened under the New South Wales Biodiversity Conservation (BC) Act 2016. A summary report on this species is required to support a separate expert report to be prepared by Dr John Read from Ecological Horizons. Our local GHD ecologists have extensive experience with this species, including conducting previous trapping programs for *P. desertor* in central Australia and in NSW where this species is poorly known.

1.2 Scope and limitations

This report: has been prepared by GHD for Biosis Pty Ltd and may only be used and relied on by Biosis Pty Ltd for the purpose agreed between GHD and Biosis Pty Ltd as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Biosis Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

GHD has prepared this report on the basis of information provided by Biosis Pty Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.3 Assumptions

The scope did not include a detailed assessment or targeted surveys for Desert Mouse (*Pseudomys desertor*) or any other flora, fauna or aquatic assessments. As a result, in the future, additional species may be present that were not observed during this assessment.

The BioNet Atlas (BioNet) database can be used to search a defined geographical area to produce species lists of flora and fauna that have been recorded within the searched area. The database lists are only as accurate as the quality and quantity of data that have been recorded and documented from the area.

Location details for many records (typically older records) have a relatively low degree of accuracy (e.g., within 1 km).

These datasets are not exhaustive. In other words, many locations locally and across New South Wales have a low level of documented survey effort for one or more groups of flora and fauna. During field surveys, it is not uncommon to find species at locations for which there are few or no previous nearby database records.

Maps presented in this report displaying site information should not be relied on for the detailed design during the construction process. Data collected and presented in maps is accurate to +/- 5 m.

2. Species Information

2.1 Desert Mouse (*Pseudomys desertor*)

2.1.1 Species description

The Desert Mouse (*Pseudomys desertor*) is a solitary medium-sized rodent with chestnut brown fur above and a light grey-brown belly. The tail is brown dorsally and lighter around the sides and ventrally and is equal in length or shorter than the head-body length. Species has large eyes with a pale orange eye-ring. Males and females are a similar size (ALA 2024b).

Figure 1 **Desert Mouse observed during a trapping program in the Tanami Desert, NT.**

2.1.2 Life cycle

The Desert Mouse has a high reproduction rate with females being fertile on a 7-9 day cycle and become reproductively mature at ten weeks old. Gestation lasts 27-28 days and litter sizes average three pups (ALA 2024b). The species has large population growth following periods of high rainfall that results in increased vegetation density. (NSW EH, 2024)

2.1.3 Distribution

The species is distributed throughout arid areas, including Central Australia, central inland Queensland, southern Kimberely and the Pilbara in Western Australia and far western New South Wales. There have been very few records of the Desert Mouse in New South Wales and therefore it is thought that NSW is at the edge of the species distribution. (ALA 2024b).

Recent studies have shown that areas with Dingo presence, the pressure of feral predation of small mammals has been reduced compared to areas without Dingoes (Christopher E. Gordon, 2015). The majority of the Desert Mouse distribution has Dingoes present however, the NSW part of its range does not. This may mean the species would become at an increased risk to predation of feral cats and foxes. Additionally, overgrazing in NSW

suppresses the species ability to spread to suitable habitat as it is reliant on dense vegetation and the Junction Rivers Wind Farm site is generally heavily overgrazed by cattle and sheep.

2.1.4 Habitat requirements

Desert Mouse is primarily found in sand dune or sand plain habitats with spinifex. They have also been found in spinifex grasslands, open eucalypt, Acacia shrubland, riparian woodlands and samphire. The species is sensitive to overgrazing due to their reliance on habitats featuring dense grass, sedge or dense groundcover. The species is also sensitive to predation, particularly by feral cats and foxes.

Mallee woodlands are ecological communities occurring in semi-arid environments dominated by multi-stemmed, low growing eucalypts. They are diverse communities that support a variety of biota that depend on the specific features of the ecosystem to persist. This includes remnant population of other rare and threatened species such as the Malleefowl (*Leipoa ocellata*), Gilberts Whistler (*Pachycephala inornata)* and Southern Scrub-robin (*Drymodes brunneopygia).*

Often mallee woodland and mallee dune habitats occur in combination with spinifex (*Triodia* sp.). Spinifex habitats provide important ground-cover needed by a variety of reptiles and ground mammal species. This includes the Desert Mouse (*Pseudomys desertor).*

3. Description of area

3.1 Landscape context

The development footprint is located in the Mallee Cliffs Sandplains, Murrumbidgee Depression Plains and Murrumbidgee Lakes, Swamps and Lunettes Mitchell Landscapes.

The Mallee Cliffs Sandplains landscape is characterised by extensive, slightly undulating sandplain of Quaternary aeolian sands with east-west trending dunes, often with blowouts, partly scalded broad swales and small depressions, relief 6 to 10m. Solonized brown soils, calcareous loamy sand, and texture-contrast soils on the plain, red and brown sands on dunes, non-cracking grey or brown clays in depressions. The landscape consists of Rosewood (*Alectryon oleifolius*), White Cypress Pine (*Callitris glaucophylla*), Sugarwood (*Myoporum platycarpum*), Belah (*Casuarina cristata*), dense clumps of Black Bluebush (*Maireana pyramidata*), or Pearl Bluebush (*Maireana sedifolia*), with variable speargrass (*Austrostipa variabilis*), bottlewashers (*Enneapogon* sp.) and copperburr (*Sclerolaena* sp.) on plains.

The Murrumbidgee Depression Plains landscape is comprised of quaternary alluvial plains with circular depressions of high floodplains or low terraces beyond the reach of average floodwaters. Grey to brown clays and clay loams with linear patterns of sandy relic streams are evident. Now occupied by extensive grasslands of white-top, windmill grass, sand brome, and spear grasses, which are heavily grazed and invaded by exotic species. Reported to have originally been comprised of Myall (*Acacia pendula*), Old Man Saltbush (*Atriplex nummularia*) and Bladder Saltbush (*Atriplex vesicaria*). Sandy ridges of relic streams support patches of White Cypress Pine (*Callitris glaucophylla*), with Needlewood (*Hakea leucoptera*), Western Pittosporum (*Pittosporum phylliraeoides*) and Spear Grasses (*Austrostipa* sp.).

Murrumbidgee Lakes, Swamps and Lunettes landscape is mainly centred around Lake Condoulpe, at the Junction Rivers Wind Farm and is characterized by large active freshwater lakes and swamps frequently flooded by the river, often almost permanently inundated and generally round or kidney shaped. Often nested within larger relic quaternary lake features. The lakes may include areas of saline plains, beaches, sand/clay pellet lunettes and sand hills on the eastern margins. Scattered Black Box (*Eucalyptus largiflorens*), River Red Gum (*Eucalyptus camaldulensis*), Nitre Goosefoot (*Chenopodium nitrariaceum*), Tangled Lignum (*Duma florulenta*), Yanga Bush (*Maireana brevifolia*) and Old Man Saltbush (*Atriplex nummularia*) are present on lakebeds. Shallower swamps are vegetated with Cumbungi (*Typha orientalis*), Common Reed (*Phragmites australis*), Bushy Groundsel (*Senecio cunninghamii*), Spike Rush (*Eleocharis* sp.) and Water Couch (*Paspalum paspalodes*). Lunettes and sand hills are vegetated with Bimble Box (*Eucalyptus populnea*), White Cypress Pine (*Callitris glaucophylla*), Yanga Bush,

bluebush (*Maireana* sp.) and grasses. Some of these habitats may have once been suitable for *Pseudomys* spp. However, many of these lakes, including Condoulpe is now cropped with limited remnant vegetation.

The Biodiversity Study Area is located around 20 km southeast from the rural township of Balranald.

3.2 Native vegetation

Much of the development footprint and surrounding land is mapped as non-native vegetation and comprised of cropping paddocks and improved pasture for grazing with scattered patches of remnant native vegetation, scattered paddock trees and scattered alluvial depressions and lakebeds. Broadly, six habitat types are described in Biosis (2024) including, mallee woodland, semi-arid open woodlands, black box woodlands, acacia shrublands and open chenopod shrublands, cleared and cropped land and natural waterbodies being generally absent with larger ephemeral lakes existing in the surrounding landscape.

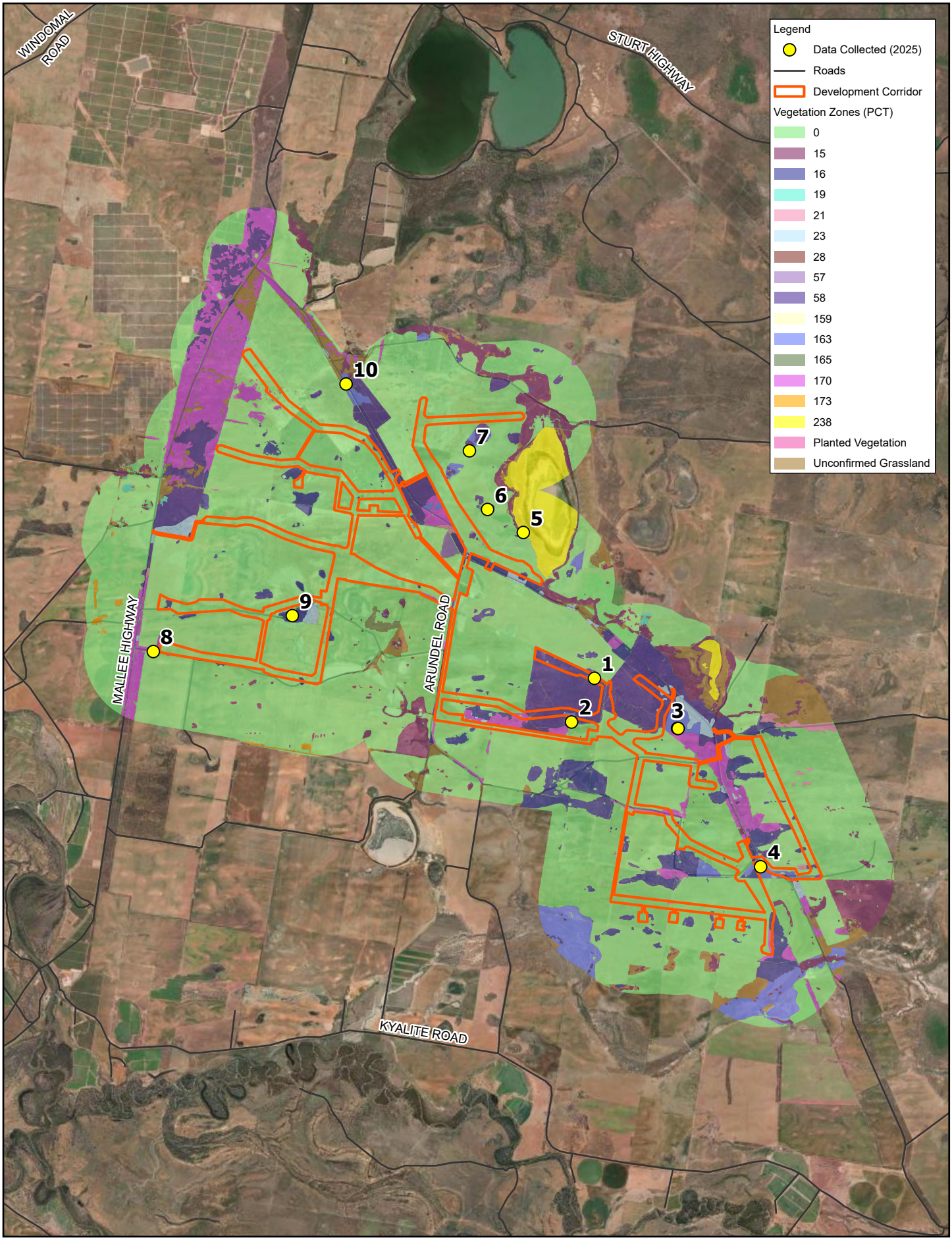
A total of approximately 768 ha is proposed to be developed for the project, of which75.68 ha supports native vegetation, comprising seven NSW Plant Community Types (PCTs). The remaining 692.32 ha comprises non-native, cropped and grazing areas as described above. The description and area of each PCT, within the broader development corridor, is shown in Figure 2 and are described below (Table 1) and is taken from Biosis (2024). Notably, PCT 163 is associated with the Desert Mouse (*Pseudomys desertor*) under BAM assessment predictive habitat mapping.

Table 1 Plant community types, status and area mapped within development footprint

PCT ID	Plant community type	Community description	Condition	Area (ha)	Suitability for Desert Mouse
58	Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	Occurs as a mid-high (about 7 m high) low open woodland or isolated clumps of trees dominated by Black Oak (*Casuarina pauper*) and Western Rosewood (*Alectryon oleifolius* subsp. *canescens*) with either a shrubby or grassy understorey. Widely distributed in the far south-western NSW mainly in the Murray Darling Depression Bioregion, generally subject to less than 400 mm of annual rainfall.	High Moderate DNG (Derived native grassland) Paddock trees	3.34 ha 73.28 ha 97.72 ha 0.32 ha	Not preferred habitat for Desert Mouse and understory heavily disturbed by grazing
170	Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	Occurs as a mallee woodland or open mallee shrubland most usually about 8 m tall dominated by several mallee species including White Mallee (*Eucalyptus dumosa*), Red Mallee (*Eucalyptus socialis*), Glossy-leaved Red Mallee (*Eucalyptus oleosa*) and Snap and Rattle (*Eucalyptus gracilis*). Chenopods shrubs form a major component of the understorey. 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.	Moderate Low DNG Paddock trees	13.87 ha 4.08 ha 22.58 ha 0.03 ha	Mallee communities do at times provide habitat for Desert Mouse, however, generally those that support a *Triodia* spp. hummock grassland that is not present on-site.
16	Black Box grassy open woodland wetland of rarely flooded depressions in south-western NSW, Riverina Bioregion and	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	Moderate Low DNG Paddock trees	9.36 ha 10.72 ha 14.76 ha 0.36 ha	Not preferred habitat for Desert Mouse and understory heavily disturbed by grazing

PCT ID	Plant community type	Community description	Condition	Area (ha)	Suitability for Desert Mouse
	Murray Darling Depression Bioregion	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. 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.			
21	Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	This PCT is comprised of Slender Cypress Pine (*Callitris gracilis subsp. murrayensis*) and Western Rosewood (*Alectryon oleifolius* subsp. *canescens*). A sparse shrub layer includes a variety of chenopods. 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/sheep, timber harvesting and clearing.	Moderate	5.02 ha	Not preferred habitat for Desert Mouse and understory heavily disturbed by grazing
23	Yarran tall open shrubland of the sandplains and plains of the semi-arid (warm) and arid climate zones	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*. Several native grasses and forbs occur. 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.	Moderate	7.73 ha	Not preferred habitat for Desert Mouse and understory heavily disturbed by grazing

PCT ID	Plant community type	Community description	Condition	Area (ha)	Suitability for Desert Mouse
57	Belah/Black Oak - Western Rosewood - Wilga woodland of central NSW including the Cobar Peneplain Bioregion	Occurs as low to mid-high woodland or open woodland dominated by Western Rosewood. 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.	Moderate	0.40 ha	Not preferred habitat for Desert Mouse and understory heavily disturbed by grazing
163	Dillon Bush (Nitre Bush) shrubland of the semi-arid and arid zones	Occurs as low open woodland or isolated stands of trees dominated by Black Oak and Western Rosewood 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 a range of native species including Dillon Bush (*Nitraria billardierei*). The ground cover is generally very sparse and includes low native shrubs and grasses. A grassy ground cover exists in some areas that have been partially cleared and display 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. The main threats to this community are clearing for opportunistic cropping and overgrazing that prevents the regeneration of key woody species.	Moderate	24.85 ha	Some patches appear potentially suitable for *Pseudomys* spp. However the majority of sites are heavily grazed by cattle and sheep and pest species such as cats/foxes are likely to heavily predate on native small ground-dwelling mammals.



Paper Size ISO A4

0 1 2 3 4

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54

N

GHD

Biosis Pty Ltd
Junction Rivers Desert
Mouse Habitat Assessment

Project No. **12665887**
Revision No. **B**
Date **02 Apr 2025**

Plant Community Types

FIGURE 2

\\ghdnet\ghd\AU\Mildura\Projects\31\12665887\GIS\Maps\Working\12665887_figure_fauna\12665887_figure_fauna.aprx
Print date: 02 Apr 2025 - 10:29

Data source: ALA,2025; Bionet 2025; GHD 2025; World Imagery: Earthstar Geographics. Created by: ekafai

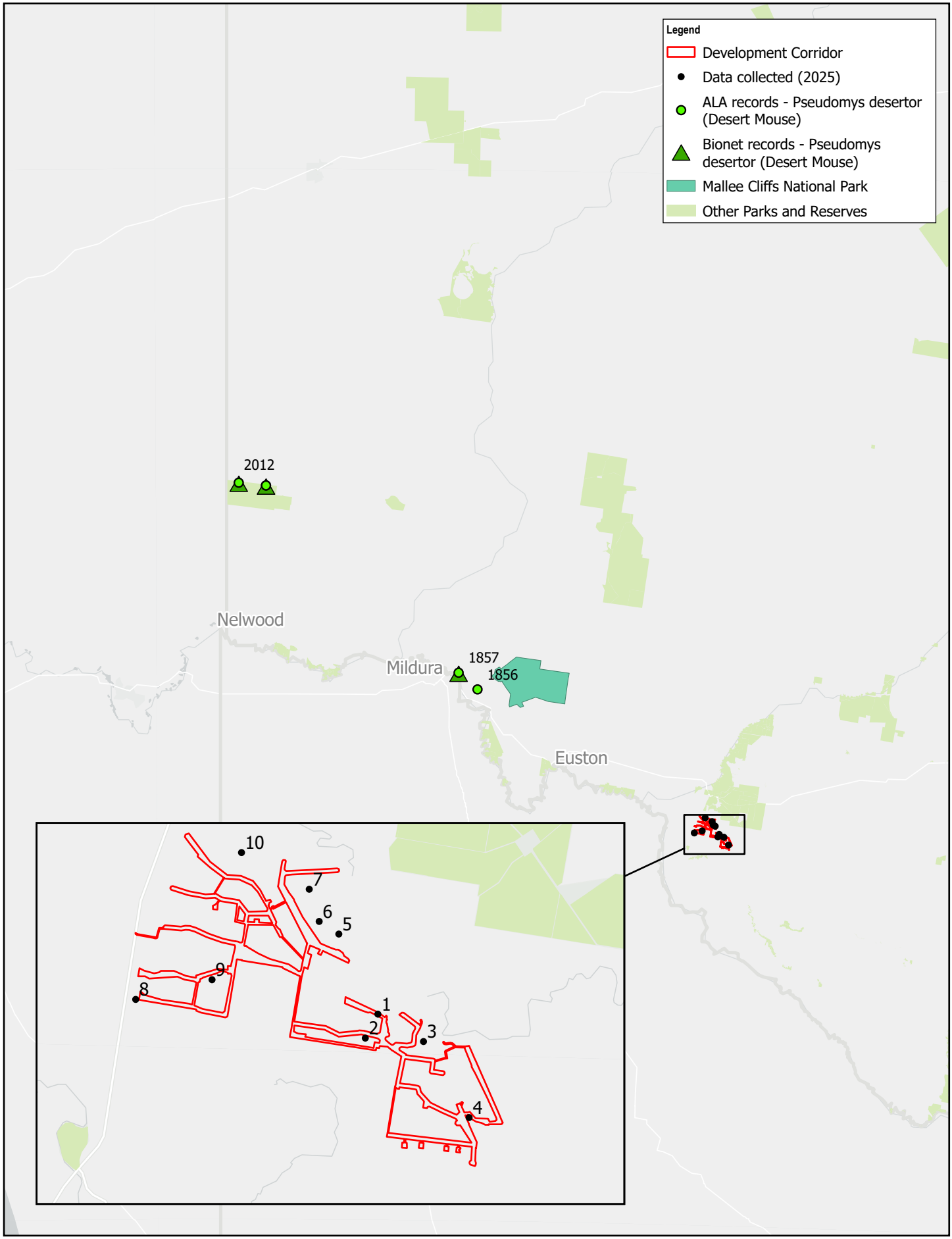
© 2025. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

4. Assessment of species presence and habitat suitability

4.1 Species records and habitat assessments

The Desert Mouse has no local records across historical survey effort in and adjacent to the study area, although Strahan (2023) indicates that it's historical range may extend to somewhere in the vicinity of the study area, although this is likely a broad extrapolation from historic records.

Previous survey effort including numerous surveys conducted across southwestern NSW by the author dating back to 2010, where pitfall and Elliot traps have been employed have not resulted in the detection of the Desert Mouse (unpublished surveys conducted for Tronox Plc and Western Local Land Services, including one survey of 11 large properties with over 3,100 pitfall trap nights). Although Mallee Cliffs National Park is some 160 km away from the study area, regular survey conducted at this location at least provides some indication of likelihood of occurrence of *P. desertor* in addition to recent surveys conducted in Yanga National Park and surrounds for the SDLAAM project, none of which have detected the species. Historical records from ALA and from BioNet across western New South Wales are displayed in Figure 3



Paper Size ISO A4

0 10 20 30 40

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 54

N

GHD

Biosis Pty Ltd

Project No. **12665887**
B
Date **01 Apr 2025**

Figure 3

\\ghdnet\ghd\AU\Mildura\Projects\31\12665887\GIS\Maps\Working\12665887_figure_fauna\12665887_figure_fauna.aprx
Print date: 01 Apr 2025 - 14:26

Data source: ALA,2025; Bionet 2025; GHD 2025; Light Gray Base: Esri, TomTom, Garmin, FAO, NOAA, USGS
Light Gray Base: Vicmap, Esri, TomTom, Garmin, METI/NASA, USGS. Created by: ekafai

4.1.1 Desert Mouse (*Pseudomys desertor*)

There are two records near Mallee Cliffs near Buronga (~160km away), however they are from 1856 and 1857 prior to exotic species such as the feral cat and fox becoming established as important threats to this species in western NSW. The next closest records of the Desert Mouse are from 2012 within the Tarawi Nature Reserve over 360km northwest. This record could be associated with the high rainfall within the two years prior which allowed the species to recolonize Tarawi Nature Reserve. Yearly rainfall statistics for the closest weather stations to Tarawi Nature Reserve is the Mildura Airport (station no. 076031), Pooncarie Mail Agency (station no. 047029) and the Balranald RSL (station no. 049002), a summary of these statistics can be seen in Table 2 ((BOM, 2024). The other record of Desert Mouse within NSW was in 2008 within Sturt National Park, approximately 900km north, where a singular male was detected (OEH 2024).

Table 2 Annual Rainfall Data from Mildura and Pooncarie

Year	Annual Rainfall in Mildura (mm)	Annual Rainfall in Pooncarie (mm)	Annual Rainfall in Balranald (mm)
2008	202.0	227.4	255.8
2009	233.0	228.6	234.2
2010	591.2	567.1	691.6
2011	657.4	533.1	588.3
2012	214.6	N/A	302.6
2013	216.4	201.9	297.2

Approximately 768 hectares of predominantly cleared and cropped land, with areas of mallee woodland, semi-arid open woodlands, black box woodlands, acacia shrublands and open chenopod shrublands and natural waterbodies are proposed to be developed within the study area. Some of these habitat, including open Dillon Bush shrubland habitats are the species preferred habitat however threats of predation and overgrazing likely limit the species ability to recolonise the area, in addition to the relative isolation of the study area from existing locations where *P. desertor* has been found due to the presence of the Murrumbidgee River.

The infrequency of records within New South Wales in general and the age of the records nearby to the development footprint (1800s) indicate that the Development Footprint is unlikely to be within the species' current distribution.

4.2 Recent surveys in the region

There has been extensive survey effort completed within the Mallee Cliffs National Park (~160 km from the study area) primarily completed by the Australian Wildlife Conservancy (AWC) from 2016 to present day. These surveys are done under the AWC-NSW Parks Partnership Projects. Across the AWC-NSW Parks Partnership Projects there have been 34,087 records of 171 species. Prior to this, records within the national park go back to 1965 producing an additional 12,419 records and 84 species.

The Desert Mouse has never been detected throughout the history of survey effort within Mallee Cliffs National Park despite extensive survey effort and suitable habitat for *P. desertor*. Various survey methods have been utilized including live trapping (box, cage, pitfall and funnel), camera traps, acoustic recorder deployment and spotlight transects across the standard monitoring sites.

As mentioned above, the author has been involved in many trapping programs throughout southwestern NSW including a survey for Western LLS that involved over 3,100 pitfall trap nights across 11 properties (unpublished data). Further recent surveys undertaken by the author in large tracts of relatively intact mallee-spinifex habitats north of Balranald for Tronox Plc (unpublished data) have also not yielded any *P. desertor* records (336 pitfall trap nights and 560 Elliot trap nights).

Surveys undertaken by Biosis 2024 included nocturnal bird survey in February 2023 over a four-day period in addition to 24 months of bird and bat utilisation studies with four-day surveys conducted each of spring, summer,

autumn and winter over 2021 and 2022. A summary of the threatened species that have been detected within the study area is listed below (Table 3). No observations of any *Pseudomys* sp. was recorded from any of the surveys, although a survey limitation is that no pitfall or Elliot trapping was undertaken.

Status

EPBC Act - Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
BC Act - Biodiversity Conservation Act 2016 or Fisheries Management Act 1994.

CE – Critically Endangered
EN – Endangered population
V – Vulnerable

Table 3 Threatened Species detected within Mallee Cliffs National Park

Scientific Name	Common Name	EPBC/BC Act Listing
Aves		
Lophochroa leadbeateri	Pink Cockatoo	- / VU
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	VU / EN

4.2.1 2021 GHD site visit

On 20th of March 2025, Alex Holmes (GHD Technical Director, Ecology) travelled to the study area to assess patches of habitat for the potential to provide habitat for the Desert Mouse (*Pseudomys desertor*). Figures 2 and 3 show the locations that were assessed, with a focus being to visit the majority of the patches of PCT 163, some mallee habitats and a patch of Black Box.

Patch 1

Scattered patches of Dillon Bush, with wide spacings between clumps and heavy grazing pressure due to cattle/sheep. Unlikely to provide habitat for *P. desertor* due to heavy grazing pressure and likely susceptibility to predation by exotic predators.

Patch 2

Patch 2 is in close proximity to Patch 1; however the grazing pressure is even more acute with very little groundcover and shrub cover reduced. Unlikely to support *P. desertor* due to heavy grazing pressure.

Patch 3

Patch 3 appears to be in better condition than Patches 1 and 2 with increased groundcover and larger shrub clumps (reduced grazing pressure), cracking clays and spider burrows. Potential exists for species such as Fat-tailed Dunnart (*Sminthopsis crassicaudata*). If *P. desertor* continued to persist throughout NSW, patches such as this could have the potential to support the species, however for all the reasons provided in this report (isolation of study area, heavy grazing elsewhere on the property, presence of exotic predators, lack of any recent records in close proximity to the study area, fragmented landscape of the study area and surrounds) it is unlikely that the species persists.

Patch 4 and 10

Similar to Patch 3, Patch 4 and 10 appears to be in better condition than Patches 1 and 2 with increased groundcover and larger shrub clumps (reduced grazing pressure), cracking clays and spider burrows. Potential exists for species such as Fat-tailed Dunnart (*Sminthopsis crassicaudata*). If *P. desertor* continued to persist throughout NSW, patches such as this could have the potential to support the species, however for all the reasons provided in this report it is unlikely that the species persists.

Patches 5, 6 and 7

Each of these patches are heavily grazed, cleared and isolated via cropping and grazing country and highly unlikely to be suitable for *P. desertor*.

Patch 8

Mallee habitat with no *Triodia* sp. understory and sparse groundlayer, which is unlikely to provide habitat for *P. desertor*.

Patch 9

Black Box woodland, heavily grazed by cattle and sheep and unlikely to be suitable for *P. desertor* due to heavy stock grazing and prevalence of exotic predators.

In summary, the likelihood of occurrence for *P. desertor* on the study area is provided in Table 4 below:

Table 4 Likelihood of occurrence table for target species

Common Name Scientific Name	BC Status	EPBC Status	Habitat association	Likelihood of occurrence
Desert Mouse *Pseudomys desertor*	CE	-	Most records of the Desert Mouse come from sand dune or sand plain habitats dominated by Spinifex (Triodia spp.). Depends on a dense groundcover of grasses, sedges or shrubs; survives in small pockets of habitat and expands into other areas following rains and subsequent vegetation growth. Found to be most abundant in areas with the least historical grazing pressure and disturbance, including fire.	**Low:** Some potentially suitable habitat could occur in the Biodiversity Study Area. The species has not been previously recorded in the locality.

5. Conclusion

Despite potentially suitable habitat being present for the Desert Mouse (*Pseudomys desertor*), the sparse records accompanied with high predation pressure, overgrazing and disturbed vegetation within the development footprint and broader study area, it is unlikely the species is present. The Desert Mouse is a small nocturnal rodent that inhabits semi-arid and arid areas with spinifex or hummock grasslands (ALA 2024b). The study area contains some patches of Dillon Bush (PCT 163), but they are highly degraded and isolated by cleared areas. The high survey effort within other parts of western NSW, including Mallee Cliffs National Park (~160 km away) through the partnership with the Australian Wildlife Conservancy in addition to numerous other trapping programs would be expected to detect the species if present in the broader region of southwestern NSW.

6. References

Atlas of Living Australia (ALA). (2024, July). *Pseudomys desertor : Desert Mouse*. Retrieved from https://bie.ala.org.au/species/https://biodiversity.org.au/afd/taxa/1c2e0a49-5530-48a2-83f3-2d853c89ab03

BOM. (2024, July). *Climate Data Online*. Retrieved from Bureau of Meterology: http://www.bom.gov.au/climate/data/index.shtml

Biosis (2024). Junction Rivers Wind Project, Biodiversity Development Assessment Report. Final report to Umwelt (Australia) Pty Ltd on behalf of Windland Pty Ltd. 15 May 2024.

Gordon Christopher E., F. A. (2015). Mesopredator suppression by an apex predator alleviates the risk of predation perceived by small prey. *Proc. R. Soc. B*, 282: 20142870.

NSW Environment and Heritage. (2024, July). *Desert Mouse (Pseudomys desertor) - crticially endangered species listing*. Retrieved from https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2008-2010/desert-mouse-pseudomys-desertor-critically-endangered-species-listing#:~:text=The%20D

Strahan (2023). Mammals of Australia. New Holland Publishers.

ghd.com

The Power of Commitment