

Biodiversity Development Assessment Report

Yanco Delta Wind Farm Jerilderie NSW

Virya Energy Pty Ltd

28 October 2022



Certification under Section 6.15 of the Biodiversity Conservation Act 2016

I, Jonathan Carr (BAAS18009) certify that this Biodiversity Development Assessment Report and the accompanying finalised credit reports dated 07 November 2022 has been prepared in accordance with therequirements of (and information provided under) the Biodiversity Assessment Method.



Jonathan Carr – BAAS18009

Executive summary

Virya Energy (the Proponent) is proposing to construct, operate and maintain the Yanco Delta Wind Farm (the Project). Approval is being sought under Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) and Part 9, Division 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project is considered State significant development (SSD) pursuant to the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) requiring the preparation of Environmental Impact Statement (EIS) and approval under Part 4, Division 4.7 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). This document is the Biodiversity Development Assessment Report (BDAR) for the project as required under the Biodiversity Assessment Method (BAM). This BDAR documents the methods and results of the biodiversity assessment undertaken for the project in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. This BDAR addresses Stage 1 and Stage 2 of the BAM (DPIE, 2020).

The Project would have a generating capacity of up to 1,500 MW and it would connect to grid via Transgrid's Dinawan Terminal Station located about 16.5 kilometres west, which is scheduled for completion in 2025. The Project area occupies approximately 33,000 hectares of land, with the Project infrastructure to occupy a disturbance footprint of 238 hectares. The land is comprised of 289 lots, owned by eight host landowners.

Landscape

The landscape is slightly undulating to flat with areas of relatively intact native grassland, Acacia and Eucalypt woodland. There are some occurrences of woodland on disturbed sandhills and riparian vegetation along the catchments of Yanco Creek and Delta Creek and there are large areas of disturbed vegetation south of Yanco Creek and north west of Delta Creek. The Project area is located within the Riverina bioregion (Interim Biogeographic Regionalisation for Australia: IBRA) and wholly within the Murrumbidgee IBRA sub-region.

The Project is considered a linear development, containing linear access tracks, cables and transmission lines that link to wind turbine points and hardstands across a very large Project area. The internal linear features also connect to collector substations and two options for the BESS/central primary substation locations. To assess the percentage of the current extent of native vegetation, a 500 metre landscape buffer was applied to the subject land to capture the linear Project features.

The 500 metre buffer is 35,893 hectares in size and contains approximately 30,703 hectares of native vegetation. The native vegetation percentage cover in the landscape buffer is 86%. This is assigned to the >70% BAM vegetation cover class.

Assessment methods

Extensive ecological surveys have been undertaken for this BDAR between September 2021 and September 2022 in accordance with the BAM (see **Table E-1**) including:

- Preliminary PCT mapping
- Identification and detailed mapping of plant community types (PCTs) involving:
 - Stratification of PCTs in survey units (vegetation zones)
 - Plot based floristic vegetation survey and vegetation integrity assessment
- Threatened species habitat assessment
- Targeted threatened species surveys, including:
 - Parallel transects undertaken across suitable habitats within the project area for threatened flora species within prescribed survey periods (seasons)
 - Targeted fauna survey methods were employed including ultrasonic call recording (bats), spotlighting, call playback, timed fixed point bird survey, nest tree survey and stagwatching.

Table E-1 Summary of survey effort, dates and locations

Biodiversity survey	Date	Location of survey
Vegetation		
Rapid PCT assessment and mapping	27-31 October 2021	Study area (all project components)
	8-12 August 2022	Study area (all project components)
Vegetation integrity assessment	15-19 August 2022	Study area (all project components)
Flora species		
Targeted flora surveys	21-30 September 2021	Study area (all project components)
	15-20 November 2021	
	23-27 November 2021	
	17 January 2022	
	5-9 September 2022.	
Fauna species		
Bird and bat utilisation survey	November 2021, February 2022, May 2022 and July 2022	Landscape buffer
Nest tree survey	November 2021, February 2022, May 2022 and July 2022	Fauna buffers
Nocturnal survey	11-14 July 2022 and 18 August 2022	Fauna buffers (100m)
Diurnal observations – nest trees	November 2021 August and September 2022	Fauna buffers
Amphibian surveys	17-21 January 2022	Landscape buffer

Native vegetation and habitats

Within the disturbance footprint there is 173.39 hectares of native vegetation, comprised of ten PCTs, including:

- River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7) – one vegetation zone (Zone 1_low to moderate)
- River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9) - one vegetation zone (Zone 2_low to moderate)
- Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13) - two vegetation zones (Zone 3_moderate to good and Zone 4_low to moderate)
- Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17) - one vegetation zones (Zone 5_moderate to good)
- Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26) - four vegetation zones (Zone 6_moderate to good_grassy, Zone 7_low to moderate_grassy, Zone 8_moderate to good_shrubby and Zone 9_low to moderate_shrubby)

- White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT 28) - one vegetation zones (Zone 10_low to moderate)
- Forb-rich Speargrass - Windmill Grass – White Top grassland of the Riverina Bioregion (PCT 44) - two vegetation zones (Zone 11_moderate to good and Zone 12_low to moderate)
- Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45) - two vegetation zones (Zone 13_moderate to good and Zone 14_low to moderate)
- Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46) - four vegetation zones (Zone 15_moderate to good, Zone 16_low to moderate, Zone 17_moderate to good_conttonbush and Zone 18_low to moderate_conttonbush)
- Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT 160) - one vegetation zone (Zone 19_low to moderate).

The above listed PCTs correspond to six vegetation classes (Keith, 2004) in the study area, that represent different broad habitat types used to stratify fauna survey, including:

- Inland Riverine Forests
- Inland Floodplain Woodlands
- Riverine Plain Woodlands
- Inland Floodplain Swamps
- Riverine Sandhill Woodlands
- Riverine Plain Grasslands.

There are three named waterways, as well as several minor, unnamed drainage depressions situated within the study area. The Project intersects with two ephemeral creeks in the northern and southern portions of the Project area, including Delta Creek in the north, and Turn Back Jimmy Creek in the south. The only perennial waterway, Yanco Creek, is located between the northern and southern portions of the Project area. All three waterways have been deemed sensitive receiving environments. Determination of SREs has considered the following:

- Key Fish Habitat
- Threatened aquatic species
- Threatened aquatic ecological communities.

Threatened Ecological Communities

Four threatened ecological communities (TECs) were confirmed to be present in the disturbance footprint and include the following:

- Natural Grasslands of the Murray Valley Plains listed as critically endangered under the EPBC Act
- Weeping Myall Woodlands listed as endangered under the EPBC Act
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed as endangered under the BC Act
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered under the BC Act.

Groundwater dependent ecosystems

The level of groundwater dependence of vegetation communities in the study area was identified using the Atlas of Groundwater Dependent Ecosystems (GDEs) (Bureau of Meteorology, 2017) and the Risk Assessment Guidelines for Groundwater Dependent Ecosystems released by the NSW DPI (Kuginis et al., 2012). Within the study area, PCTs with a high groundwater dependence and potential for interaction include the following:

- PCT 7: River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion
- PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion.

Threatened species

Two threatened flora species *Swainsona murrayana* and *Swainsona sericea* were identified during targeted surveys. An additional 12 threatened flora species are assumed present in suitable habitat with associated PCTs:

- *Austrostipa wakoolica* – PCTs 17, 26, 28
- *Brachyscome muelleroides* – PCTs 44, 45, 46
- *Brachyscome papillosa* - PCTs 44, 45, 46, 160
- *Caladenia arenaria* – PCT 28
- *Convolvulus tedmoorei* – PCTs 26, 44
- *Cullen parvum* - PCTs 7, 9, 44
- *Lepidium monoplocoides* - PCTs 26, 160
- *Leptorhynchos orientalis* – PCTs 26, 44, 45, 46
- *Maireana cheelii* – PCTs 26, 44, 46
- *Pilularia novae-hollandiae* – PCTs 9, 13, 26, 45
- *Sclerolaena napiformis* – PCTs 26, PCT 44
- *Swainsona plagiotropis* – PCTs 26, 44, 45, 46.

Fauna surveys identified 11 bird species including:

- Spotted Harrier
- White-fronted Chat
- Dusky Woodswallow
- Little Eagle
- Square-tailed Kite
- Grey-crowned Babbler
- Superb Parrot
- Diamond Firetail
- Flame Robin
- Black Falcon
- Varied Sittella.

Southern Myotis and Yellow-bellied Sheath-tail-bat are assumed to be present in areas with suitable habitat. Echolocation calls from Anabat devices for these species could not be positively confirmed.

Plains-wanderer populations are known to occur in the Project area with important area mapping within the study area.

Avoidance and minimisation of impacts

The Project has implemented changes to the design since it began in September 2021. The biodiversity constraints assessment completed in April 2022 identified key locations with high biodiversity conservation value to avoid or minimise impacts. This was informed by biodiversity field surveys, including a rapid PCT mapping survey. The constraints assessment also identified disturbed sites with exotic vegetation, existing access tracks and agricultural cultivated land as opportunities to move infrastructure to avoid high biodiversity values.

During the development of the Project, considerable attention and flexibility was given to the avoidance of the important local habitats. The outcomes of the constraints assessment, ongoing field surveys and advice from BCS identified the following key biodiversity values that have been avoided and impacts minimised to the greatest extent possible.

Biodiversity impacts – direct impacts

While the Project design has avoided and minimised large areas of native vegetation clearing including in areas classified as non-native vegetation, the Project will result in the direct removal of native vegetation (173.39 hectares). The installation of underground cabling will require a narrow clearing of the groundcover and avoid trees and large shrubs where possible.

There will be direct impacts with the clearing of four threatened ecological communities, including:

- Natural Grasslands of the Murray Valley Plains listed critically endangered under the EPBC Act – 88.33 ha
- Weeping Myall Woodlands listed endangered under the EPBC Act – 29.69 ha
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed endangered under the BC Act – 31.09 ha
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed endangered under the BC Act – 10.28 ha.

A large number of hollow-bearing trees and stick nests were recorded in the Project area. Many of these breeding structures are in Eucalypt woodland patches and scattered Cypress Pine trees and are unlikely to be directly impacted during vegetation clearing in the disturbance footprint. Impact to Eucalypt woodland patches (PCTs 7, 9 and 13) comprise 2.01 ha, however this is generally confined to ground trenching for cabling and limited impacts to trees will occur. Proposed powerlines across the Yanco Creek may result in trimming and lopping of *Eucalyptus camaldulensis* (PCT 7). Two medium sized hollow bearing trees are located in the disturbance footprint for cabling and will be avoided during construction.

The estimated total clearing of native vegetation will result in the direct removal and permanent loss of habitat assumed to be occupied by following threatened flora species:

- | | |
|--|--|
| ▪ <i>Austrostipa wakoolica</i> - 19.57 hectares | ▪ <i>Maireana cheelii</i> – 25.75 hectares |
| ▪ <i>Brachyscome muelleroides</i> – 23.57 hectares | ▪ <i>Pilularia novae-hollandiae</i> – 14.43 hectares |
| ▪ <i>Brachyscome papillosa</i> – 23.60 hectares | ▪ <i>Sclerolaena napiformis</i> 25.75 hectares |
| ▪ <i>Caladenia arenaria</i> – 1.49 hectares | ▪ <i>Swainsona murrayana</i> 32.12 hectares
(includes 1.69 hectares of confirmed populations) |
| ▪ <i>Convolvulus tedmoorei</i> - 14.23 hectares | ▪ <i>Swainsona plagiotropis</i> – 28.94 hectares |
| ▪ <i>Cullen parvum</i> – 35.29 hectares | ▪ <i>Swainsona sericea</i> – 27.24 hectares. |
| ▪ <i>Lepidium monoplocoides</i> - 12.92 hectares | |
| ▪ <i>Leptorhynchus orientalis</i> – 25.75 hectares | |

The estimated total clearing of native vegetation will result in the direct removal and permanent loss of habitat that was confirmed to be occupied and utilised by the following threatened fauna species:

- Southern Myotis - 0.9 hectares
- Plains-wanderer – 1.78 hectares.

Biodiversity impacts – indirect impacts

Indirect impacts cannot be quantified, the potential for indirect impacts can be minimised through the application of stringent mitigation measures and monitoring the performance of these. The potential indirect impacts that are applicable to this Project include the following:

- Inadvertent impacts on adjacent vegetation and threatened species habitat: edges effects
- Changed hydrology and sedimentation
- Weed invasion and risk of pathogens
- Increase in predator and pest animal populations
- Collisions and electrocution of fauna with transmission lines
- Changed fire regimes during operation

- Noise, vibration, and light pollution
- Dust pollution
- Contaminant pollution.

Biodiversity impacts – prescribed impacts

Prescribed impacts that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. Prescribed impacts are often difficult to quantify or offset as they often affect unique biodiversity values that are often irreplaceable. Identification of potential prescribed impacts on threatened species or communities and include the following:

- Non-native vegetation as habitat of threatened species or ecological communities
- Connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- Wind turbine strikes on protected animals
- Vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

Biodiversity impacts – uncertain and cumulative impacts

The above summary of impacts from the Project has identified direct, indirect, and prescribed impacts. In some instances the extent, duration and consequence of the impact is uncertain and the management and monitoring of these is important and is a focus of the mitigation and monitoring strategy.

The removal of vegetation for this project would contribute to the cumulative loss of vegetation in the surrounding landscape. The Project would involve removal of around 173.39 hectares of native vegetation, of which 129.70 hectares are TECs. In addition to this there is an estimated 1,554.88 hectares of native vegetation of which 133.20 hectares are TECs that are similar to the Project and are also proposed for removal associated with the approved Project EnergyConnect (Eastern). This is a conservative estimate only based on publicly available information.

Biodiversity impacts – serious and irreversible impacts

Entities at risk of an SAI relevant to the Project and as identified by the BAM-C entities have been evaluated against the principles and criteria set out in subsection 9.1.2 of the BAM for each species. following:

- *Brachyscome muelleroides*
- *Caladenia arenaria*
- *Convolvulus tedmoorei*
- Plains-wanderer.

Mitigation and monitoring

The impacts described are addressed in a mitigation strategy as part of the Construction Environmental Management Plan (CEMP) and applied during the construction and operational phases.

Mitigation measures form the basis and framework for development of project specific Biodiversity Management Plan (BMP) that will include a biodiversity monitoring program to be developed post-approval of the Project. The measures are intended to provide a framework for developing the BMP. The BMP will expand on, and provide more specific detail on the biodiversity mitigation measures.

The BDAR has identified a potential risk of bird and bat collision with turbine blades associated with the operation of the wind farm. Blake strike collision may impact numerous bird and bat with a moderate to high risk rating and affect their home range, their dispersal and genetic exchange in the landscape. A Bird and Bat Adaptive Management Plan will also be developed for the Project and will aim to address the prescribed

impact associated with fauna mortality from blade strike and uncertainty of consequences on regional aerial fauna populations.

The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. The BMP will include a program to evaluate and publicly report on the outcomes of such monitoring.

Offset requirements

The Project will have direct impacts on 173.39 hectares of native vegetation within the disturbance footprint. Project impacts and offset obligations will be revised throughout the life of the Project through the monitoring program. Where there is opportunity to modify the clearing extent and the potential biodiversity impact post-approval, this will be done as part of the detailed design and analysis of operational management requirements.

Indirect impacts are subject to the efficacy of implemented environmental controls. These are mitigated through effective environmental management during construction and associated with adaptive management. The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. Any substantial loss in future VI that cannot be mitigated will need to be reflected in the future offset obligation.

In summary, a credit requirement has been generated by the BAM-C for the project and comprise the following totals:

- 5,854 ecosystem credits
- 13,675 species credits.

Contents

Executive summary	ii
Glossary of terms	1
Glossary of acronyms	4
1. Introduction.....	5
1.1 Background.....	5
1.2 Legislative context.....	5
1.3 Minimum requirements for a BDAR.....	7
1.4 Terms and definitions.....	8
1.5 Agency consultation.....	8
1.6 Personnel.....	9
2. Description of the Project	15
2.1 Project location	15
2.2 Key Project elements	15
2.3 Excluded impacts	20
3. Landscape features.....	28
3.1 Background research and key information sources	29
3.2 Bioregion and subregion	29
3.3 NSW (Mitchell) landscapes.....	29
3.4 Rivers and streams.....	30
3.5 Wetlands.....	30
3.6 Connectivity of habitat.....	31
3.7 Areas of geological significance.....	31
3.8 Soil landscapes.....	31
3.9 Soil hazard features.....	32
3.10 Acid sulfate soils.....	32
3.11 Areas of outstanding biodiversity value.....	32
3.12 Native vegetation extent	32
4. Native vegetation and vegetation integrity.....	41
4.1 Background research and key information sources	42
4.2 Mapping native vegetation extent.....	42
4.3 Plant community type identification	43
4.4 Plant community types.....	73
4.5 Vegetation zones and vegetation integrity scores	105
4.6 Assessment of patch size	111
4.7 Threatened ecological communities	112
4.8 Groundwater dependent ecosystems	122
4.9 Vegetation survey limitations.....	123
5. Threatened species.....	125
5.1 Habitat assessment	125
5.2 Targeted species survey methods	141

5.3	Threatened species survey results.....	173
6.	Identification of prescribed impacts.....	226
6.1	Impacts of wind farm strikes on protected animals	228
7.	Aquatic assessment.....	251
7.1	Methodology.....	252
7.2	Sensitive Receiving environments.....	256
8.	Assessment for Matters of National Environmental Significance.....	262
8.1	World heritage properties and national heritage places	262
8.2	Wetlands of international and national importance.....	262
8.3	Threatened ecological communities	262
8.4	Threatened species.....	263
8.5	Migratory species	264
8.6	Summary findings of the assessment of significance.....	264
9.	Impact avoidance and minimisation	267
9.1	Locating the Project to avoid and minimise direct and indirect impacts on biodiversity values	267
9.1.2	Designing the Project to avoid and minimise direct and indirect impacts on biodiversity values.....	268
9.1.3	Locating and designing the Project to avoid and minimise prescribed impacts.....	269
9.2	Summary of measures to avoid and minimise impacts	270
10.	Assessment of impacts	272
10.1	Direct impacts.....	272
10.2	Indirect impacts on native vegetation and habitat	278
10.3	Prescribed impacts	295
10.4	Summary of uncertain impacts.....	302
10.5	Cumulative impacts.....	302
11.	Serious and irreversible impacts	308
12.	Mitigation and managing impacts.....	310
12.1	Mitigation measures.....	310
12.2	Monitoring program and adaptive management.....	327
13.	Impact summary	331
13.1	Impacts for which the assessor is required to determine an offset requirement.....	331
13.2	Impacts for which the assessor is not required to determine an offset requirement.....	335
13.3	Impacts that do not need further assessment.....	335
14.	Biodiversity credit requirements	339
15.	References	344

Glossary of terms

Terms	Definitions
Biodiversity Assessment Method (BAM)	The BAM (2020) is the assessment manual that outlines how an accredited person assesses impacts on biodiversity at development sites and stewardship sites. It is a scientific document that provides: <ul style="list-style-type: none"> a consistent method for the assessment of biodiversity on a proposed development or major Project, or clearing site, guidance on how a proponent can avoid and minimise potential biodiversity impacts, and the number and class of biodiversity credits that need to be offset to achieve a standard of 'no net loss' of biodiversity.
Biodiversity credits	Ecosystem credits or species credits.
Biodiversity credit report	The report produced by the BAM Calculator (BAM-C) that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land in order to compensate for losses to biodiversity values from the impacts of development.
Biodiversity Offset Scheme (BOS)	The BOS is a NSW government framework which creates a transparent, consistent, and scientifically based approach to biodiversity assessment and offsetting for development that is likely to have a significant impact on biodiversity.
Biodiversity Offset Strategy	A strategy for offsetting residual impacts associated with a development.
Biodiversity Assessment Method Calculator (BAM-C)	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development.
Bioregion	Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale.
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to the Projects Secretary's Environmental Assessment Requirements for cumulative impact assessment requirements.
Direct impact	An impact on biodiversity values that is a direct result of vegetation clearance and loss of habitat for a development. It is predictable, usually occurs at or near to the Project area and can be readily identified during the planning, design, construction, and operational phases of a development.
Disturbance footprint	Maximum extent of physical disturbance likely to be required to accommodate construction and operational activities including minor adjustment to design and temporary and permanent infrastructure
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms living in a unique location. Ecological communities can be listed as threatened under the EPBC Act and/or BC Act.
Ecosystem credit	A measurement of the value of endangered ecological communities (EECs), critically endangered ecological communities (CEECs) and threatened species habitat for species that can be reliably predicted to occur with a plant community type (PCT). Ecosystem credits measure the loss in biodiversity values at a Project area and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	Threatened species that can be reliably predicted to occur with a PCT, for which species-specific biodiversity credits are not required.
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population, or ecological community, including any biotic or abiotic component.

Biodiversity Development Assessment Report

Terms	Definitions
Indirect impact	<p>An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact.</p> <p>Compared to direct impacts, indirect impacts often:</p> <ul style="list-style-type: none"> ▪ occur over a wider area than just the site of the development ▪ have a lower intensity of impact in the extent to which they occur compared to direct impacts ▪ occur off site ▪ have a lower predictability of when the impact occurs ▪ have unclear boundaries of responsibility.
Landscape buffer	Subject land with a 500 metre buffer; assessment area required by the BAM to identify landscape features (see Chapter 3) surrounding the transmission line to provide site context and to inform the likely habitat suitability
Local population	The population that occurs in the Project area. In cases where multiple populations occur in the Project area and/or a population occupies part of the Project area, impacts on the entirety of each population must be assessed separately.
Locality	Bioregion sub-regions in which the Project would be located – the Murrumbidgee sub-region of the Riverina Bioregion.
MNES	A matter of national environmental significance (MNES) protected by a provision of Part 3 of the Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils, and broad vegetation types, mapped at a scale of 1: 250,000.
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Patch	A patch is defined in the BAM as an area of intact native vegetation that occurs on the subject land. The patch may extend onto adjoining land beyond the Project area of the subject land, and for woody ecosystems, includes native vegetation separated by ≤ 100 m from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to ≤ 30 m.
Plant community type	A NSW plant community type (PCT) is identified using the PCT classification system. The classification system is approved by the NSW Plant Community Type Control Panel and described in the BioNet Vegetation Classification database, which describes how to identify PCTs and TECs as per the NSW PCT classification, and details each PCT and its geographic distribution.
Population	A group of organisms, all of the same species, occupying a particular area.
Project area	The Project area is defined as the property boundaries of Host landowners (i.e. landowners that have entered into agreements with Virya Energy to have WTGs or associated infrastructure on their properties).
Sensitivity to gain class	The biodiversity risk weighting (Section 6.6 of the BAM) is one tool used in the Biodiversity Offsets Scheme to mitigate the risk in offsetting the loss of vegetation, threatened entities and/or their habitat. The biodiversity risk weighting does this by increasing the quantum of credits required at an impact site. Sensitivity to potential gain is based on life history characteristics and ecological information for a species.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Species credit species	Threatened species that are assessed according to Section 5.22 of the BAM which may generate species-specific biodiversity credit requirements.
Study area	Land within the Project area which was subject to the vegetation integrity assessment and targeted candidate species searches
subject land	<p>Study area with a 500 metre buffer; this is the land that is subject to development, activity, and/or clearing; this is used for:</p> <ul style="list-style-type: none"> ▪ the capture the biodiversity values outside of the study area for nest trees ▪ any indirect impacts.
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.

Biodiversity Development Assessment Report

Terms	Definitions
Threatened Biodiversity Data Collection	Part of the BioNet database, accessible from the BioNet website at www.bionet.nsw.gov.au .
Threatened species	A species listed under the NSW <i>Biodiversity Conservation Act 2016</i> (BC Act), <i>Fisheries Management Act 1994</i> (FM Act) or EPBC Act.
Threatened ecological community	A community of different species associated with one another and sharing the same habitat, that is listed under the BC Act, FM Act and EPBC Act. Threatened ecological communities are listed as endangered or critically endangered under the NSW BC Act, or may be listed as vulnerable, endangered, or critically endangered under the Commonwealth EPBC Act.

Glossary of acronyms

Acronym	Definitions
APZ	Asset protection zone
BAM	Biodiversity Assessment Method 2020
BAM-C	Biodiversity Assessment Method Calculator
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BCS	NSW Biodiversity, Conservation & Science
BDAR	Biodiversity Development Assessment Report
BESS	Battery energy storage system
CEMP	Construction environmental management plan
DPE	Department of Planning and Environment (NSW)
DPIE	Department of Planning, Industry and Environment (NSW) (replaced by DPE)
DPI	Department of Primary Industries (NSW)
EEC	Endangered Ecological Community
EESG	Environment, Energy and Science Group (NSW DPE)
EIS	Environmental impact statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
IBRA	Interim Biogeographic Regionalisation for Australia
kV	Kilovolt
MW	Megawatt
MWh	Megawatt hour
MNES	Matters of National Environmental Significance
NEM	National Energy Market
NSW	New South Wales
OEH	Office of Environment and Heritage (replaced by EESG)
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State significant development
South-West REZ	South-West Renewable Energy Zone
TBDC	Threatened Biodiversity Data Collection (BioNet)
TECs	Threatened Ecological Communities
TSC Act	<i>Threatened Species Conservation Act 1995</i>
VIS	Vegetation information system (BioNet Vegetation Classification)
WTGs	Wind turbine generators

1. Introduction

1.1 Background

Virya Energy (the Proponent) is proposing to construct, operate and maintain the Yanco Delta Wind Farm (the Project). Approval is being sought under Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) and Part 9, Division 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Project would involve the construction, operation and maintenance of a wind farm with up to 208 wind turbine generators (WTGs), a battery energy storage system (BESS) and associated electrical infrastructure. The generating capacity of the wind farm is approximately 1,500 megawatts (MW). The Project would be located within the South-West Renewable Energy Zone (REZ), 10 km north-west of the town of Jerilderie, within the Murrumbidgee Council and Edward River Council Local Government Areas (LGAs) (refer to **Figure 1-1**).

The Project area is defined as the property boundaries of Host landowners (i.e. landowners that have entered into agreements with Virya Energy to have WTGs or associated infrastructure on their properties). The Project area occupies approximately 33,000 hectares of land, with the Project infrastructure to occupy a disturbance footprint of 238 hectares. The land is comprised of 289 lots, owned by eight host landowners. Each host landholder has signed Option to Lease agreements with Virya Energy to have WTGs or Project associated infrastructure on their properties.

The Project would have a generating capacity of up to 1,500 megawatts (MW) and it would connect to the grid via Transgrid's Dinawan Terminal Station, which is scheduled for completion in 2025 as part of Project EnergyConnect. The Project would further contribute and improve the reliability of renewable energy supply by providing storage and firming capacity to the National Energy Market (NEM).

1.2 Legislative context

The Project is considered State significant development (SSD) pursuant to the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) requiring the preparation of Environmental Impact Statement (EIS) and approval under Part 4, Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Under the NSW *Biodiversity Conservation Act 2016* (BC Act) an SSD application must also be accompanied by a Biodiversity Development Assessment Report (BDAR). This BDAR is one of several technical papers that form part of the EIS prepared for the Project.

In accordance with Part 6 of the NSW BC Act, the Biodiversity Offsets Scheme (BOS) applies to all SSD unless the Secretary of DPE and the Chief Executive of the Environment Energy & Science (EES) Group determine that the Project is not likely to have a significant impact. The BOS is the legislated framework that is required when addressing impacts on terrestrial biodiversity from development and clearing. It also ensures that land used to offset impacts is secured in the long term.

A referral was submitted by the Proponent to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) [formerly referred to as the Department of Agriculture, Water and the Environment (DAWE)], on 28 June 2022 (EPBC Referral 09214). The referral identified potential for significant impacts to Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) listed matters of national environmental significance (MNES), which are likely to occur or use habitat within the Project area and be impacted by the project.

The Commonwealth Minister for the Environment and Water determined that the Project is likely to have a significant impact on MNES and therefore is a 'controlled action' under Part 7 of the EPBC Act. Consequently, the Project will be assessed under an Assessment Bilateral Agreement, allowing a single environmental impact assessment process for both the Commonwealth and NSW government.

Secretary's Environmental Assessment Requirements (SEARs) (SSD-41743746) were issued on 27 May 2022 by the Planning Secretary of the NSW Department of Planning and Environment (DPE) for the Project. Supplementary SEARs applicable to EPBC Act listed MNES were issued on 08 September 2022 by the Planning Secretary of the NSW DPE.

Biodiversity Development Assessment Report

This BDAR has been prepared in accordance with the requirements of both the SEARs and the supplementary SEARs. The key biodiversity issues and the section of this report where they are addressed are detailed in **Table 1-1**.

Table 1-1. SEARs and supplementary SEARs – Biodiversity

Biodiversity key issues		Section addressed
SEARs		
<ul style="list-style-type: none"> an assessment of the biodiversity values and the likely biodiversity impacts of the Project, including impacts associated with transport route road upgrades in accordance with the <i>Biodiversity Conservation Act 2016</i> (NSW), the Biodiversity Assessment Method (BAM) 2020 and documented in a Biodiversity Development Assessment Report (BDAR), including a detailed description of the proposed regime for avoiding, minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the BC Act 	<p>This report is a BDAR that has been prepared in accordance with the BC Act and BAM</p> <p>The BDAR has identified the following biodiversity values that may be impacted by the Project in Chapter 10.</p> <p>A detailed description of the proposed regime for avoiding, minimising, managing and reporting on the biodiversity impacts is described in Chapter 12.</p>	
<ul style="list-style-type: none"> an assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the <i>Fisheries Management Act 1994</i>, and a description of the measures to minimise and rehabilitate impacts, including impacts to Delta Creek, Yanco Creek and Turn Back Jimmy Creek 	<p>The BDAR has identified the following aquatic biodiversity values in the study area in Chapter 6 and assessment of impacts addressed in Chapter 10.</p>	
<ul style="list-style-type: none"> an assessment of 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 	<p>An assessment of the impacts of the development on birds and bats is provided in for prescribed impacts section in Section 10.3.</p>	
<ul style="list-style-type: none"> if an offset is required, include details of the measures proposed to address the offset obligation. 	<p>Residual impacts of the Project that require offsets are described in Chapter 14.</p>	
Commonwealth DCCEEW Environmental Assessment Requirements – Supplementary SEARs		
15.	<p>The EIS must identify each EPBC Act listed threatened species and community and migratory species likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the Project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted</p>	<p>The assessment of EPBC listed entities is presented in Chapter 8, and nature, quantum and consequences assessed in Chapter 10 with Assessment of Significance presented in Appendix J and Appendix K.</p>
16.	<p>Further analysis of the impacts of the 2019-2020 bushfires on EPBC Act listed threatened species and communities should be undertaken during the assessment. Further assessment will determine whether the remaining habitat within the proposed action area is of substantially greater importance to the survival of the listed threatened species following the fires and/or whether the population of the species in the area is considered an important population. This information, once obtained, can be considered when determining avoidance, mitigation and offset measures for these species.</p>	<p>Not applicable.</p>

Biodiversity key issues		Section addressed
17.	<p>For each of the EPBC Act listed threatened species and communities and migratory species likely to be impacted by the action the EIS must provide a separate:</p> <ol style="list-style-type: none"> i. description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans ii. details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements iii. description of the relevant impacts of the action having regard to the full national extent of the species or community's range iv. description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action v. identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account; vi. a description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established vii. details of how the current published NSW Biodiversity Assessment Method (BAM) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts viii. details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the BAM and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites. 	<p>The survey and assessment of EPBC listed entities is presented in Chapter 4, Chapter 5, Chapter 6 and Chapter 8. Avoidance and mitigation measures and presented in Chapter 9 and Chapter 12. The nature, quantum and consequences assessed in Chapter 10 with Assessment of Significance presented in Appendix J and Appendix K.</p>
18.	<p>Any significant residual impacts not addressed by the BAM may need to be addressed in accordance with the EPBC Act 1999 Environmental Offset Policy. https://www.dcceew.gov.au/environment/epbc/publications/epbc-act-environmental-offsets-policy .</p>	<p>The Project has potential significant residual impacts on Natural Grasslands of the Murray Valley Plains and Plains-wanderer</p>

1.3 Minimum requirements for a BDAR

This BDAR has been prepared in accordance with the Biodiversity Assessment Method (BAM) (DPIE 2020), documenting the first two stages:

- Stage 1 – Biodiversity assessment
- Stage 2 – Impact assessment (biodiversity values and prescribed impacts).

The BAM Calculator (BAM-C) case number 29138/29139 / Revision 2 are associated with this BDAR. The BAM Calculator and case file has been formally submitted on 02 November 2022.

The minimum information requirements as detailed in Appendix K of the BAM (DPIE 2020) and the corresponding section of this report where they are addressed are provided in **Appendix A**.

1.4 Terms and definitions

The following terms are used throughout this report to describe particular geographic areas (**Figure 1-2**):

- **Project area:** defined as the property boundaries of Project landowners hosting WTGs
- **Study area:** the land within the Project area which was subject to the vegetation integrity assessment and targeted candidate species searches. The study area represents the limit of disturbance during construction and is the disturbance footprint with a 10 m buffer
- **Subject land:** includes the study area with a 500 m buffer. It is the land that is subject to the development, activity, and/or clearing and is used to capture:
 - The biodiversity values outside of the study area, including nest trees buffers
 - Any indirect impacts.
- **Habitat buffer:** the area of a habitat buffer (flora or fauna) applies to species credit species to define a species polygon where suitable habitat occurs within a vegetation zone. The purpose of the habitat buffer is to show the area to minimise disturbance/avoid clearing for both direct and indirect impacts within the subject land. The size of a habitat buffer varies for each species.
- **Disturbance footprint:** maximum extent of physical disturbance likely to be required to accommodate construction, operational and decommissioning activities for temporary and permanent infrastructure. The disturbance footprint is used to determine:
 - The direct impact on biodiversity values
 - The vegetation clearing limit that the Proponent is seeking Project approval.
- **Landscape buffer:** the area of land that includes the subject land and a 500 m buffer surrounding the outside edge of the subject land boundary to provide site context and to inform the potential for species habitat suitability. The landscape buffer is equivalent to an assessment area defined in the BAM and describes an area of land that includes a 500 m buffer around the subject land identified as per section 3.1.2 of the BAM
- **Locality:** the sub-region in which the Project would be located – the sub-region of the Riverina Bioregion.

1.5 Agency consultation

The NSW Biodiversity, Conservation & Science (BCS) (formerly Biodiversity Conservation Division) directorate of DPE, and Commonwealth DCCEEW (formerly DAWE) were consulted throughout the development of this BDAR to confirm survey adequacy and to inform them of key findings identified during the assessment. Discussions also included agency guidance and advice regarding proposed survey methodology, timing and the requirements in accordance with the BAM (DPIE 2020).

Two formal meetings were held with BCS personnel Miranda Kerr, Andrew Fisher and threatened species officers via teams on:

- 17 November 2022 – the meeting was targeted around the review, discussion and approval of the proposed Project survey design. BCS personnel also consulted internally with BCS threatened species officers to advise on best timing for surveys and survey effort. Advice was also given in relation to timing of vegetation integrity assessment for late winter and approach to assigning PCTs and vegetation zones, particularly with relationships between natural grassland, derived grassland and open woodland.
- 07 June 2022 – discussion on whether additional targeted surveys for threatened flora detectable in September were required to meet the BAM (DPIE 2020) as a result of a revised disturbance footprint. An additionally survey was mobilised the first week of September 2022 targeting 11 (flora) species credit species.

The timing of late winter surveys for the vegetation integrity assessment was considered best for detecting ground layer species at their optimal life cycle. This advice was endorsed by BCS and is recommended in the Approved Conservation Advice for Natural Grasslands of the Murray Valley Plains (TSSC, 2012).

1.6 Personnel

The work required to prepare this BDAR was undertaken by appropriately qualified and experienced ecologists. Details regarding the personnel, their roles, qualifications and years of experience which contributed to the biodiversity assessment for the Project are provided in **Appendix B**.

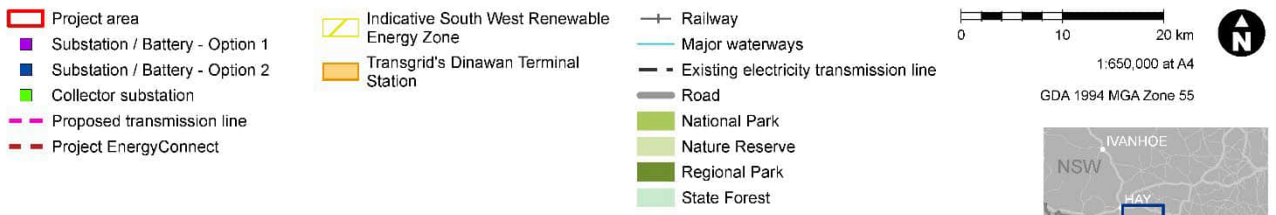
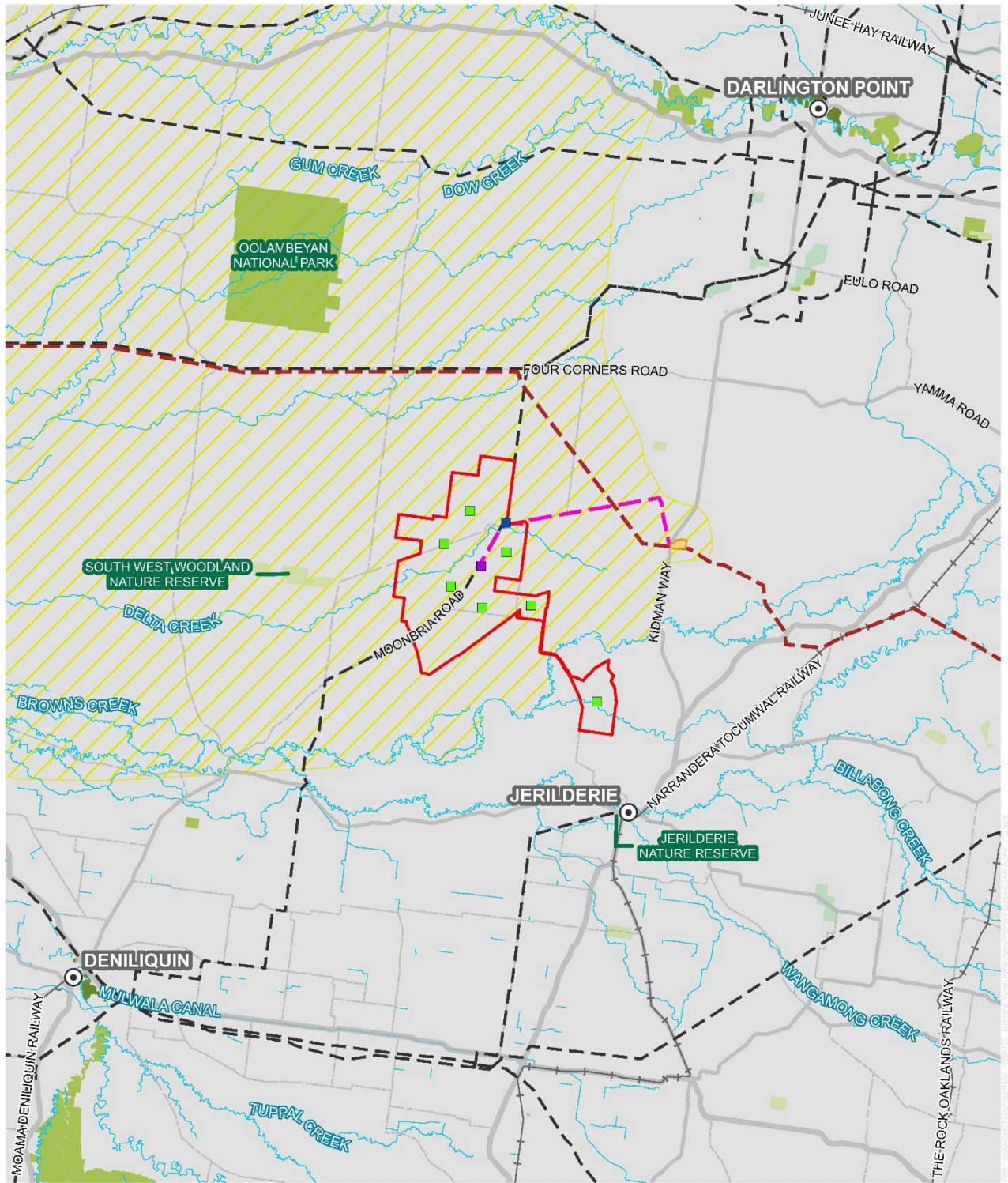
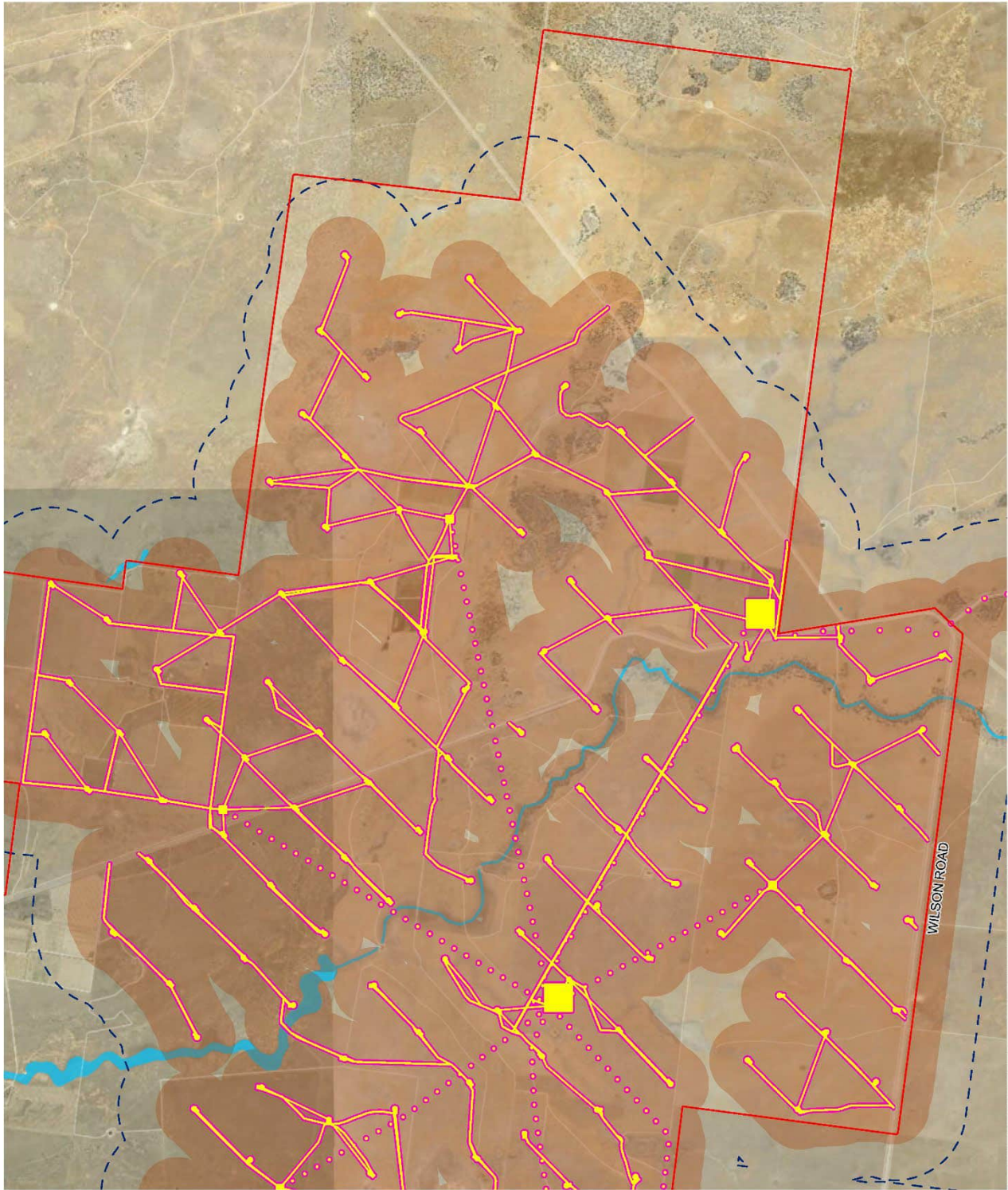


Figure 1-1. Project location

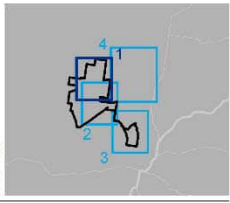
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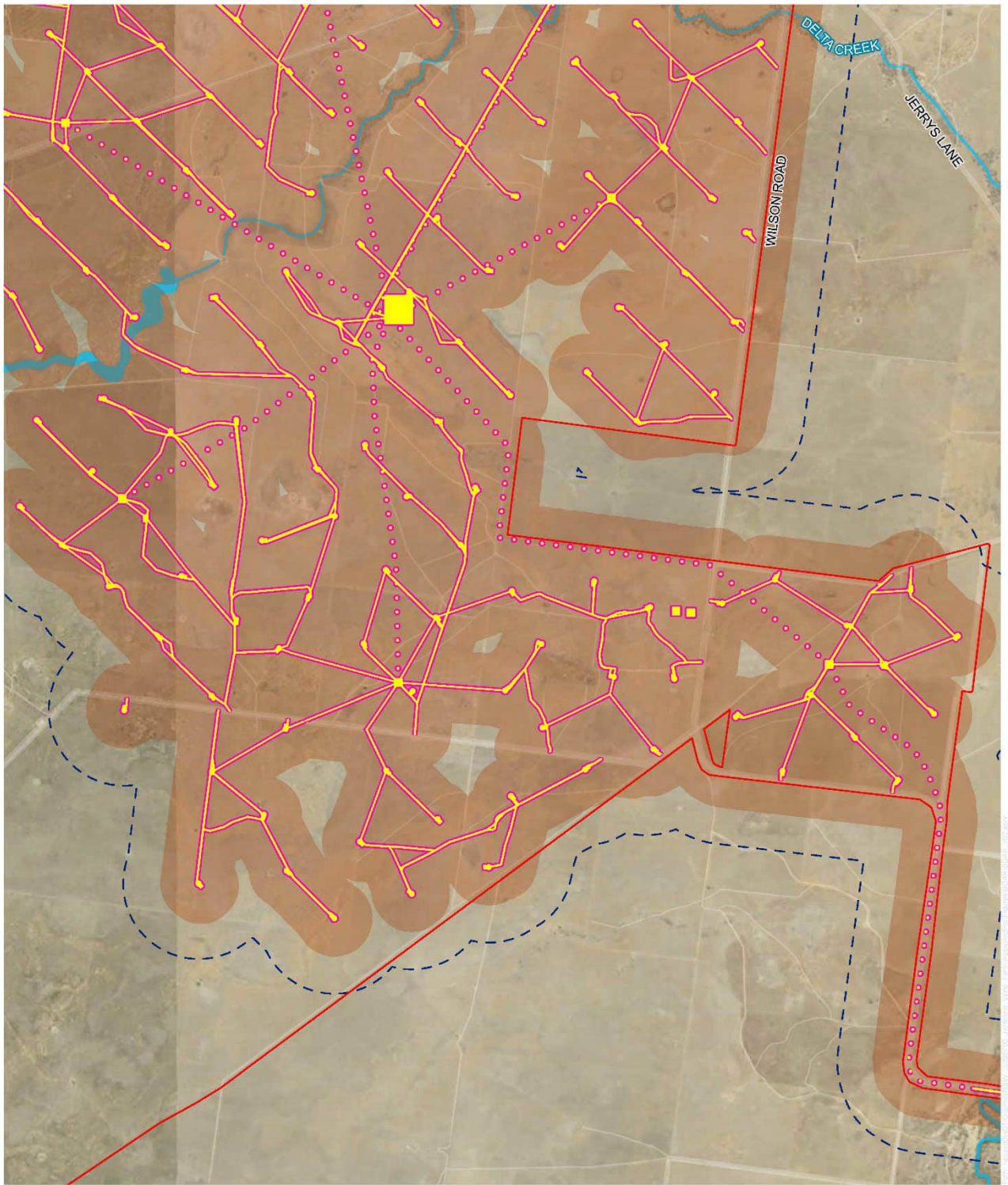
- Disturbance footprint
- Study area
- Waterways
- Project area
- Subject land
- Landscape buffer

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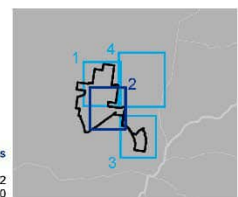
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Figure 1-2. Site map (Page 1 of 4)



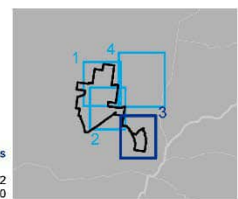
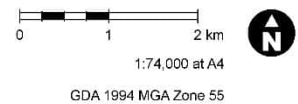
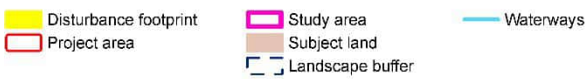
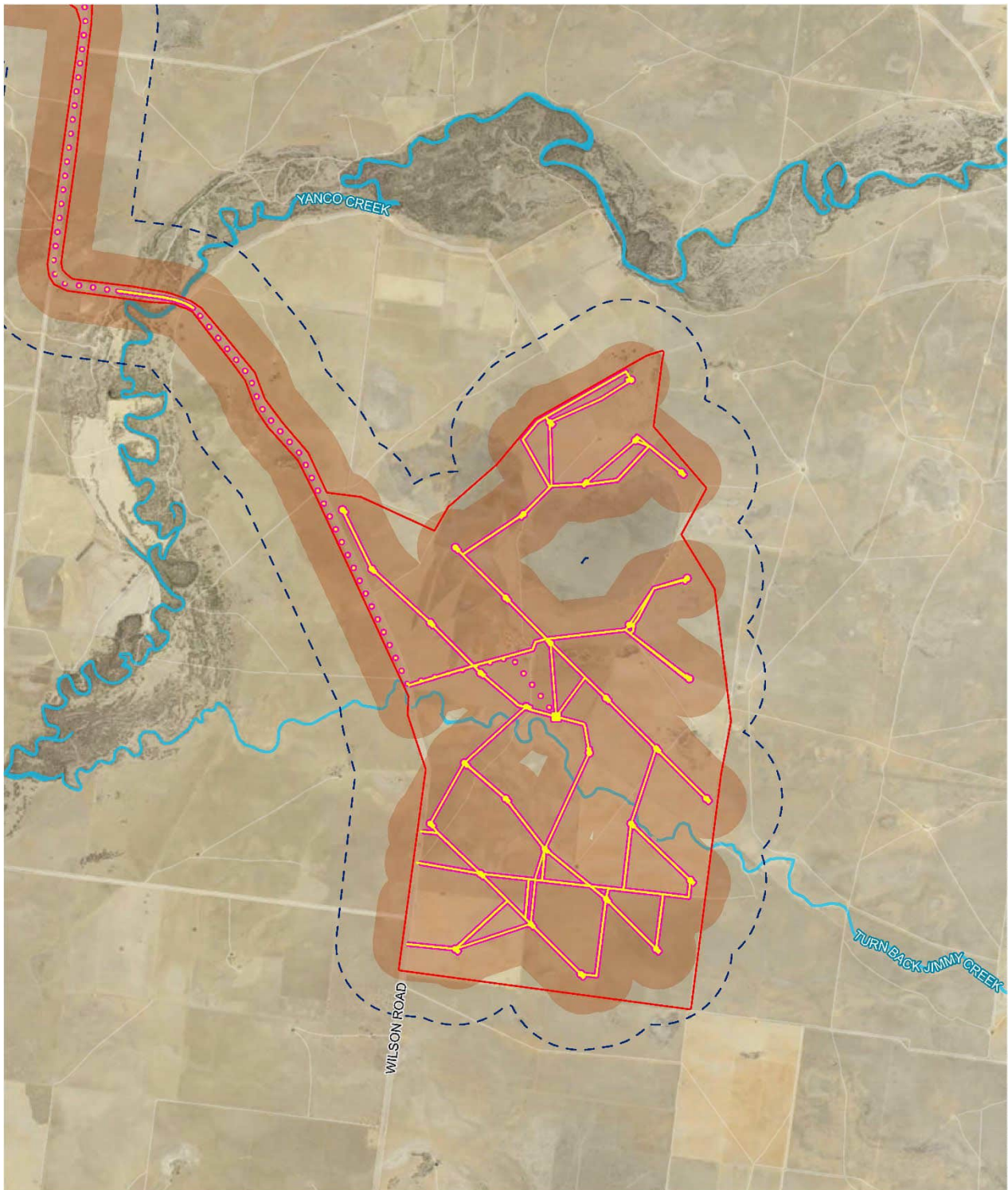
- Disturbance footprint
- Study area
- Waterways
- Project area
- Subject land
- Landscape buffer

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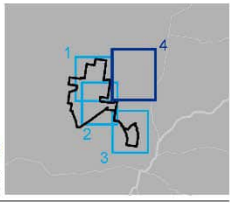
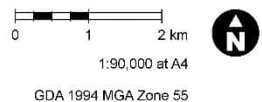
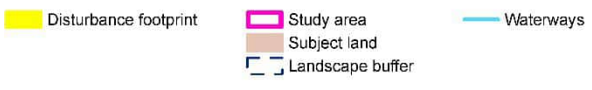
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Figure 1-2. Site map (Page 2 of 4)



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Figure 1-2. Site map (Page 3 of 4)



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Figure 1-2. Site map (Page 4 of 4)

2. Description of the Project

2.1 Project location

The Project is located across the Murrumbidgee Council and Edward River Council LGAs within the South-West REZ. The Project area occupies approximately 33,000 hectares of land, with the Project infrastructure to occupy a disturbance footprint of 238 hectares. The land is comprised of 289 lots wholly owned by eight host landowners. Each host landholder has entered into an Option to Lease agreement with Virya Energy to have WTGs or Project associated infrastructure on their properties (refer to **Figure 2-1**).

The Project area is zoned RU1 – Primary Production under the *Conargo Local Environment Plan 2013* (Conargo LEP) and *Jerilderie Local Environmental Plan 2012* (Jerilderie LEP). Historic and current land use for the Project area consists of agricultural activities predominantly sheep grazing, in addition to cereal cropping and more recently smaller parcels of cotton. A portion of the Project area (west of Wilson Road) is mapped as Category 3 bush fire prone land, presenting a medium bush fire risk. The Project area lies within an alluvial plain and contains three watercourses:

- Yanco Creek – a major perennial watercourse flowing south-west across the Project area toward the Murray River
- Delta Creek – a minor, ephemeral watercourse flowing south-west during significant rainfall events, connecting to downstream channels only when flooding occurs
- Turn Back Jimmy Creek – a minor watercourse which flows across the south of the Project area.

The landscape is slightly undulating to flat with areas of relatively intact native grassland, Acacia and Eucalypt woodland. There are some occurrences of woodland on disturbed sandhills and riparian vegetation along the catchments of Yanco Creek and Delta Creek and there are large areas of disturbed vegetation south of Yanco Creek and north west of Delta Creek.

The Jerilderie Nature Reserve is about ten kilometres south of the Project area (refer to **Figure 1-1**). Three small nature reserves of South West Woodland about eight kilometres west, 17 kilometres east, and 23 kilometres south of the Project area. Oolambeyan National Park is approximately 24 kilometres north-west of the Project area and the Murray Valley National Park is located about 33.5 kilometres south-west.

2.2 Key Project elements

An overview of the Project layout is presented in **Figure 2-1** and the key Project elements are summarised below.

The Project would have a generating capacity of up to 1,500 MW and it would connect to grid via Transgrid's Dinawan Terminal Station located about 16.5 kilometres west, which is scheduled for completion in 2025. The use of wind power as the predominant generation type for the Project has been driven by the requirement to harness energy and charge batteries at night, minimising the area of land to be impacted. Wind power consumes less energy, produces more energy and contributes less carbon dioxide to the atmosphere than other renewable energy options.

The Project consists of the construction, operation and decommissioning of the following:

- Project access would be via a designated and upgraded access track from Liddles Lane, four kilometres east of Wilson Road
- Up to 208 three-bladed WTGs, each consisting of:
 - Up to 8 MW in generation capacity
 - Tip height – up to 270 metres
 - Rotor diameter – up to 220 metres*
 - Tower (hub) height – up to 180 metres*
 - Blade length – up to 110 metres (split blade)*
 - Crane hardstand area and turbine laydown area

*Note the combination of the rotor diameter/blade length and hub height would be a maximum of 270 metres

- A 800 MW / 800 megawatt hour (MWh) BESS
- Electrical reticulation infrastructure, including:
 - A central primary substation
 - Up to eight collector substations and associated overhead power lines to connect to the central substation
 - Underground and/or overhead 33 kV or 66 kV power lines to transmit the electricity generated by the WTGs to the collector substations and/or the BESS
 - 330 kV or 500 kV transmission line to connect the central primary substation to Dinawan Terminal Station via McLennons Bore Road and Cadell Road.
- Permanent ancillary infrastructure, including:
 - An operation and maintenance facility, including site offices and car park
 - Up to eight permanent meteorological masts, located close to a WTG location, with a maximum height of 180 metres
 - Internal access tracks to, from and in between WTGs and substations.
- Temporary construction facilities including:
 - One construction compound with laydown areas
 - Stockpile areas
 - Up to two concrete batch plants adjacent to the construction compound
 - Gravel borrow pits (if feasible).
- Upgrades and minor modifications to local roads and crossings where required for the delivery, installation and maintenance of WTG components and associated materials and structures.

Two options for BESS/central primary substation have been considered as part of the EIS, where Option 1 occurs in native vegetation and BESS Option 2 occurs in non-native vegetation. During detailed design, one option will be chosen with an impact up to 15 hectares with consideration of avoiding and minimising impacts to biodiversity values. For the purposes of this assessment, Option 1 has been adopted to consider worst-case impacts.

There are no other related developments or additional components of the Project that would need to be incorporated at a later stage or through a separate approval process to facilitate Project operation. If successful in obtaining planning approval and the grid connection agreement, the construction of the Project would begin in 2024/2025. The expected construction duration of the Project would be 36 months.

2.2.1 Project disturbance footprint

The disturbance footprint is the maximum extent of physical disturbance likely to be required to accommodate construction and operational Project activities, including minor adjustment during detailed design and siting temporary and permanent infrastructure. For the purposes of determining the maximum area to be directly impacted, the disturbance footprint was defined using the indicative areas provided in **Table 2-1** and shown on **Figure 2-1**.

The indicative disturbance footprint for each element may vary slightly on a case by case basis, however, the disturbance footprint would be about 238 hectares. The remaining 32,000 hectares of land within the Project area would be retained and undisturbed.

Table 2-1. Indicative disturbance footprints

Element	Indicative disturbance
Within Project area	
Single WTG foundation excavation	25 to 30 metre radius
Single WTG hardstand	Up to 40 by 50 metres
BESS/ central primary substation	Up to 15 hectares
Access tracks	Five metres wide to accommodate micro-siting
Underground cabling	About 0.5 metre wide trenching per cable route
Overhead power lines	Five to ten metre radius around each pole, poles set at maximum 200 metres apart
Operation and maintenance facility/ Substation/ Collector substations/ Construction compound	Up to one hectare each on average
Within and outside of Project area	
Road upgrades	Refer to Table 2-2
Transmission line (overhead)	Ten metre radius around each pole, poles set at maximum 400 metres apart

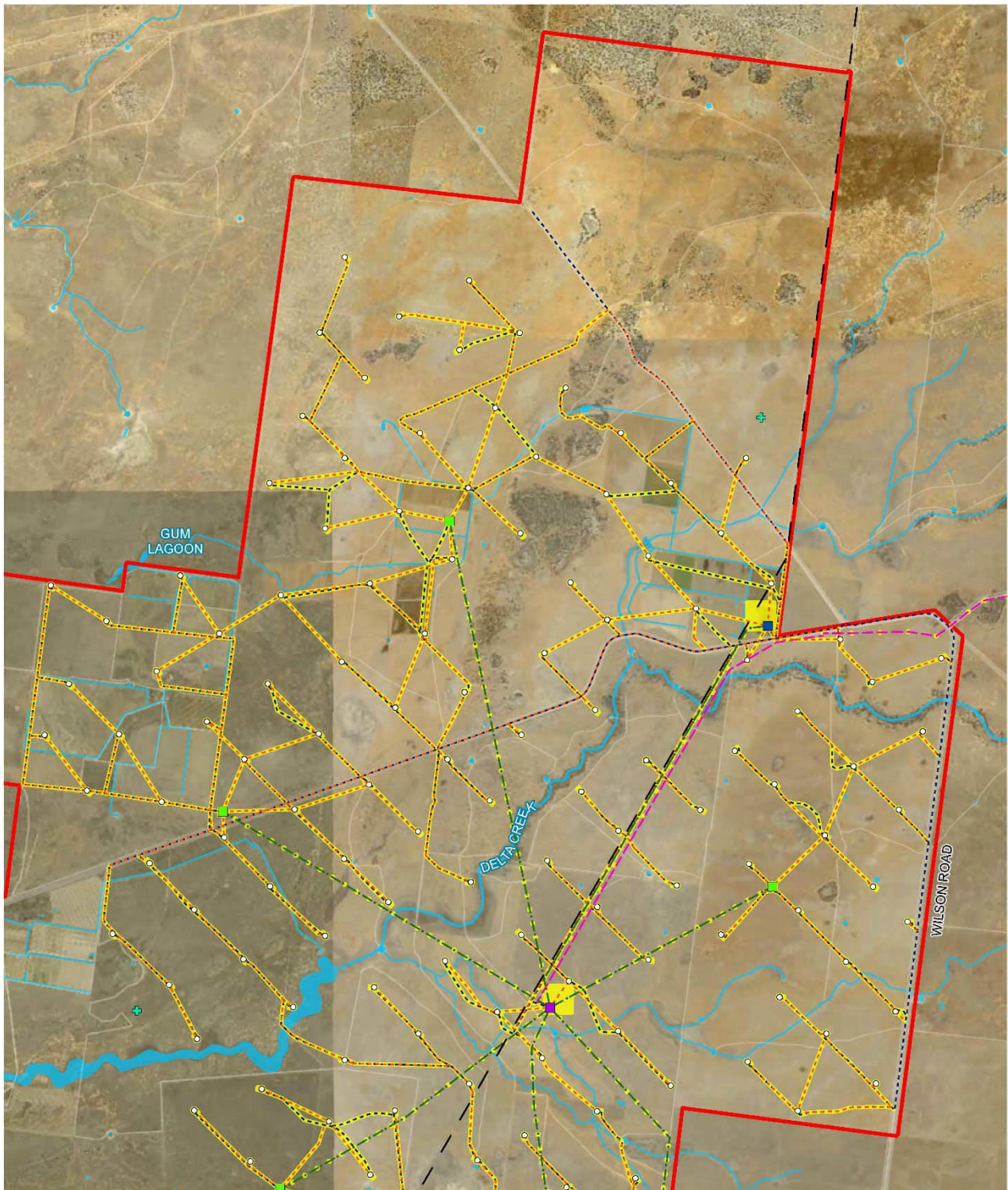
An oversize, overmass (OSOM) route assessment was conducted to identify potential issues and pinch points on the proposed OSOM haulage routes to the Project. **Table 2-2** provides the schedule of proposed NSW road and intersection upgrade work to facilitate OSOM vehicles to the Project area. The site-specific upgrades would be assessed in greater detail once the WTG design and transporting vehicle dimensions are confirmed and as part of the OSOM Transport Management Plan.

Table 2-2. Schedule of proposed road upgrades

Intersection / road	Proposed upgrade	Timing
Intersection of Newell Highway with Conargo Road, Jerilderie	Temporary removal of road signs and street lighting	As required to accommodate OSOM vehicle movements
Intersection of Newell Highway and Kidman Way	Minor earthworks to provide level roadside environment to support the path of travel	Prior to delivery of OSOM components to Project
Intersection of Kidman Way and Jerrys Lane	Additional hardstand required to accommodate the vehicle swept path; as well as extension and protection of existing culvert to sustain vehicle loads	Prior to delivery of OSOM components to Project
Jerrys Lane	Vegetation clearing / trimming and road widening as required along Jerrys Lane to provide a clear path of travel, as well as consideration of surface treatment and drainage upgrades to ensure all weather access is achievable	Prior to delivery of OSOM components to Project
Intersection of Jerrys Lane and Liddles Lane	Vegetation clearing and local road widening to accommodate the vehicle swept path	Prior to delivery of OSOM components to Project
Liddles Lane	Vegetation clearing / trimming and road widening as required along Liddles Lane to provide a clear path of travel, as well as consideration of surface treatment and drainage upgrades to ensure all weather access is achievable	Prior to delivery of OSOM components to Project
Bend on Liddles Lane, east of Wilson Road	Local widening of road footprint as required	Prior to delivery of OSOM components to Project
Intersection of Liddles Lane and Wilson Road	Vegetation clearing and local road widening to accommodate the vehicle swept path	Prior to delivery of OSOM components to Project
Wilson Road	Vegetation clearing / trimming and road widening as required along Wilson Road to provide a clear path of travel, as well as consideration regarding surface treatment and drainage upgrades to ensure all weather access is achievable	Prior to delivery of OSOM components to Project

Biodiversity Development Assessment Report

Intersection / road	Proposed upgrade	Timing
Intersection of Wilson Road and Moonbria Road	Vegetation clearing and local road widening to accommodate the vehicle swept path	Prior to delivery of OSOM components to Project
Moonbria Road	Vegetation clearing / trimming and road widening as required along Moonbria Road to provide a clear path of travel, as well as consideration to surface treatment and drainage upgrades to ensure all weather access is achievable	Prior to delivery of OSOM components to Project
Wilson Road bridge over Yanco Creek	Bridge weight structure will be assessed to determine suitability for equipment and load combination to be transported along this route	Prior to delivery of OSOM components to Project



- Indicative Project
- Disturbance footprint
- Project area
- Turbine locations
- Substation / Battery - Option 1
- Substation / Battery - Option 2
- Collector substation
- Access tracks
- Internal cabling
- Overhead powerline
- Proposed transmission line

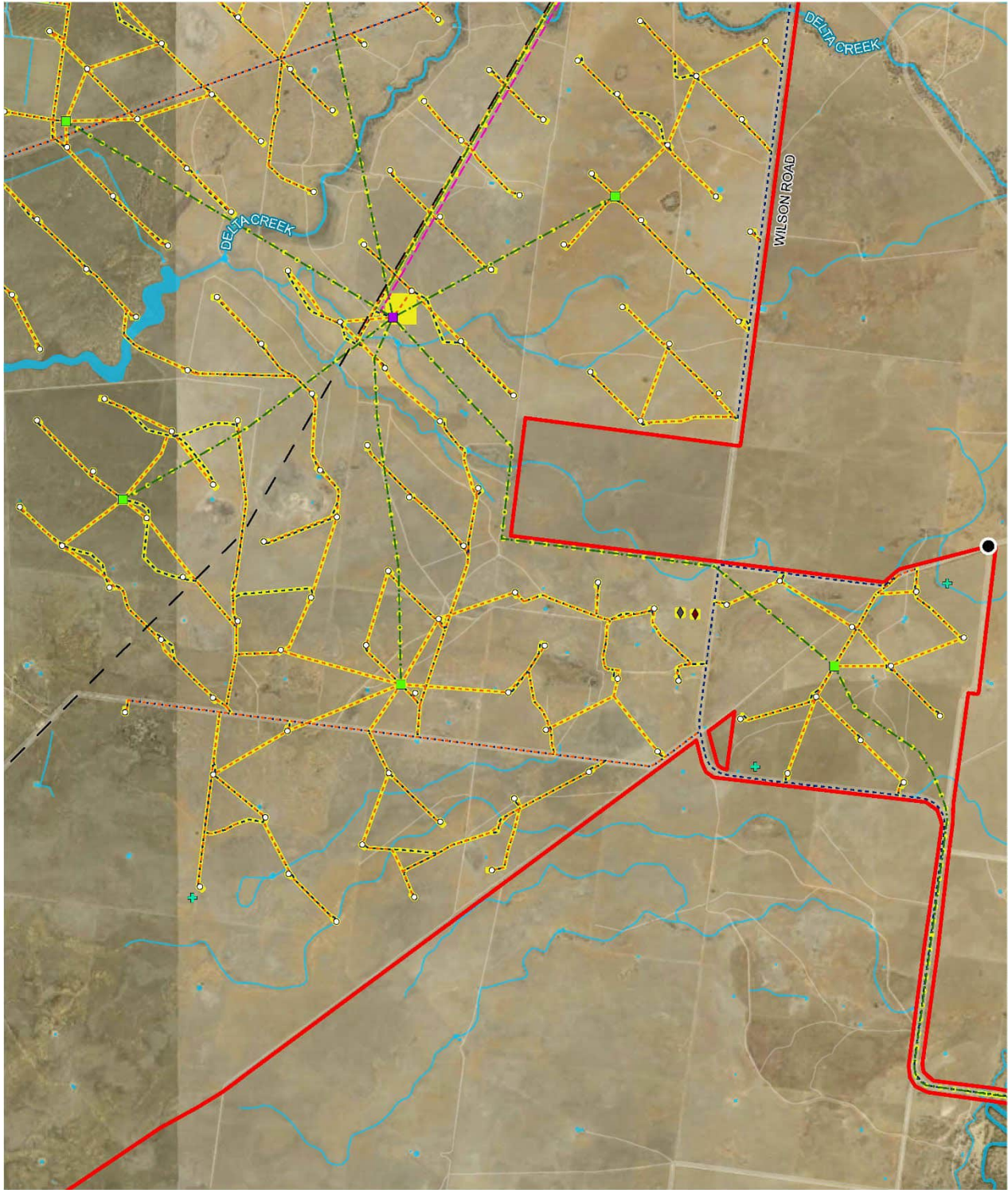
- Permanent MET mast
- Waterways
- Existing 132KV transmission line
- Road

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Figure 2-1. Overview of Project layout (Page 1 of 4)

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- Indicative Project**
- Disturbance footprint
 - Project area
 - Turbine locations
 - Substation / Battery - Option 1
 - Collector substation
 - - - Access tracks
 - - - Internal cabling
 - - - Overhead powerline
 - - - Proposed transmission line

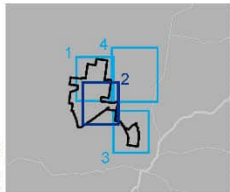
- Site facilities**
- Permanent MET mast
 - O&M facility
 - Site compound

- Site access
- Waterways
- - Existing 132kV transmission line
- Road

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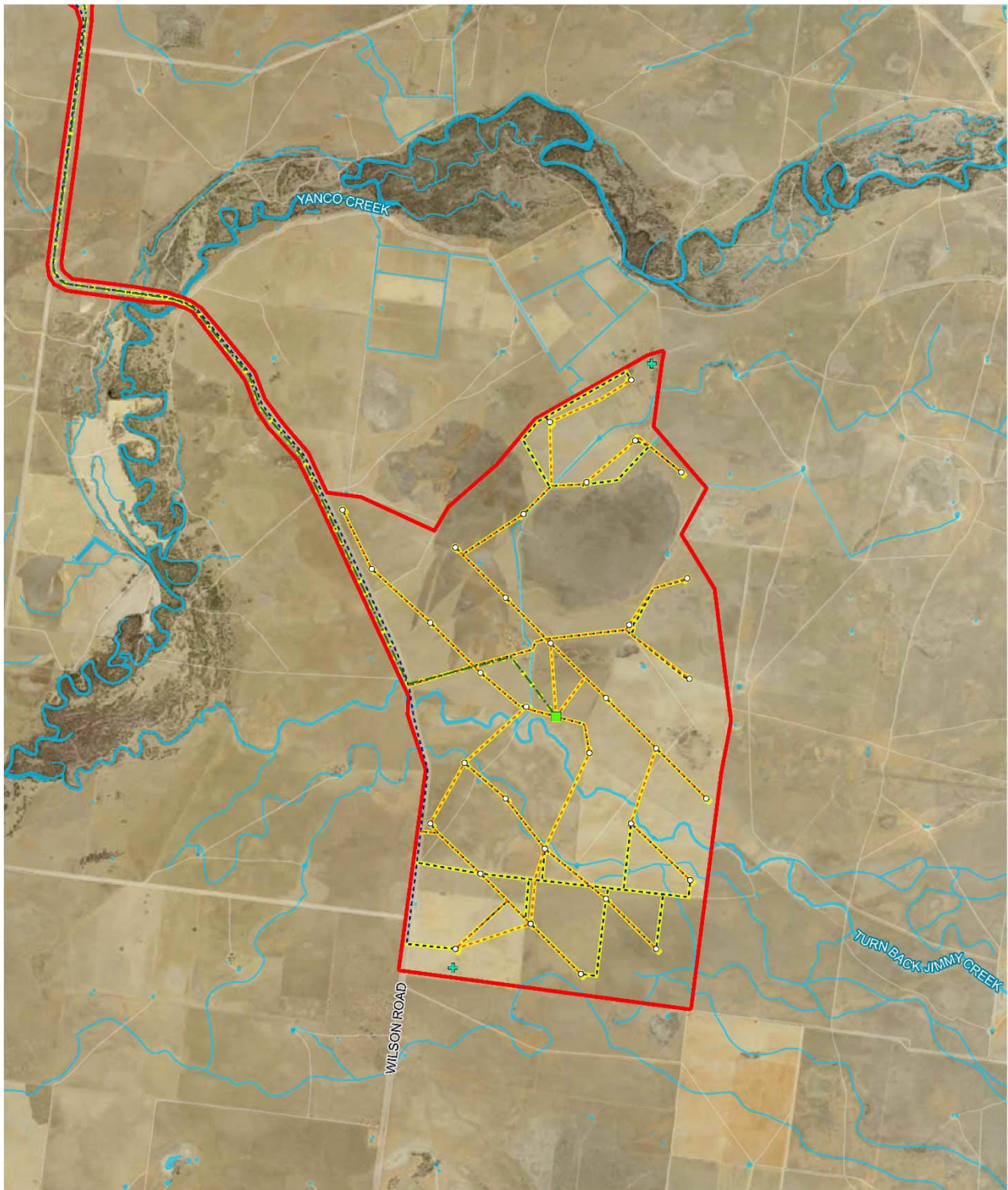
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Figure 2-1. Overview of Project layout (Page 2 of 4)

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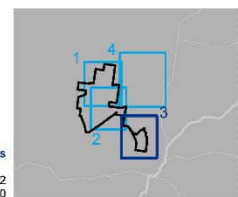


- Indicative Project
- Disturbance footprint
 - Project area
 - Turbine locations
 - Collector substation
 - Access tracks
 - Internal cabling
 - Overhead powerline
 - Proposed transmission line

+ Permanent MET mast

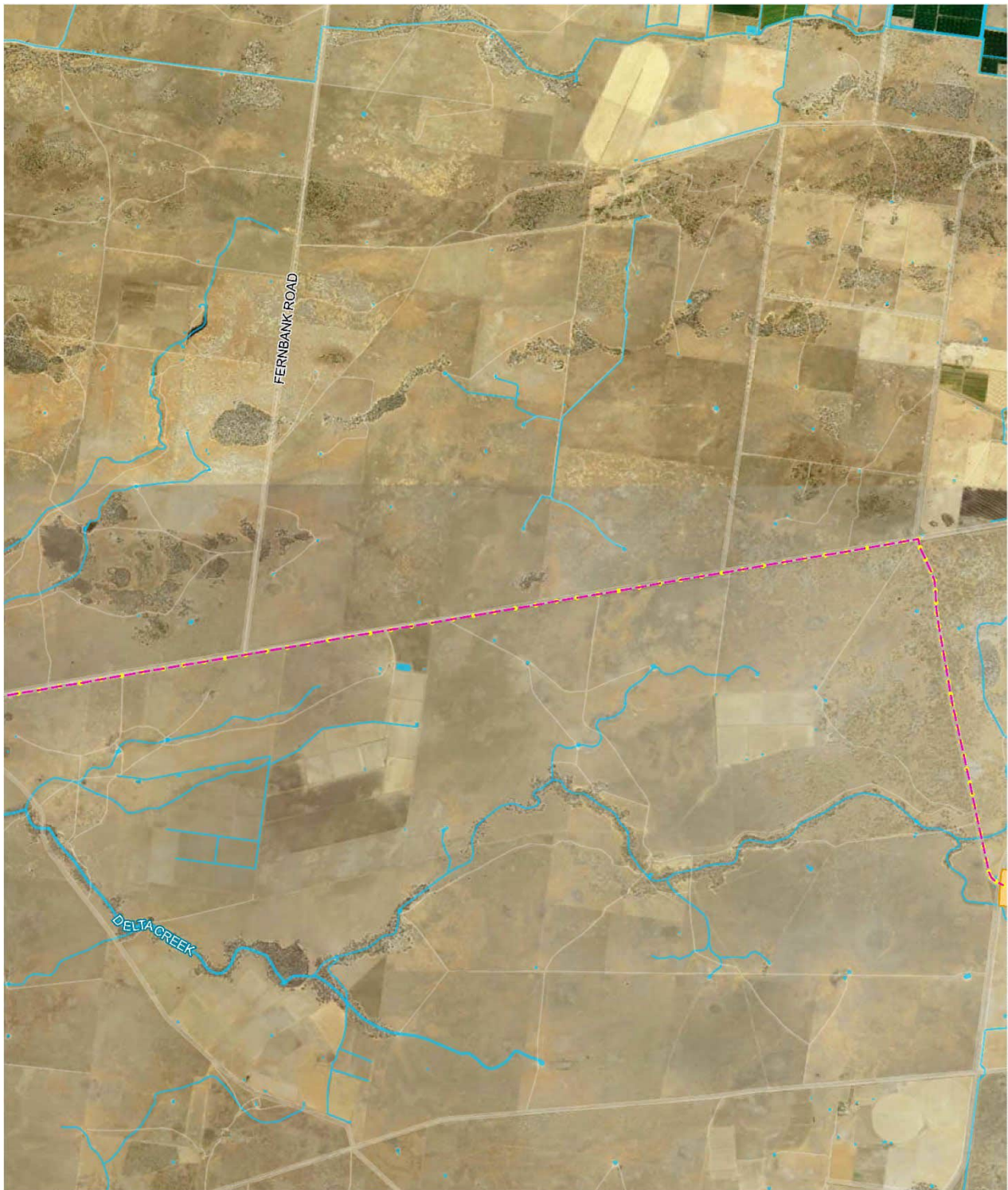
— Waterways
— Road

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Figure 2-1. Overview of Project layout (Page 3 of 4)

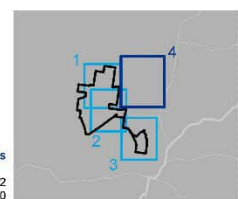


- | | |
|----------------------------|-----------------------------|
| Indicative Project | Proposed Dinawan substation |
| Disturbance footprint | Waterways |
| Proposed transmission line | Road |



1:90,000 at A4

GDA 1994 MGA Zone 55



Data sources

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Figure 2-1. Overview of Project layout (Page 4 of 4)

2.3 Excluded impacts

Much of the land categories in the Project area are currently unmapped in the Native Vegetation Regulated (NVR) map. A reasonable approximation was made to determine land categories in the Project area. This section summarises the method and results of land categorisation for the Project area and native vegetation regulatory mapping on proposed category 1 – exempt land. The NVR Map Method Statement was used in the assessment of Category 1 - exempt land (DPE, 2022).

The first approach was to identify whether land meets criteria for Category 2 - Regulated Land, prior to Category 1 - exempt Land. In some circumstances, land may meet multiple map criteria i.e. criteria for Category 2 - Regulated Land, and Category 1 - exempt Land. In most circumstances' Category 2 - Regulated Land criteria will determine the categorisation of the land, rather than Category 1 - exempt Land criteria.

The Project area has non-native vegetation including cultivated land has been ploughed regularly. Many of these areas in the study area were ground truthed to confirm the absence of native species. Other proposed locations that may meet Category 1 - exempt land are farm dams and some existing tracks.

Under section 6.8(3) of the BC Act, the BAM can exclude the assessment of impacts of any clearing of native vegetation and loss of habitat on Category 1 - Exempt Land. Category 1 - Exempt Land is not currently mapped for public view. Category 1 - Exempt Land is land where, due to historical land use and detectable clearing or significant modification/disturbance since 1 January 1990, clearing on the land is not regulated (that is, it does not require approval) (OEH, 2017).

Section 60F of the Local Land Services (LLS) Act 2013 provides the transitional arrangements that are in place until a comprehensive NVR Map with all the land categories is published. During the 'transitional period' assessors can make a reasonable approximation of land categorisation for unpublished layers, in consultation with the landholder. Preliminary mapping of Category 1 - Exempt Land was undertaken to identify locations in the Project area that would need to be endorsed by DPE.

A description of how excluded land was determined is provided in **Appendix M**.

Due to the long history of agriculture in the Project area, much of the landscape has been disturbed or modified over the course of 150 years, mainly from grazing and fire wood collection during drought periods. However, the lack of 'perennial' weeds/exotic plants make the detection of Category 1 - Exempt Land difficult. There are obvious locations in the landscape where track and farm dam construction, ploughing and cropping are evident. Indicative areas of category 1 - exempt Land have been mapped in the Project area based on the observations and analysis of clearing in non-woody vegetation:

- Historical and current aerial imagery
- Large scale ploughing of paddocks for cultivation
- Existing constructed vehicle tracks
- Location of farm dams with major earthworks
- Anecdotal dialogue from landholders.
- Consultation with BCS

There is an extensive network existing farm tracks across the Project area. Many of these tracks vary in condition, width and use by landholders. Many tracks are not constructed and have compacted over time with regular use or have regenerated with native grassland with irregular use. Due to the difficulty in mapping the variety of track types and conditions, the majority of tracks have been classed as native vegetation and assigned to vegetation zone based on observed vegetation mapping.

A reasonable approximation was made to determine land categories in the Project area. Preliminary exclusion mapping was provided to BCS for review in early September 2022. Comments were provided in late September 2022 with an indicative map of land not meeting the criteria and requiring further evidence.

Further revision of the excluded land map were carried out following comments from BCS in late September 2022. Some locations had recent evidence of cultivation that didn't provide enough evidence to support the criteria for determining category 1 – exempt land and were categorised as category 2 land. However, rapid floristic surveys confirmed the absence of native species at these locations and justified the land to be

assigned to non-native vegetation. This land is considered degraded for the purposes of threatened flora and fauna habitat and targeted surveys were not carried out. However, all locations categorisations were assessed for prescribed impacts to biodiversity, including potential frog habitat at farm dam locations and bird and bat blade strike from windfarms.

A map of excluded land in the disturbance footprint with category 2 and category 1 land is provided in **Figure 2-2**. The excluded land map requires final endorsement from BCS.

The assessment of land categorisations identified the following areas in the disturbance footprint:

- Category 1 – exempt land – non-native vegetation (comprising paddocks of cultivated land) – 54.71 hectares
- Category 1 – exempt land – constructed internal tracks – 3.08 hectares
- Category 1 – exempt land – constructed farm dams – 0.11 hectares
- Category 2 – native vegetation – 173.39 hectares
- Category 2 – non-native vegetation – 5.58 hectares.

Other areas of category 1 – exempt land not mapped in the study area include established main roads including Wilson Road, Mabins Well Road, Liddles Lane, Moonbria Lane, Liddles Lane, Jerrys Lane and Goolgumbra Road. All these roads are greater than 5 metres wide with constructed swales and embankments and are maintained regularly. The road surfaces are hard comprising introduced gravel. The southern portion of Wilson Road comprises bitumen.

Road upgrades within the Project area were assessed as part of the study area. Field surveys were undertaken for each proposed upgrade. The field assessment found that very small areas of native vegetation may require disturbance in the Project area at the junctions of Moonbria Lane/Wilson Road, Liddles Lane/Wilson Road and Jerrys Lane/ Liddles Lane. These roads have wide man-made embankments and swales that are maintained by Council to drain water from the roads. As a result, these roads are considered to be category 1 – exempt land within the envelope of the roads and biodiversity values do not need to be assessed, except prescribed impacts where relevant.

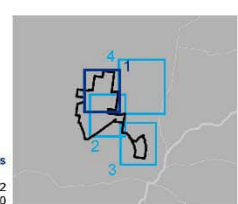
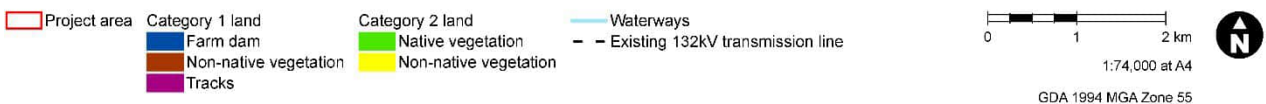
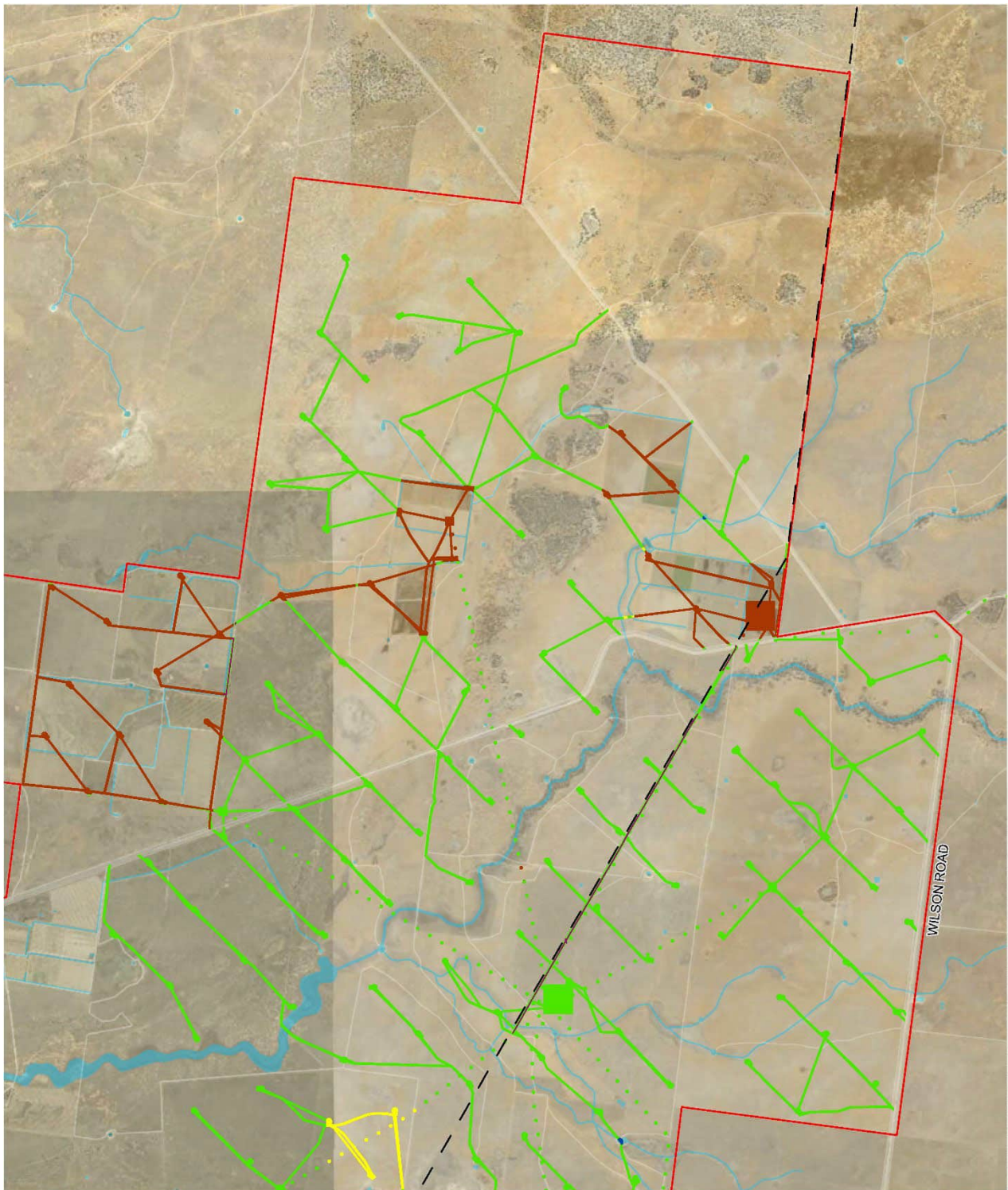


Figure 2-2 Excluded land (Page 1 of 4)

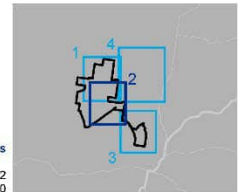
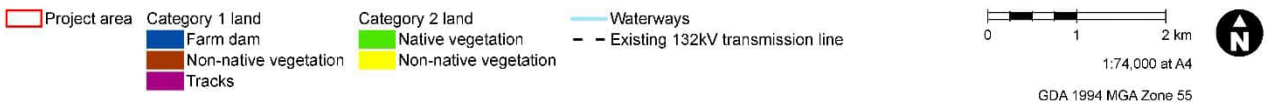
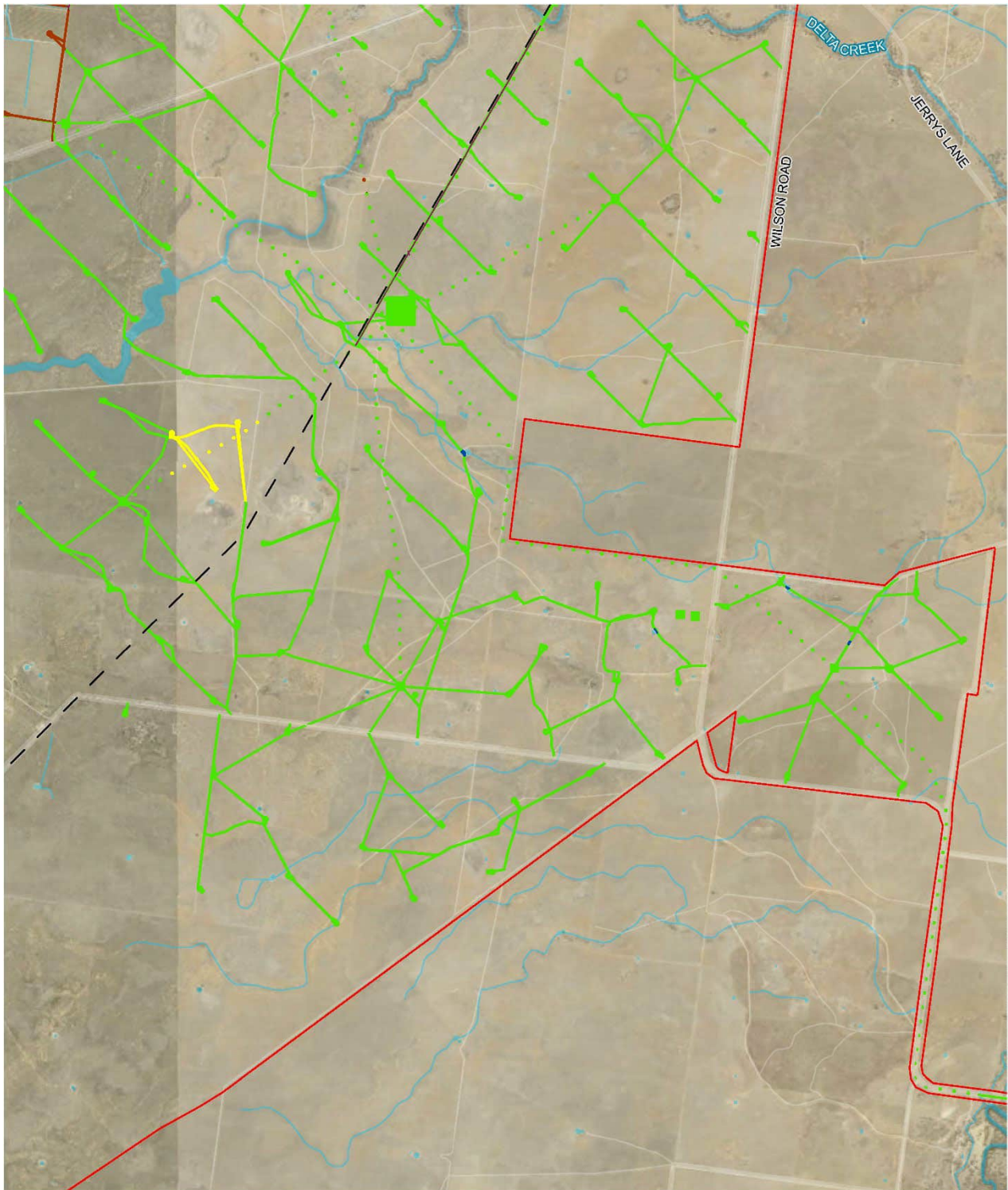
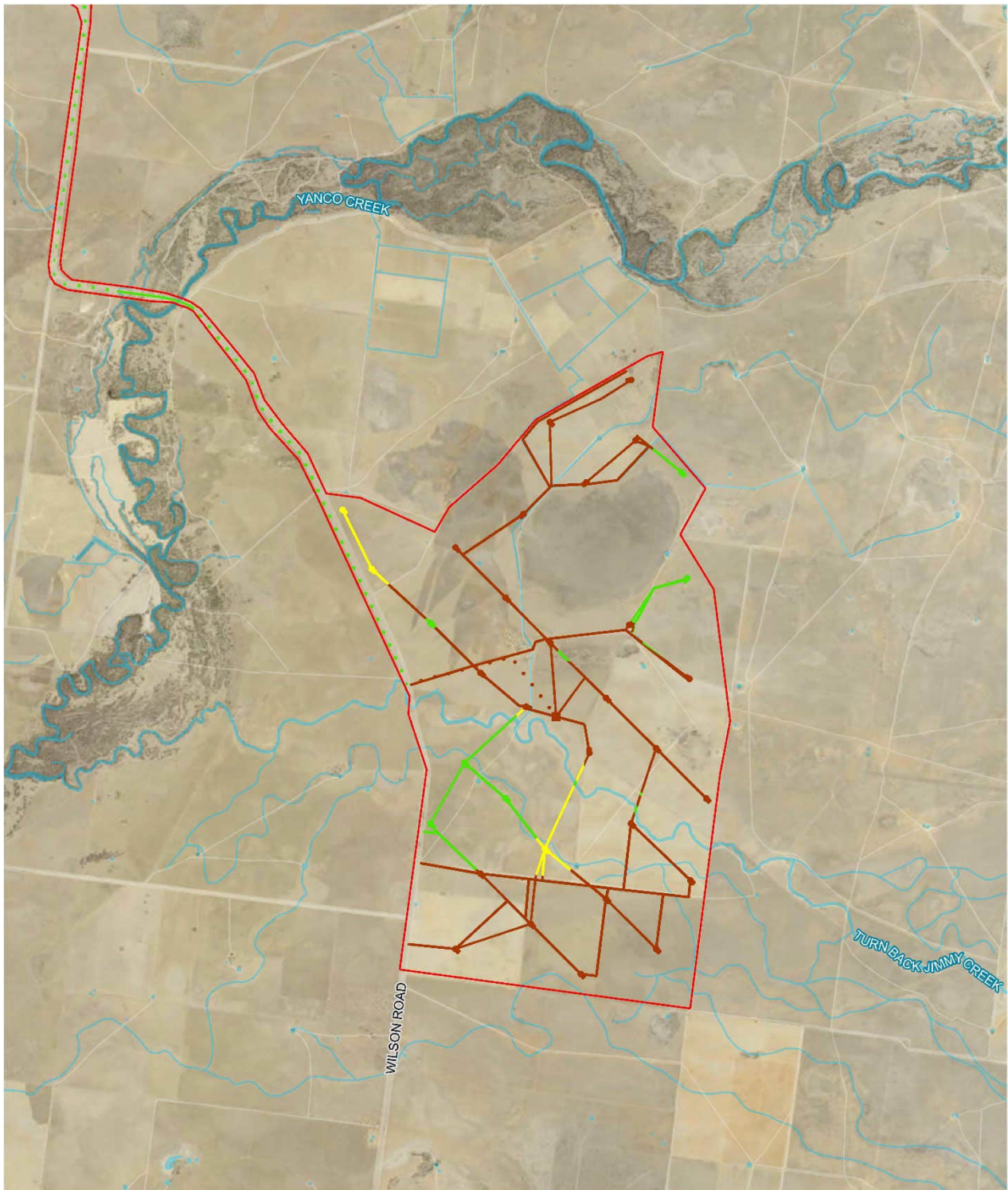


Figure 2-2 Excluded land (Page 2 of 4)



Project area

 Category 1 land
 Non-native vegetation

 Category 2 land
 Native vegetation

 Non-native vegetation

 Waterways

0 1 2 km

1:74,000 at A4

GDA 1994 MGA Zone 55

Data sources

Jacobs 2022
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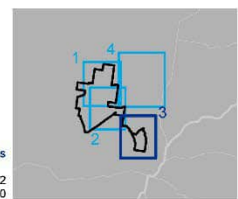
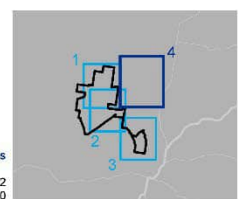


Figure 2-2 Excluded land (Page 3 of 4)



Project area
 Category 2 land
 Native vegetation
 Waterways

0 1 2 km
 1:90,000 at A4
 GDA 1994 MGA Zone 55



Data sources
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Figure 2-2 Excluded land (Page 4 of 4)

3. Landscape features

3.1 Background research and key information sources

A background review of existing information was undertaken to identify the landscape features within and surrounding the Project area. The review focused on database searches, relevant ecological reports pertaining to the Project area and relevant Geographic Information System (GIS) layers. The following databases were searched:

- NSW (Mitchell) Landscapes version 3.1
- NSW Biodiversity Values Map and Threshold Tool (DPE 2022)
- DCCEEW Directory of Important Wetlands in Australia Tool
- State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469 (OEH 2016b)
- Jerilderie 1:250 000 Geological Map (Tuckwel 1976)
- Deniliquin 1:250 000 Geological Map (Brown and Stephenson 1991)
- DPE Division of Resources and Geoscience (DPE 2022)
- Australian Soil Resource Information System (ARIS 2013)
- DPE eSPADE (2022).

3.2 Bioregion and subregion

The Project area is located within the Riverina bioregion (Interim Biogeographic Regionalisation for Australia: IBRA) and wholly within the Murrumbidgee IBRA sub-region. The Riverina bioregion lies in southwest NSW, extending into central-north Victoria. It ranges from Ivanhoe in the Murray Darling Depression Bioregion south to Bendigo, and from Narrandera in the east to Balranald in the west. 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.

Characteristic landforms of the Murrumbidgee IBRA sub-region include alluvial fan with distributary channels and floodplains and undulating plains with depressions. The Riverina covers the alluvial fans of the Lachlan, Murrumbidgee and Murray Rivers west of the Great Dividing Range and extends down the Murray. The region is relatively constrained by sediments from northern Victorian rivers, the Murrumbidgee fan and the Cadell fault. Soils are typically highly fertile red brown earths and grey clays with deep siliceous sands on elevated dunes. The red-brown and grey clays in the bioregion support grassland communities that are nationally significant (NSW NPWS, 2003). An overview of the landscape features in the Project area is presented in **Figure 3-1**.

3.3 NSW (Mitchell) landscapes

The Project area is mapped as occurring across five NSW (Mitchell) Landscapes (DPIE, 2016), a brief summary of each landscape is provided below:

- Murray Source-bordering Dunes:
 - Characterised by sandy rises adjacent to river channels or prior streambeds, deep red and brown sands and loams, relief 3 to 12 metres. Often heavily grazed and subject to wind erosion.
- Murray Depression Plains:
 - Characterised by Quaternary alluvial plains with numerous circular depressions interpreted as high floodplains or low terraces beyond the reach of average floodwaters (Mitchell 2002). Sandy rises and levees trace ancestral streams and stand above the general plain. Relief is between one to three metres.

- Murray Lakes, Swamps and Lunettes:
 - Includes parts of two land systems: Leaghur and Victoria and is characterised by large active freshwater lakes and swamps frequently flooded and generally round or kidney shaped (Mitchell 2002). Often nested within larger relic Quaternary lake features. Beaches, sand and clay pellet lunettes and sand hills on the eastern margins. Relief of lakes and channels to 10 metres, lunettes to 20 metres.
- Murray Scalded Plains
 - Characterised by quaternary alluvial plains with extensive scalding interpreted as relic floodplains, terraces or part of the Cadell tilt block. Red brown texture-contrast soils with extensive scalds. Prior stream channels of deep coarse sands with sandy levees and grey, brown and red cracking clays in depressions, relief 5 to 15 metres. Mostly cleared, cropped and grazed, formerly open woodland and grasslands.
- Murray Channels and Floodplains:
 - Includes parts of four land systems: Canally, Murrumbidgee, Riverland and Wentworth are characterised by active channels and seasonally inundated floodplains of the Murray streams in Quaternary alluvium with associated billabongs, swamps, channels, levees and source bordering dunes, relief to ten metres (Mitchell 2002).

3.4 Rivers and streams

The Project area is located within the Murrumbidgee catchment. Key waterways identified within the Project area include Delta Creek, Yanco Creek and Turn Back Jimmy Creek. Delta Creek occurs in the north, Turn Back Jimmy Creek in the south and Yanco Creek is located between the northern and southern portions of the Project area (**Figure 3-1**). Yanco Creek is the only permanent waterway in the Project area, with Delta Creek, Turn Back Jimmy Creek and the drainage depressions classified as ephemeral.

In addition to the mapped waterways, the Project area exhibits some minor drainage depressions that hold water during rainfall and flooding, and flow in a south-westerly direction. A slope dips toward Delta Creek in the northern portion of the Project area. Several minor topographic depressions on the floodplain hold water for longer, creating scattered swamp environments within the Project area.

Yanco Creek is a major breakout channel from the Murrumbidgee River, diverging from the Murrumbidgee River 14 kilometres downstream of Narrandera in the vicinity of the Yanco regulator and offtake structures. From that location, Yanco Creek flows south and then south-west, intersecting the Project area 31 kilometres downstream of the town of Bundure. Downstream of the Project area, Yanco Creek continues to flow in a westerly direction.

The regional water table is relatively deep, between 20 metres and 25 metres below ground, and uniform depth, however localised perched groundwater systems are considered likely to be present across low-lying parts of the Project area.

The Murrumbidgee River, Edward River, Yanco Creek, Billabong Creek systems and associated tributaries form part of the Lower Murray River aquatic ecological community listed as an endangered ecological community under the *Fisheries Management Act 1994* (FM Act). This community provides habitat for a range of native fish, wetland birds and aquatic invertebrates, including five threatened species with potential to occur within the River Basin.

3.5 Wetlands

There are no Ramsar Wetlands or Important Wetlands as listed in the Directory of Important Wetlands of Australia located within the Project area. Within the Riverina bioregion important wetlands, which can support more than 20,000 waterbirds, occur in the Murrumbidgee-Lachlan confluence, Barmah-Millewa Forest, and Edward and Murrumbidgee River floodplains. Eight wetlands have been identified as having bioregional significance in the Riverina, including Lake Urana, Loorica Lake, an unnamed swamp southeast of Lake Tala, Gol Gol Lake, the Edward River Floodplain, Tuppall Creek Floodplain, Morrisons Lake, Barrenbox Swamp and Boologal wetland.

3.6 Connectivity of habitat

The Project area is located within a landscape that has been highly modified over a long history for agriculture and most areas have been cleared of remnant woody vegetation. The only high-quality habitat connectivity within the Project area is within the narrow intact riparian zones along Delta and Yanco Creek, which contain remnant woodland. The riparian habitat along these two creek systems are separate and not connected in the landscape within the Project area. There are not any formally mapped biodiversity corridors within the Project area.

The landscape itself has some local connectivity of habitat present in a large mosaic of natural habitats comprising grasslands, open myall woodland, partly wooded sandhills, Eucalypt woodland and lignum swamps. These habitats provide dependable links for birds, microbats, and large macropods within existing sheep and cattle grazing practices. The woodland patches provide very important stepping stones for native fauna between open natural grassland. Old drainage lines and large swamps with lignum and nitre goosefoot also provide important linkages for wildlife movement in the landscape.

3.7 Areas of geological significance

No karst, caves, crevices, cliff or areas of geological significance occur within the Project area or surrounding landscape. The landscape is flat with river channel and floodplain features dominant and the complexities of geomorphology and surface sediment distribution all reflect past climates and different river discharge regimes. The dominant geological formation in the Project area is the Cainozoic Shepparton Formation (Czs), deriving from sediments deposited during the Plio-Pleistocene Epoch (5,000,000 to 12,000 years ago).

The Cainozoic Shepparton Formation is found throughout the Riverina, between the Murray and Lachlan Rivers. These deposits represent the most recent infilling of the Tertiary Murray Basin and consist of poorly consolidated clay, alluvial sand, silt and gravel (The Geological Society of America, 2012). The sediments within the Shepparton Formation form the subsurface component to the Riverine Plain and range from poorly sorted gravels to clay.

3.8 Soil landscapes

Soil landscape mapping is available from eSpade for the southern half of the Project area only (south of Moonbria) (DPE 2022). Based on a review of the 1:250,000 scale Soil Landscape Reconnaissance Maps for the Murray Catchment (OEH 2010), the southern half of the Project area includes predominantly three soil landscapes as follows:

- Jerilderie (jex) – Broad level plains on alluvium deposits from the Riverine Plains
- Coleambally (clo) – Undulating sand plains deposited from re-worked alluvium, sand ridges and swales present
- Yancobong (ybz) – Confined alluvial floodplains and channels from Billabong Creek and Yanco Creek, and their paleo channels.

Small pockets of the following other soil landscapes are also present within the Project area:

- Currawarna (cww) – Slight undulation and gently inclined dunes of thick (>2 metres) windblown sand layers, underlain by thick alluvium
- Lake Gunbar (lgt) – Low-lying areas and depressions within the Riverine Plains, comprised of cracking clays, self-mulching and surface crusting surfaces
- Lake Urana (lky) – Ephemeral clay lake beds of varying size, with lunettes (ylw) to the east and north.
- Yanga Lunettes (ylw) – Crescent-shaped dunes formed on the eastern margins of lake beds and water body relicts. Calcareous soils dominate, with duplex and solodic soils present on lower slopes
- Niemur River (nmu) – Active inset floodplains and meander plains of the Niemur, Edward and Wakool Rivers and their tributaries and distributaries, extending from Lockhart in the east into the far west of the catchment
- Coleambally Variant A (cloa) – Level sandplains, with relicts of prior streams now infilled with shallow aeolian deposits.

3.9 Soil hazard features

Soils present throughout the southern half of the Project area have a high potential for erosion via wind and/or water. There is the potential for soils to be dispersed or transported to other locations within the Project area as well as offsite. Erodibility potential may also be increased in sodic, dispersive or reactive soils by construction activities such as excavation, vehicle and machinery traffic movements. If high intensity rainfall or flooding events occur during construction, the likelihood of adverse water erosion effects would also increase. Areas within the Project area have been noted to have a high potential for land salinity, and a moderate overall salinity hazard. Additional saline areas may be present which have not yet been identified or may occur if site conditions change adversely.

3.10 Acid sulfate soils

There is the potential for Acid sulfate soils (ASS) to be encountered in small areas, in the vicinity of waterbodies and water courses within the Project area, however, the groundwater table is moderately deep as described and unlikely to be lowered or impacted by the Project. All potential impacts of ASS that may be identified can be managed subject to undertaking ASS investigations prior to construction activities in areas of high ASS potential as part of the pre-construction phase and developing/implementing appropriate plans should ASS be identified.

3.11 Areas of outstanding biodiversity value

Areas of declared critical habitat that were listed under the now repealed *Threatened Species Conservation Act 1995* (TSC Act) have become declared areas of outstanding biodiversity value (AOBVs) in NSW with the commencement of the BC Act. AOBVs are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. These areas are declared by the Minister for the Environment. There are no declared AOBV within the Project area.

3.12 Native vegetation extent

The Project is considered a linear development, containing linear access tracks, cables and transmission lines that link to wind turbine points and hardstands across a very large Project area. The internal linear features also connect to substations and two options for the BESS/central primary substation locations. To assess the percentage of the current extent of native vegetation, a 500 metre landscape buffer was applied to the subject land to capture the linear Project features.

The 500 metre buffer is 35,893 hectares in size and contains approximately 30,703 hectares of native vegetation (refer to **Figure 3-2**). This area was calculated using a combination of available resources including:

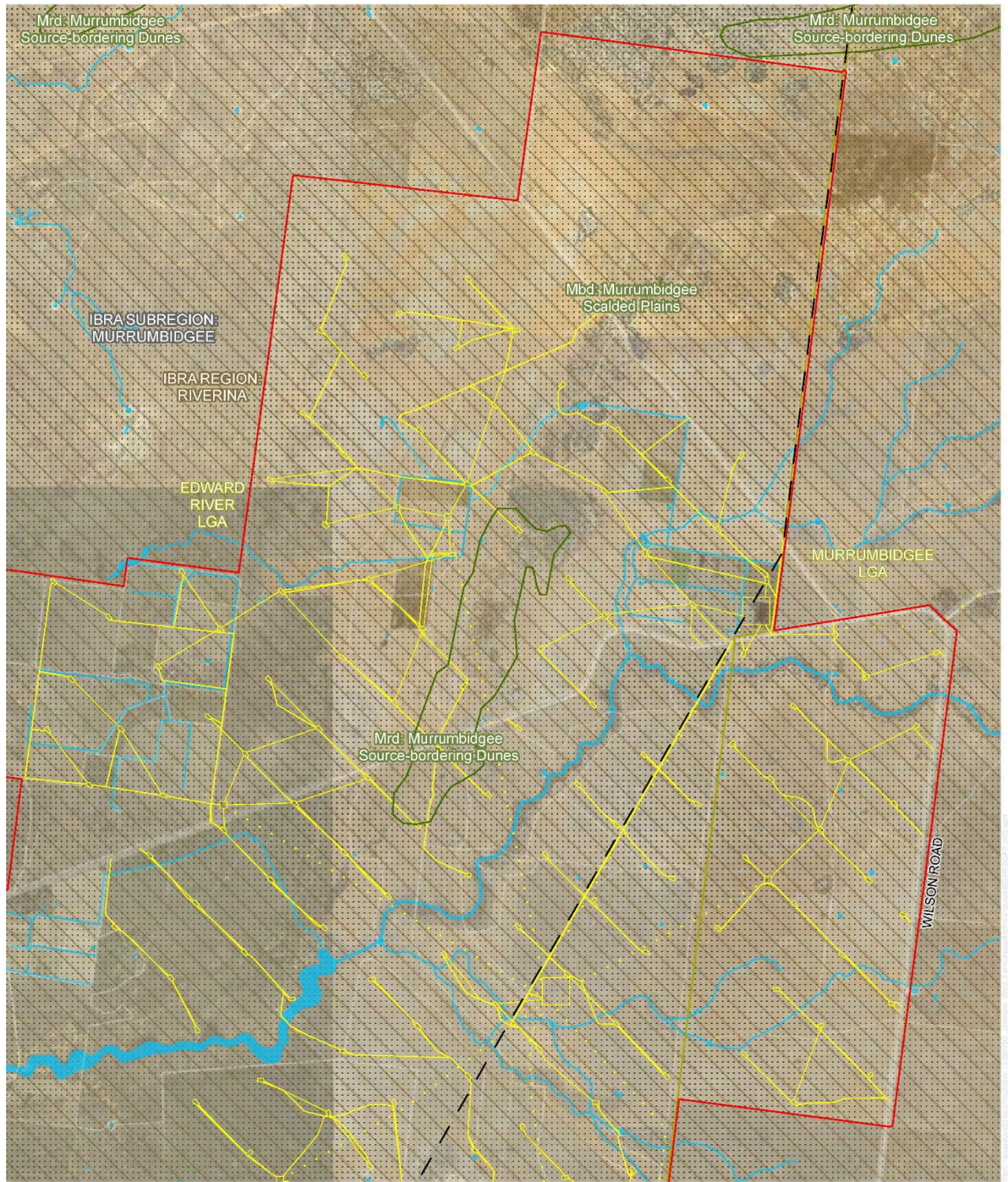
- Native vegetation (both overstorey and native grassland) was digitised using GIS and aerial photography
- Numerous site visits for biodiversity surveys across the Project area to confirm native vegetation
- State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469 (OEH 2016b).

The State Vegetation Type was mostly relied on for areas beyond the subject land, particularly on properties with no access.

Native vegetation cover was assessed in accordance with Section 3.2 of the BAM. Cleared areas known or expected to contain cropping land (non-native grassland) were excluded from the mapping. The calculations are subject to a degree of error as the mapping is desktop based and subject to limited ground truthing. The native vegetation percentage cover in the landscape buffer is 86%. This is assigned to the >70% BAM vegetation cover class.

The purpose of the percentage vegetation cover calculation is to create a figure of native vegetation cover that is used in the BAM-C to predict threatened species likely to occur or use habitat on a site. Minor adjustments to polygon boundaries will not affect the >70% vegetation cover class present within the landscape buffer. Mapping is broad-scale and does not represent detailed site-specific mapping of native vegetation cover in the landscape and should not be used for any purpose other than the estimation of native vegetation cover under the BAM.

Wilson road is a wide bitumen road separating parts of the Project area, but it is not wide enough to constitute a break in a patch and vegetation on either side is classed as part of the same patch. This also applies to vegetation either side of Mabins Well Road and Moonbria Lane which have native grassland edges.



Disturbance footprint	NSW (Mitchell) landscape	Waterways
Project area	IBRA subregions	Existing 132kV transmission line
	IBRA regions	Local Government Area

1:74,000 at A4
GDA 1994 MGA Zone 55

Data sources
 Jacobs 2022
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Figure 3-1. Landscape features (Page 1 of 4)

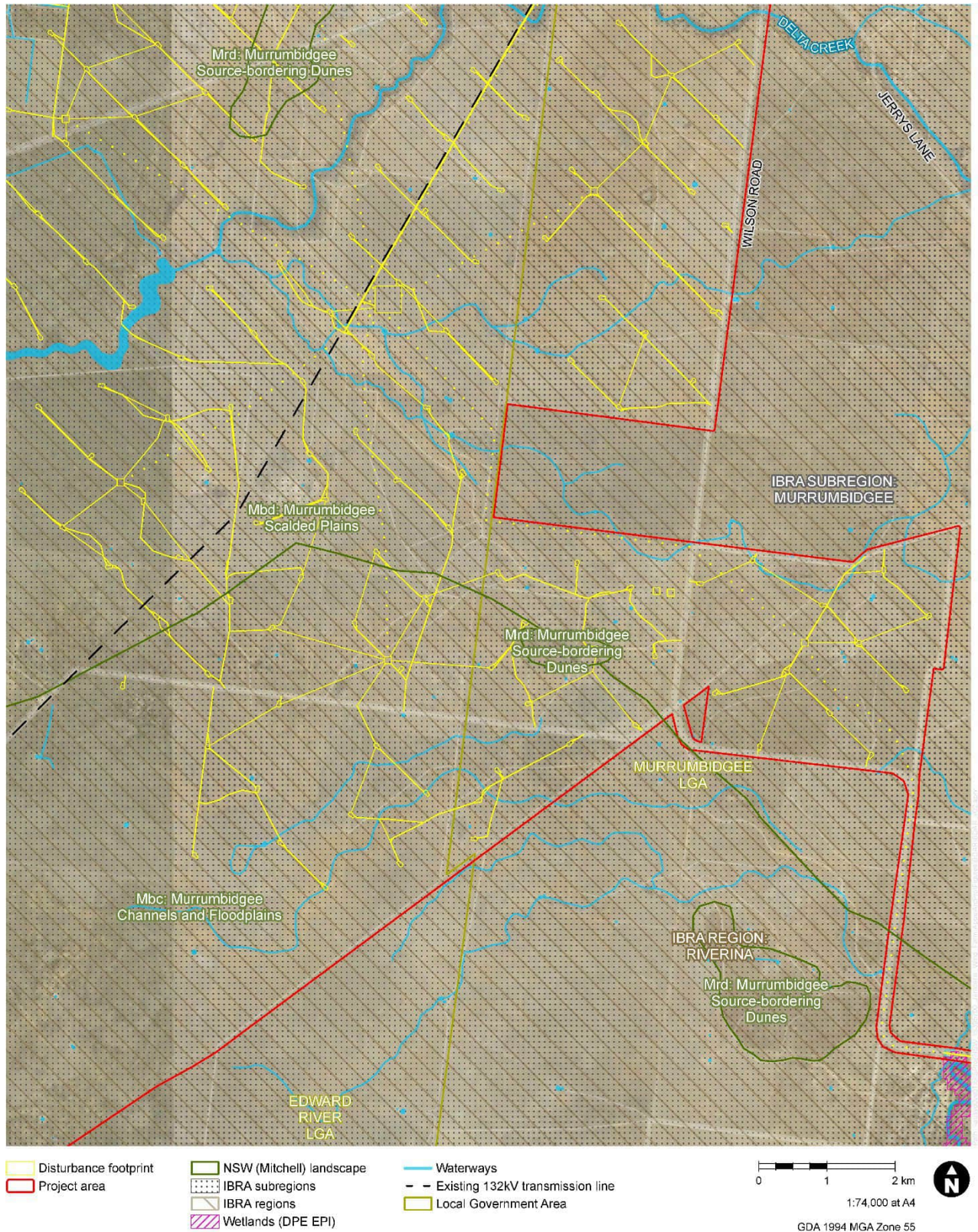


Figure 3-1. Landscape features (Page 2 of 4)

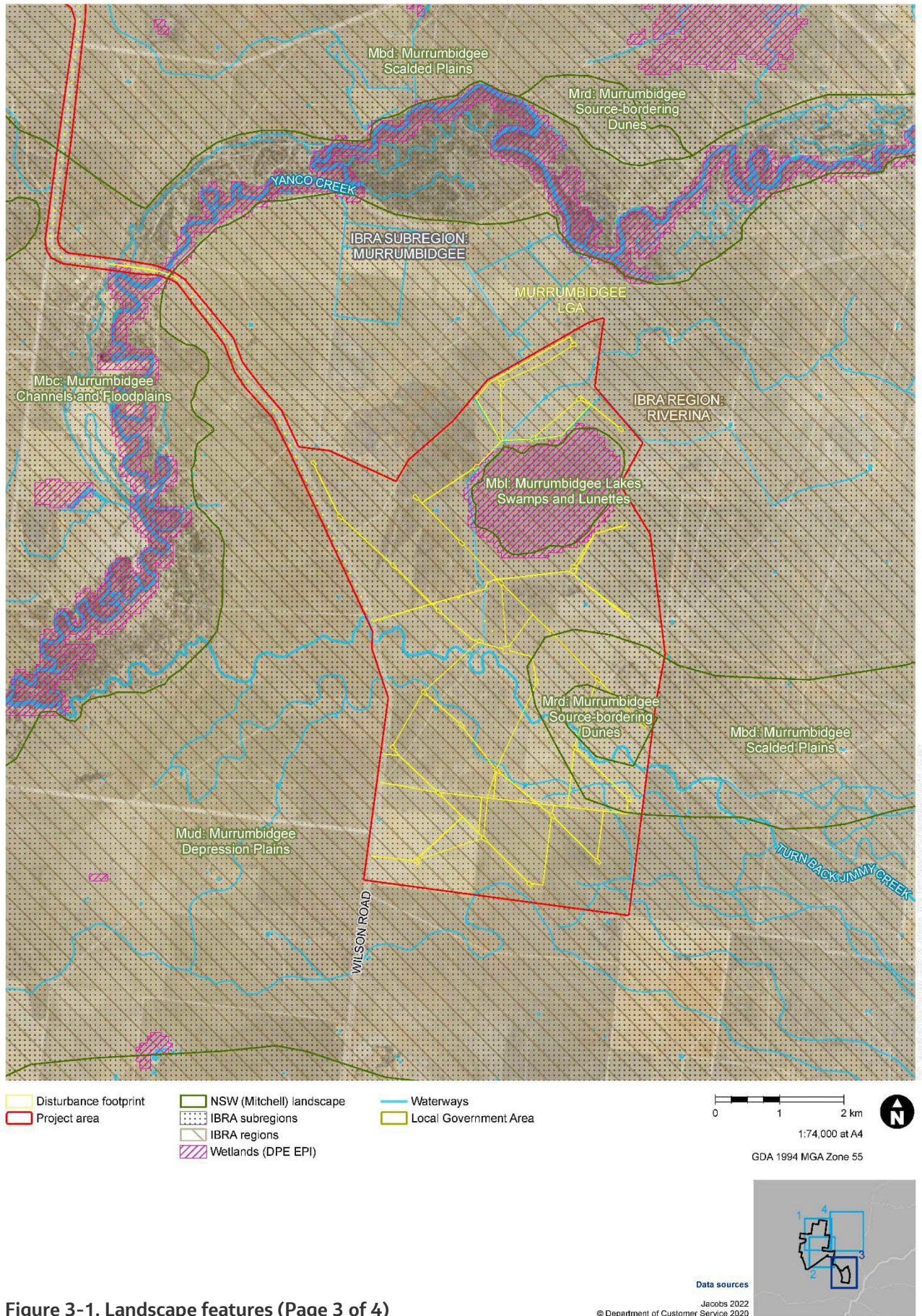


Figure 3-1. Landscape features (Page 3 of 4)

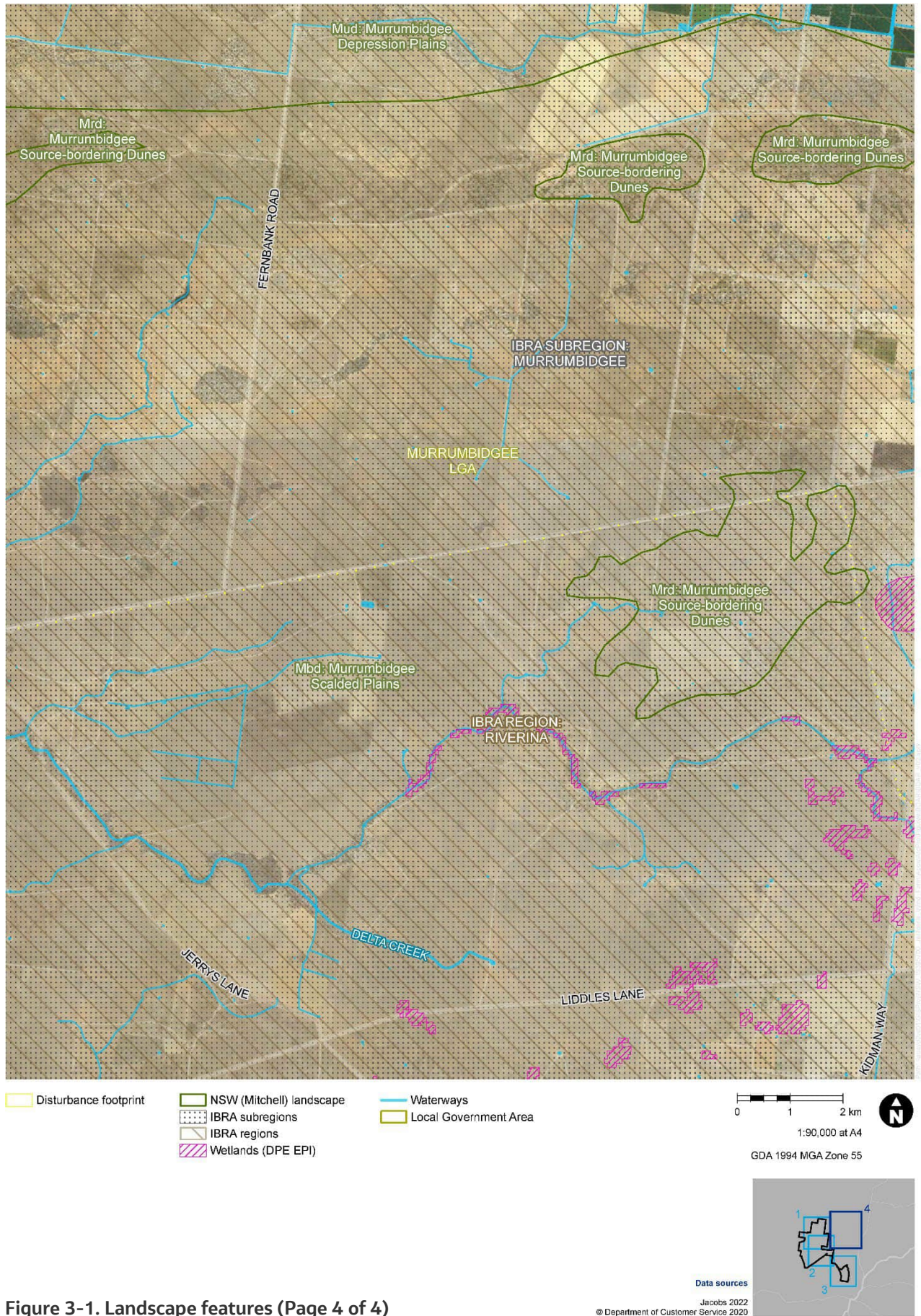
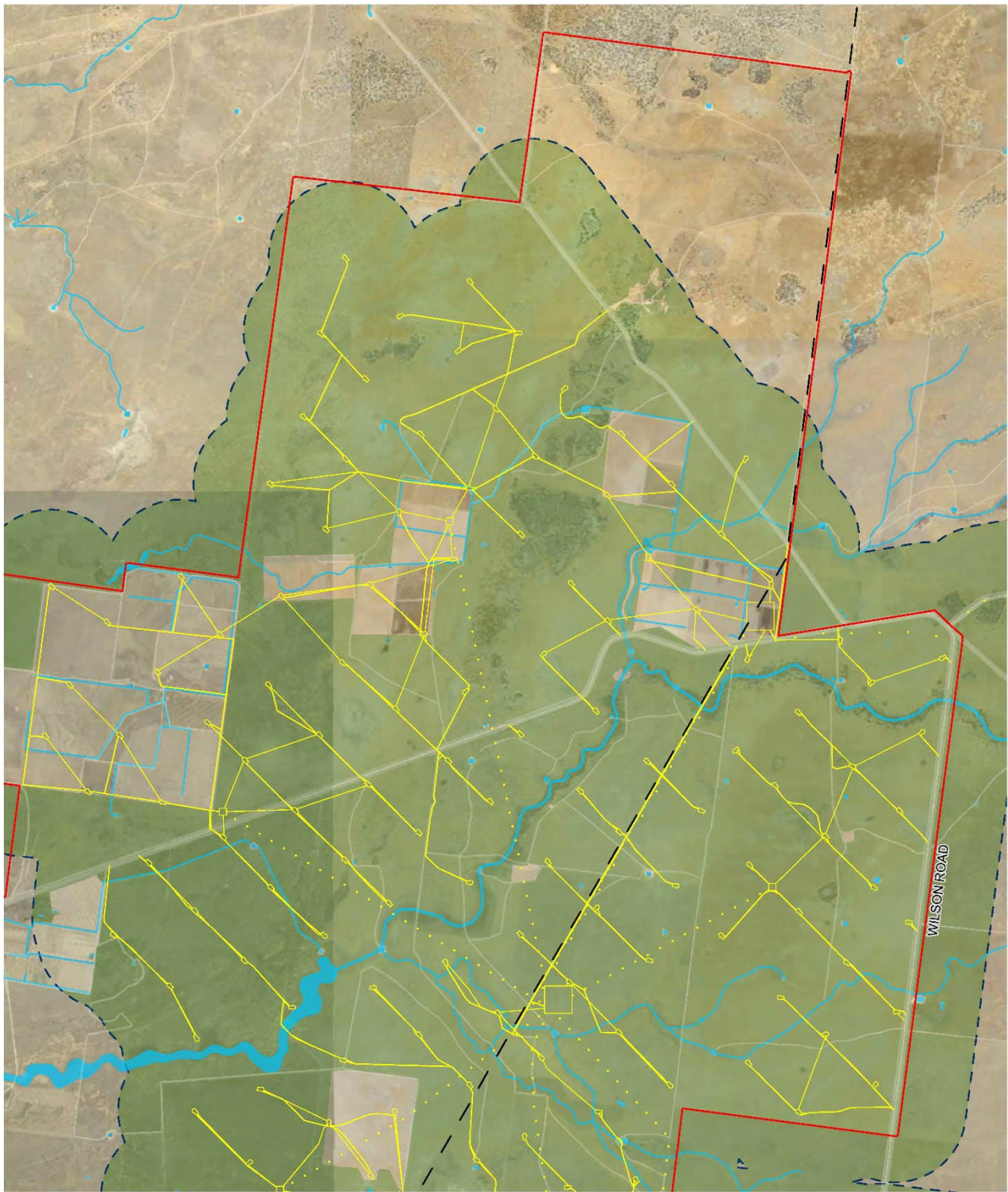


Figure 3-1. Landscape features (Page 4 of 4)

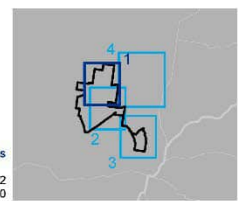


- Disturbance footprint
- Native vegetation cover
- Waterways
- Project area
- Landscape buffer 500m
- Existing 132kV transmission line

0 1 2 km

1:74,000 at A4

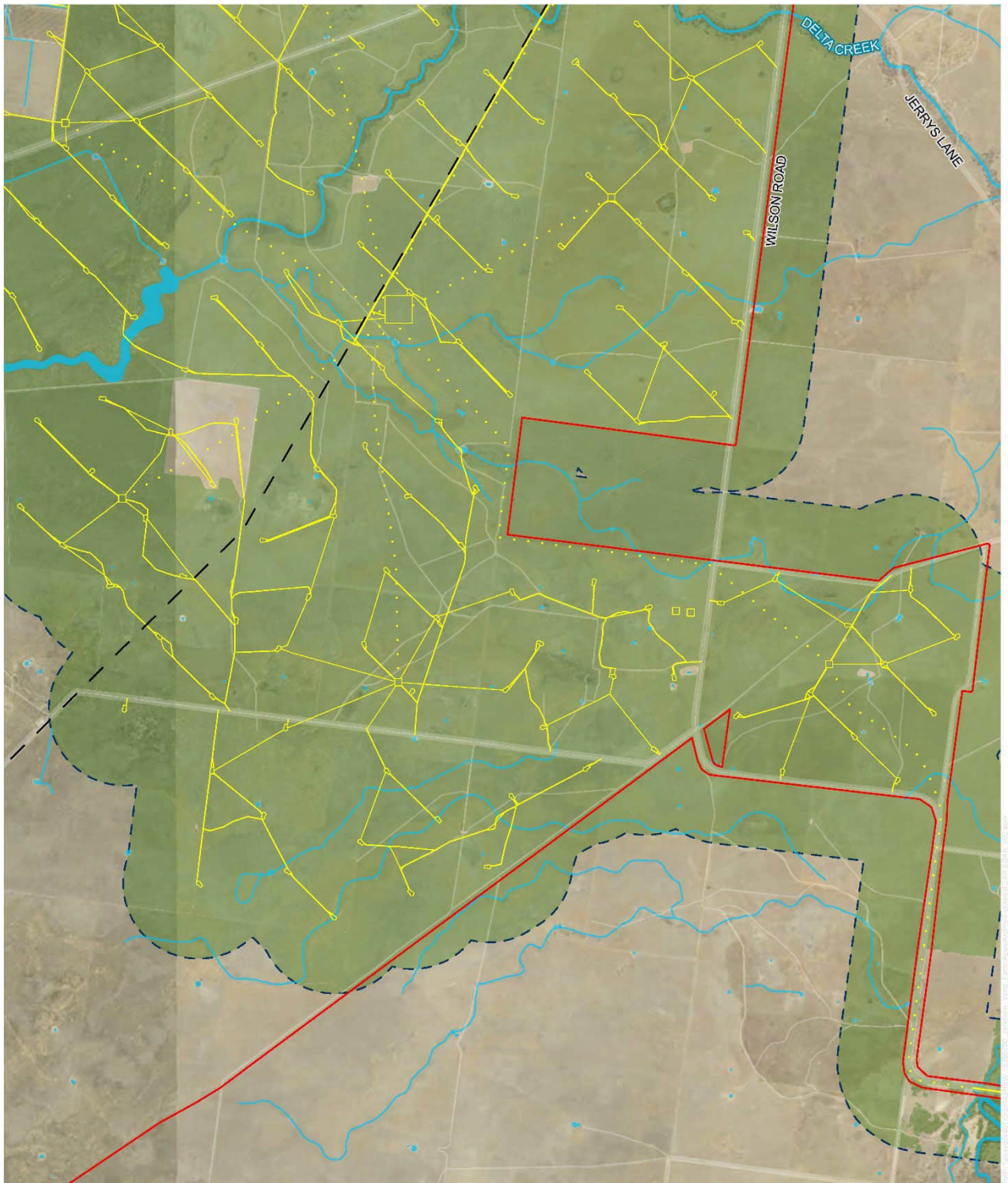
GDA 1994 MGA Zone 55



Data sources

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Figure 3-2. Native vegetation extent (Page 1 of 4)

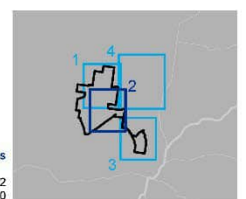


- Disturbance footprint
- Native vegetation cover
- Waterways
- Project area
- Landscape buffer 500m
- Existing 132kV transmission line

0 1 2 km

1:74,000 at A4

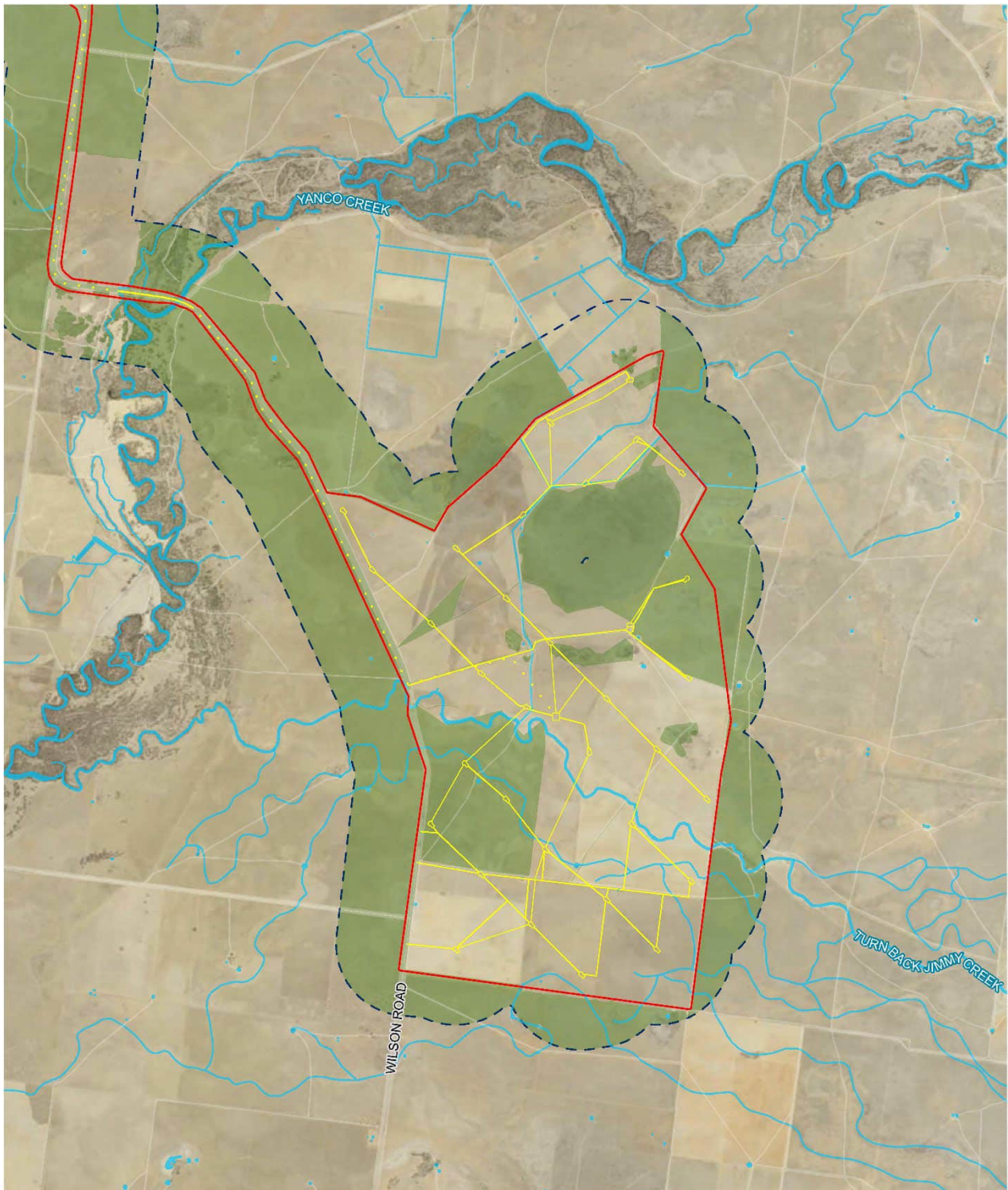
GDA 1994 MGA Zone 55



Data sources

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Figure 3-2. Native vegetation extent (Page 2 of 4)



Disturbance footprint
 Native vegetation cover
 Waterways

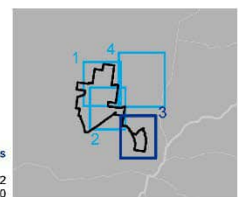
Landscape buffer 500m

Project area

0 1 2 km

1:74,000 at A4

GDA 1994 MGA Zone 55



Data sources

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Figure 3-2. Native vegetation extent (Page 3 of 4)



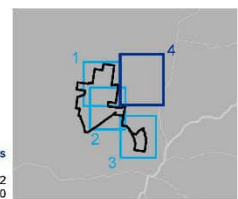
Disturbance footprint

 Native vegetation cover

 Waterways

Landscape buffer 500m

0 1 2 km
 1:90,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
 © Department of Customer Service 2022

Figure 3-2. Native vegetation extent (Page 4 of 4)

4. Native vegetation and vegetation integrity

4.1 Background research and key information sources

A background review of existing information was undertaken to identify existing areas of known native vegetation and to assist with preliminary survey identification and classification of native vegetation. The review focussed on database searches, relevant ecological reports and relevant spatial data pertaining to the Project area and included.

Regional vegetation mapping, geology and soil mapping Projects such as:

- State Vegetation Type Map: Riverina Region Version v1.2 – VIS_ID 4469 (Office of Environment and Heritage, 2016b)
- Jerilderie 1:250 000 Geological Map (Tuckwell, 1976)
- Deniliquin 1:250 000 Geological Map (Brown and Stephenson, 1991)
- Australian Soil Classification (ASC) Soil Type map of NSW (State Government of NSW and Office of Environment and Heritage (OEH), 2012).

The mapping provided in the State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469 (Office of Environment and Heritage, 2016) was found to be unreliable in terms of providing accurate polygon boundaries. However, it was referred to as a resource to gather a list potential PCTs within the Project area. This dataset was used initially to allocate PCTs and associated species credit species to plan targeted flora surveys but was not used extensively during other field work such as the rapid PCT mapping survey.

4.2 Mapping native vegetation extent

The native vegetation extent has been mapped in the landscape buffer, which includes a buffer of 500 metres surrounding the outside edge of the subject land in accordance with Section 3.1 of the BAM (refer to **Figure 3-2**). The native vegetation extent has been mapped as accurately as possible to assess the percentage of the current extent of native vegetation. However, some boundary errors may still exist over such a large area. Percent native vegetation cover in the landscape buffer was calculated using a combination of regional vegetation mapping, aerial imagery and mapping completed for this assessment.

Up to date aerial imagery and State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469 (DPIE, 2016) was used to map native vegetation across the Project area. This was supplemented with a rapid vegetation mapping survey was completed in parts of the Project area by two ecologists over five days between 27-31 October 2021 and subsequent biodiversity surveys completed up to September 2022, including the vegetation integrity assessment completed in late August 2022. Polygons were digitised in a GIS (ArcGIS 10.7) at a scale of between 1:1,000 and 1:5,000.

4.2.1 Definition of native vegetation

A plant is native to NSW if it was established in NSW before European settlement, including native planted vegetation. Under the BAM, native vegetation has the same meaning as in section 1.6 of the BC Act which states that native vegetation and clearing native vegetation have the same meanings as in Part 5A of the *Local Land Services Act 2013*. Part 5A 60B of the LLS Act defines the meaning of native vegetation as any of the following types of plants native to New South Wales:

- Trees (including any sapling or shrub or any scrub)
- Understorey plants
- Groundcover (being any type of herbaceous vegetation)

The Project area contain native trees, understorey plants, and groundcover species. Whilst some of the Project area has been cleared for agricultural practices, there are very large areas of native grasslands, shrublands and open woodland common in the landscape. Historical clearing of woodland has likely created areas of derived grassland. As such, these areas have been assigned to the most likely original PCT, which can be determined with reasonable confidence based on floristic value and position in the landscape.

4.3 Plant community type identification

Rapid PCT mapping surveys were completed in the study area during different stages of the Project:

- Five days between 27-31 October 2021
- Five days between 8-12 August 2022.

The October survey primarily focused on mapping indicative locations of all WTGs, internal access roads and four proposed transmission line options in the study area. Further additions were made to the Project design in April 2022, including the location of cabling, substations, BESS, additional transmission lines and modifications to the existing design. As a result, August surveys supplemented the survey gaps in the study area. These surveys identified and mapped PCTs and delineated each PCT into broad condition classes to assign separate vegetation zones. This mapped outcome of these surveys was used to inform the severity of biodiversity constraints and planning to avoid and minimise Project impacts on biodiversity values. This method was based on the BAM (DPIE, 2020) and was utilised as part of the vegetation mapping process to develop the vegetation integrity assessment. This process included:

- Transects and traverses using a hand-held tablet containing ArcGIS Field Maps to record boundaries of, and variation within stratification units not apparent from aerial imagery
- Collection of data from rapid data points (RDPs) to obtain information on vegetation community structure, composition and landscape position, soil, and past land uses/disturbance history, to accurately assign stratification units to PCTs and vegetation zones.

The type and distribution of PCTs within the Project area were identified and mapped progressively during all field surveys. The identification of PCTs presented in this BDAR is in accordance with the NSW PCT classification as described in the BioNet Vegetation Classification database (DPE, 2022c). Each PCT was assigned to the relevant corresponding Threatened Ecological Community (TEC) where applicable.

4.3.1 Stratification of native vegetation into survey units

The vegetation surveys were completed using field survey methods in line with Chapter 4 of the BAM. The survey was stratified and targeted to assess the expected environmental variation. Using the existing vegetation mapping, survey sites (plots/midlines) were established within each area of mapped vegetation to provide a representative assessment of the vegetation prior to the field survey. Plots were also positioned to provide a wide spatial coverage of the Project area and survey boundary. Once the identification of PCTs had been finalised, each PCT was then divided into vegetation zones (an area of native vegetation that is the same PCT and has a similar broad condition state). The PCTs identified within the Project area are described in detail below.

The vegetation within the Project area has been assigned to a PCT as listed in the BioNet Vegetation Classification database based on the observed plant species composition, vegetation structure, landscape position, and underlying geology and soils.

4.3.2 Plot based floristic vegetation and vegetation integrity assessment

A plot-based full floristic survey and vegetation integrity (VI) assessment was carried out in accordance with the BAM. The location of each plot/mid-line completed during the survey is illustrated in **Figure 4-1**. Plots/mid-lines were established to provide a representative assessment of the vegetation integrity of the vegetation zone, accounting for the level of variation in the broad condition state of the vegetation zone. The emphasis was on identifying broad condition states within each PCT and no attempt was made at fine scale mapping in areas of variable vegetation density.

Plots were randomly located in designated vegetation zones and a random bearing was created (in a random number application) for the direction of each plot. In some circumstances to achieve a representative sample of a vegetation zones plots were placed in locations dictated by narrow disturbance footprints such as cabling or roadsides.

A total of 82 VI assessment plots were completed over 5 days by four ecologists, including two BAM accredited assessors between 15-19 August 2022. Correspondence with BCS noted vegetation integrity survey timing was appropriate for assessing native vegetation in optimum condition, particularly grassland in

the study area. The Listing Advice on Natural Grasslands of the Murray Valley Plains also recommends late winter-spring and not soon after disturbance such as grazing as appropriate timing for vegetation assessment.

Rainfall in the three months preceding the vegetation survey (May-July 2022) comprised 79.8 mm (Deniliquin Airport AWS 074258). Rainfall was above average for May, but below average for June and July.

The minimum survey requirements for most vegetation zones were met or generally exceeded so that the variation within each PCT could be adequately sampled. VI plots were positioned to sample vegetation integrity within the disturbance footprint. Most plots were completed as 20 x 20 m plots (or equivalent 400 m² area) nested inside a 20 x 50 m plot (or equivalent 1,000 m² area). Due to the linear features of the Project design (e.g. narrow access tracks, cabling and roadsides), some plots were completed as 40 x 10 m plots nested inside a 100 x 10 m plot to capture the most accurate vegetation integrity impacted in the disturbance footprint and avoid edge effects of roads where possible.

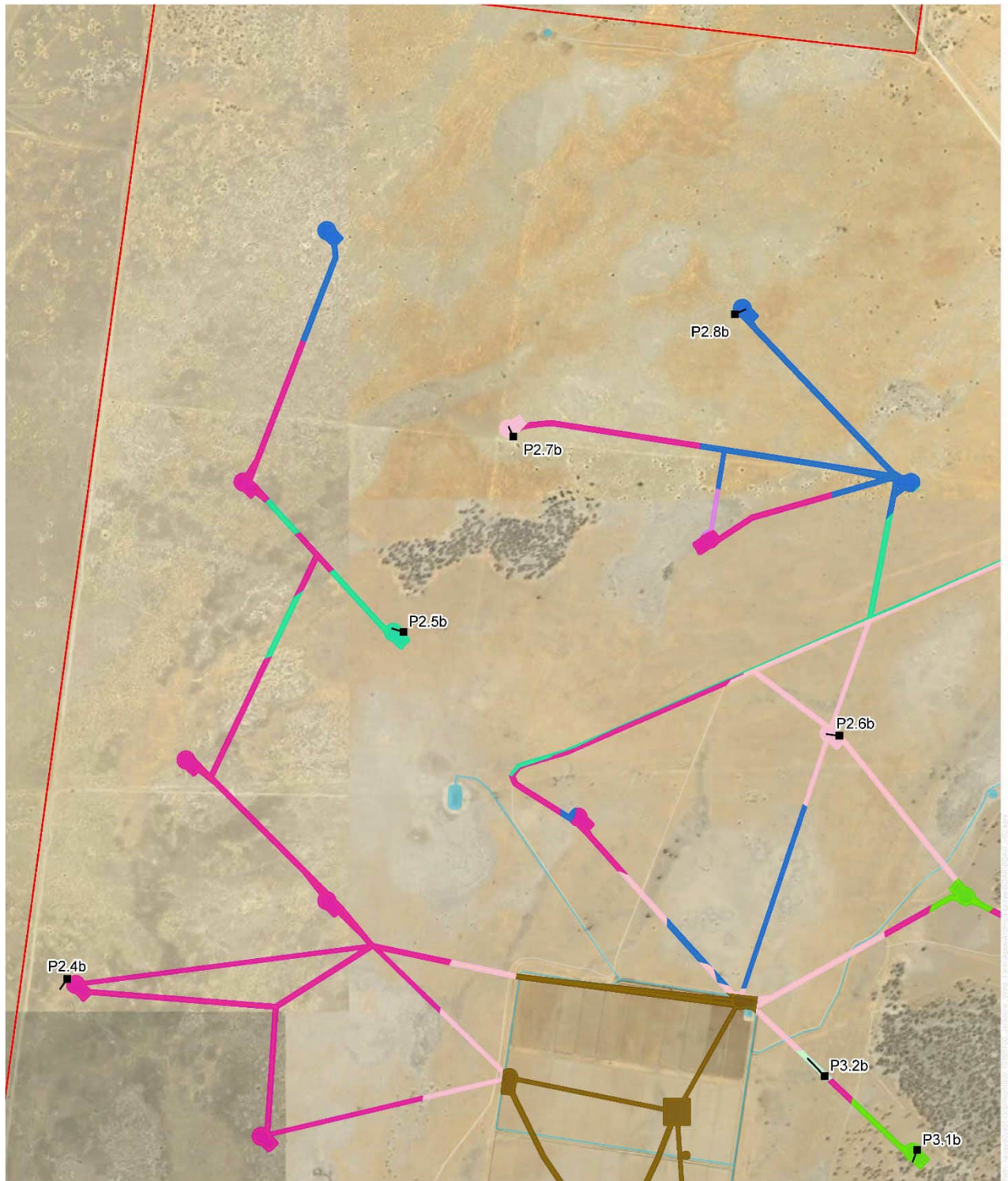
A summary of vegetation survey effort, outlining the number of vegetation zones and respective number of floristic plots / transects sampled in the field is presented in **Table 4-1**.

Table 4-1. Plant community types and vegetation zones completed within the disturbance footprint

Vegetation zone	Plant community type name	Broad condition class	Vegetation zone area in disturbance footprint (ha)	Minimum number of plots/mid-lines required	Number of plots/mid-lines completed
1	River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)	Low to Moderate	1.10	1	1
2	River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)	Low to Moderate	0.22	1	1
3	Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)	Moderate to Good	0.58	1	2
4		Low to Moderate	0.11	1	1
5	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)	Moderate to Good	1.86	1	6
6	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26)	Moderate to Good_grassy	27.00	4	10
7		Low to Moderate_grassy	1.40	1	2
8		Moderate to Good_shrubby	2.10	2	3
9		Low to Moderate_shrubby	0.59	1	1

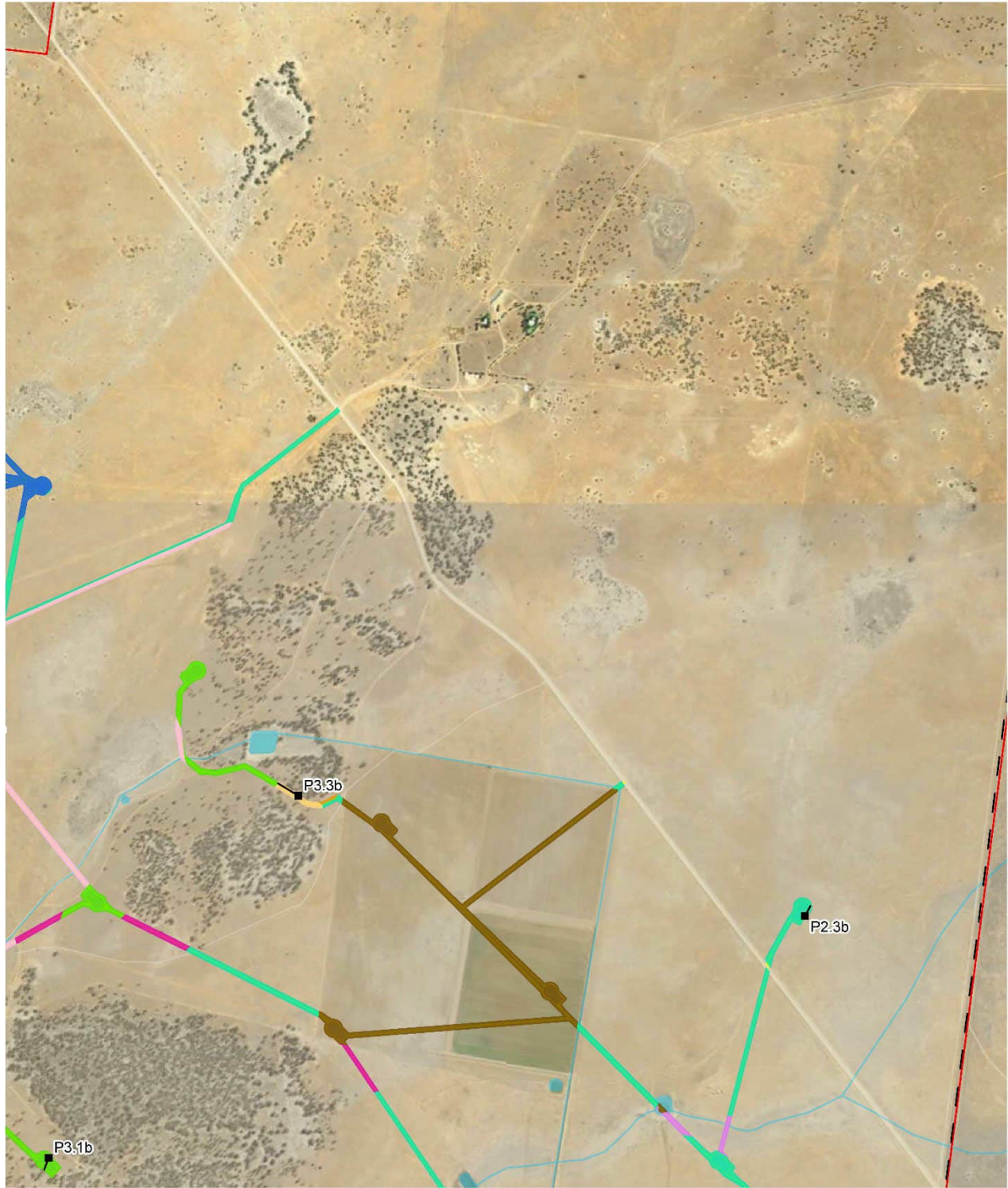
Biodiversity Development Assessment Report

Vegetation zone	Plant community type name	Broad condition class	Vegetation zone area in disturbance footprint (ha)	Minimum number of plots/mid-lines required	Number of plots/mid-lines completed
10	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28)	Low to Moderate	10.28	3	7
11	Forb-rich Speargrass – Windmill Grass – White Top grassland of the Riverina Bioregion (PCT44)	Moderate to Good	32.99	4	14
12		Low to Moderate	3.15	2	4
13	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)	Moderate to Good	1.42	1	2
14		Low to Moderate	0.81	1	1
15	Curly Windmill Grass – speargrass – wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46)	Moderate to Good	31.29	4	10
16		Low to Moderate	13.32	3	5
17		Moderate to Good_Cottonbush	23.49	4	6
18		Low to Moderate_Cottonbush	22.51	4	5
19	Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160)	Moderate to Good	0.03	1	1
Total			173.39	40	82



<ul style="list-style-type: none"> Disturbance footprint Project area Vegetation integrity plots Vegetation integrity transects Road Waterways Non-native vegetation 	<ul style="list-style-type: none"> PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion Low - moderate Moderate - good PCT 44: Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion Low - moderate Moderate - good 	<ul style="list-style-type: none"> PCT 28: White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone Low - moderate PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion Moderate - good grassy PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) Moderate - good 	<p>0 250 500 m</p> <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> <p>Data sources Jacobs 2022 © Department of Customer Service 2020</p>
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 1 of 27)

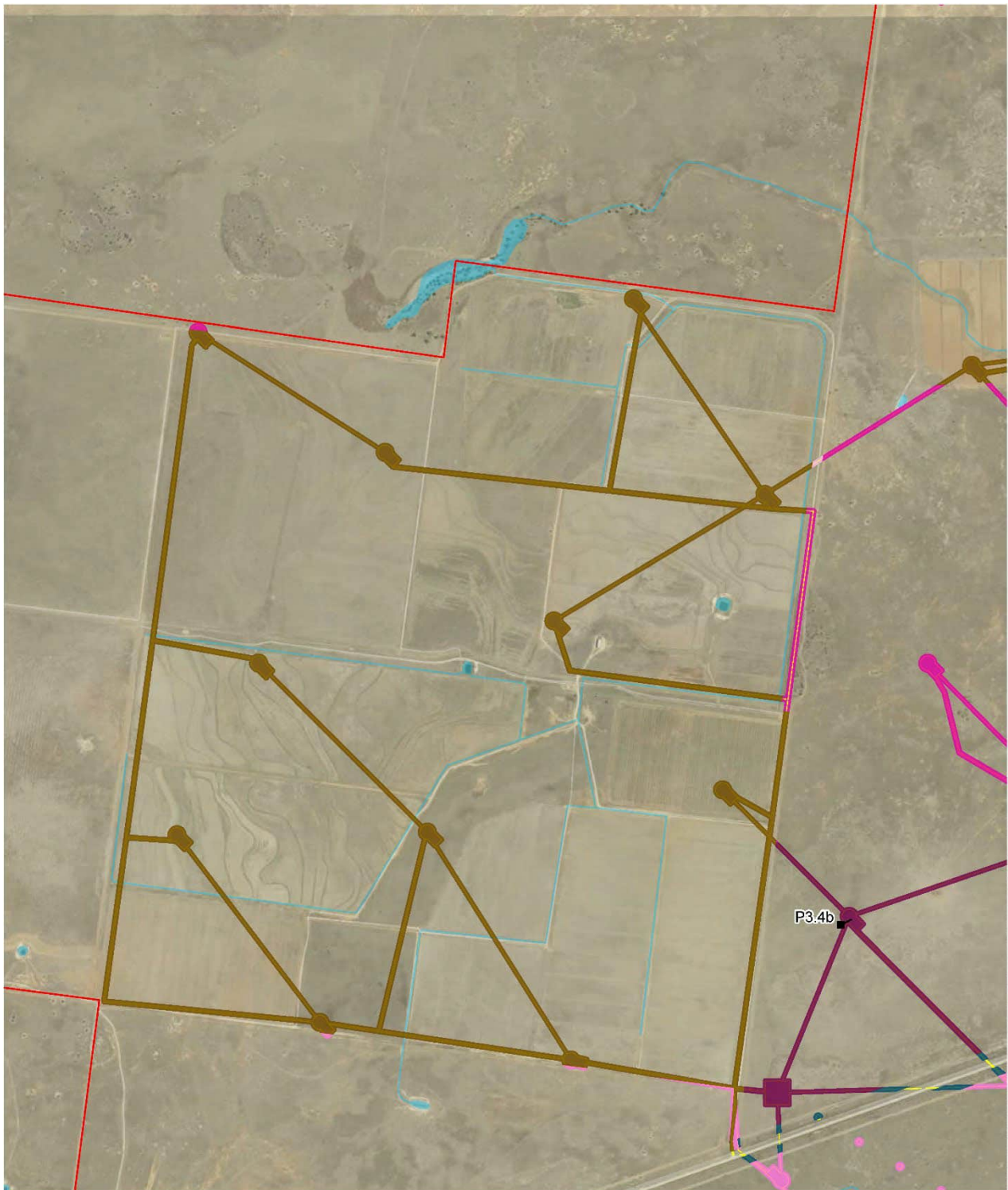


<ul style="list-style-type: none"> Disturbance footprint Project area Vegetation integrity plots Vegetation integrity transects Road Existing 132kV transmission line Waterways Non-native vegetation 	<ul style="list-style-type: none"> PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion <li style="padding-left: 20px;"> Low - moderate <li style="padding-left: 20px;"> Moderate - good PCT 44: Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion <li style="padding-left: 20px;"> Moderate - good PCT 28: White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone <li style="padding-left: 20px;"> Low - moderate 	<ul style="list-style-type: none"> PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion <li style="padding-left: 20px;"> Moderate - good grassy PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) <li style="padding-left: 20px;"> Moderate - good 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) <li style="padding-left: 20px;"> Low - moderate <li style="padding-left: 20px;"> Moderate - good 	<p>0 250 500 m</p> <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> <p>Data sources Jacobs 2022 © Department of Customer Service 2020</p>
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 2 of 27)

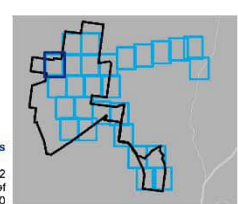
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- Disturbance footprint
- Project area
- Vegetation integrity plots
- Vegetation integrity transects
- Road
- Waterways
- Non-native vegetation
- PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion
- Low - moderate
- Low - moderate Cottonbush
- Moderate - good
- Moderate - good Cottonbush
- PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- Moderate - good shrubby

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 3 of 27)

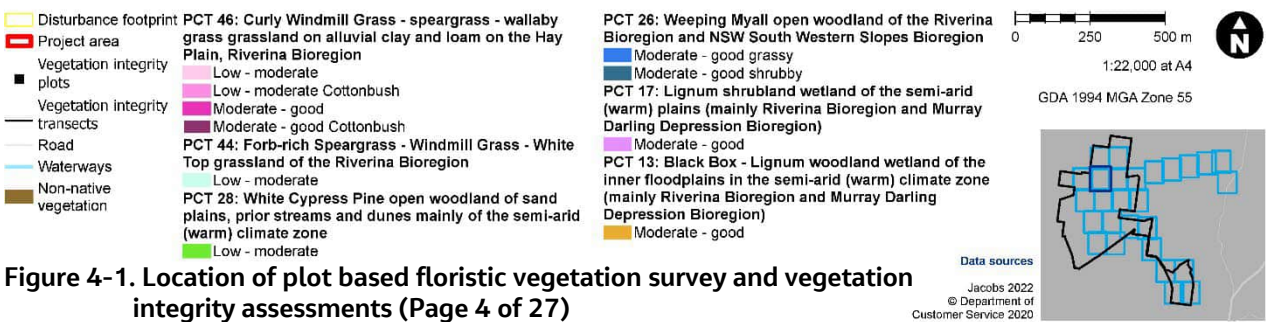
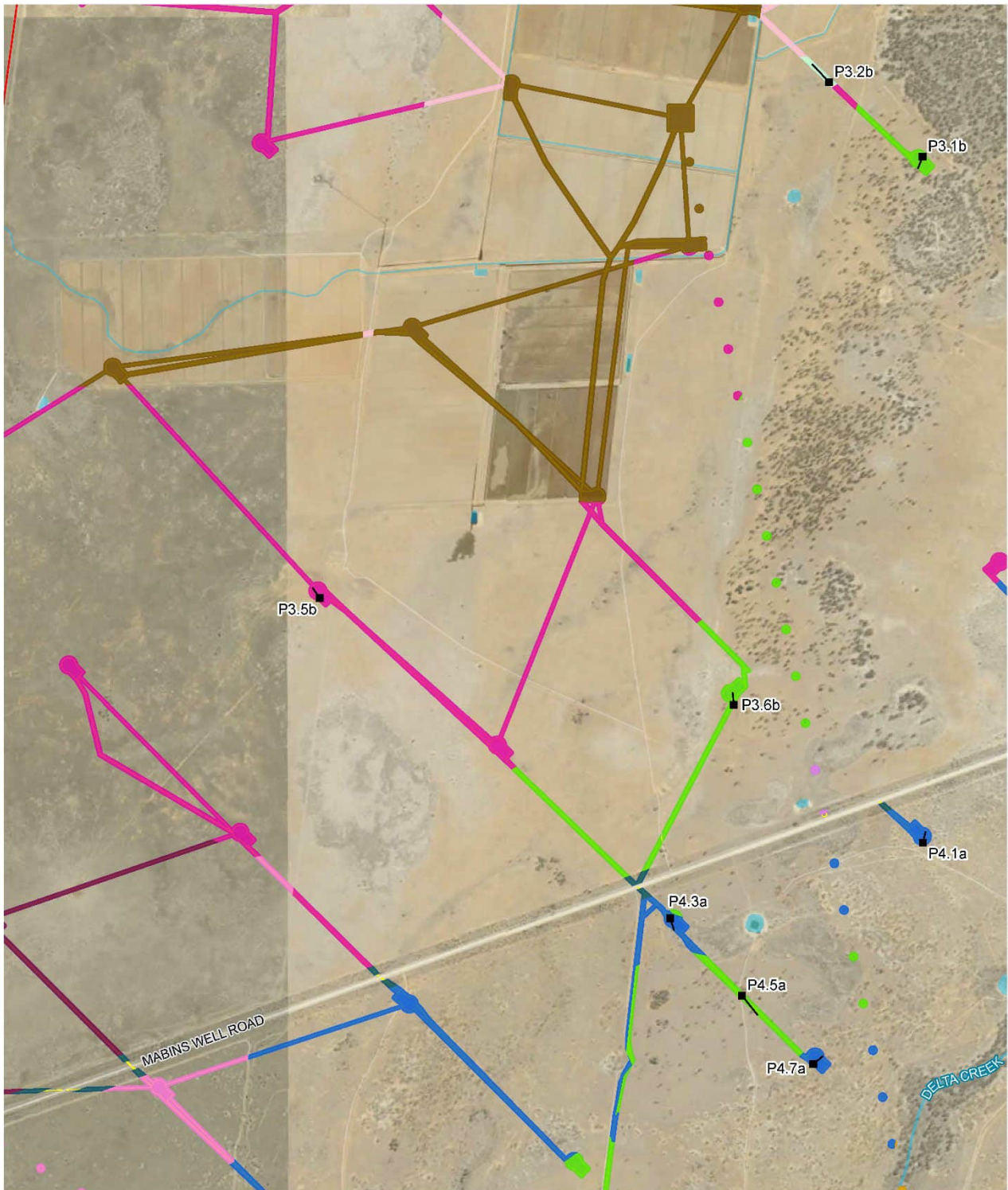


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 4 of 27)

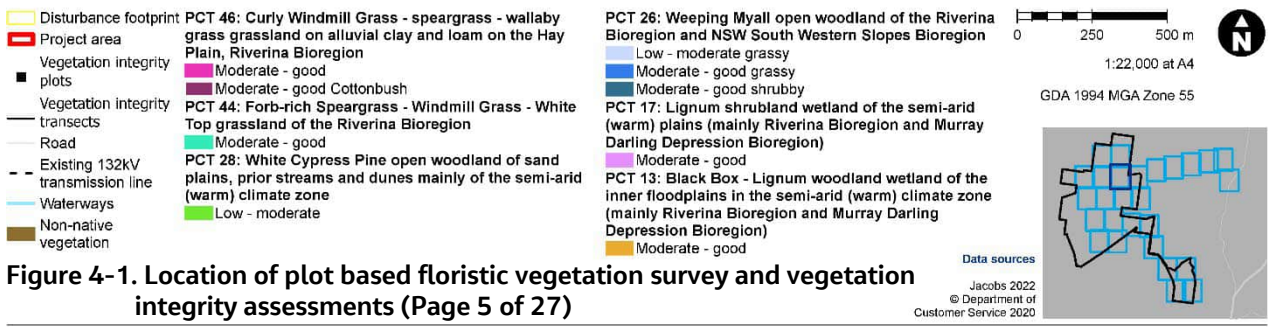
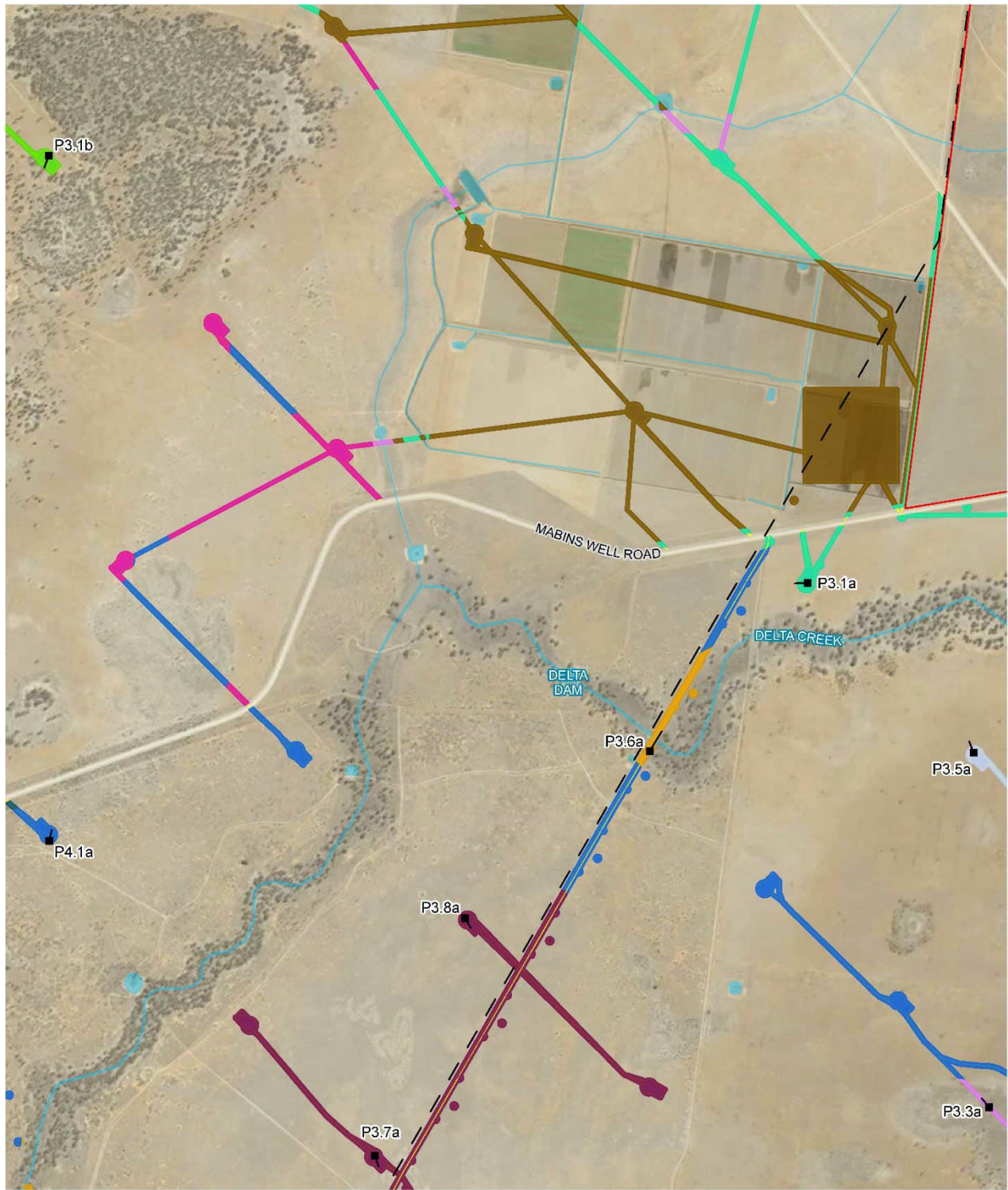


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 5 of 27)

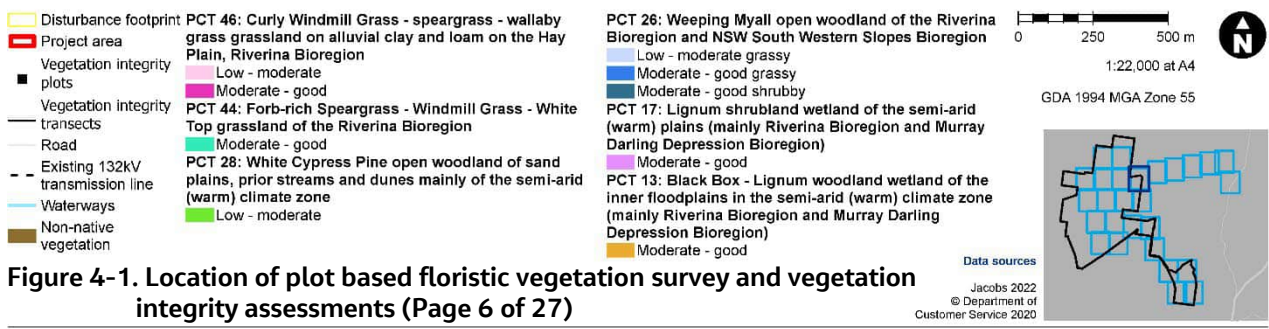
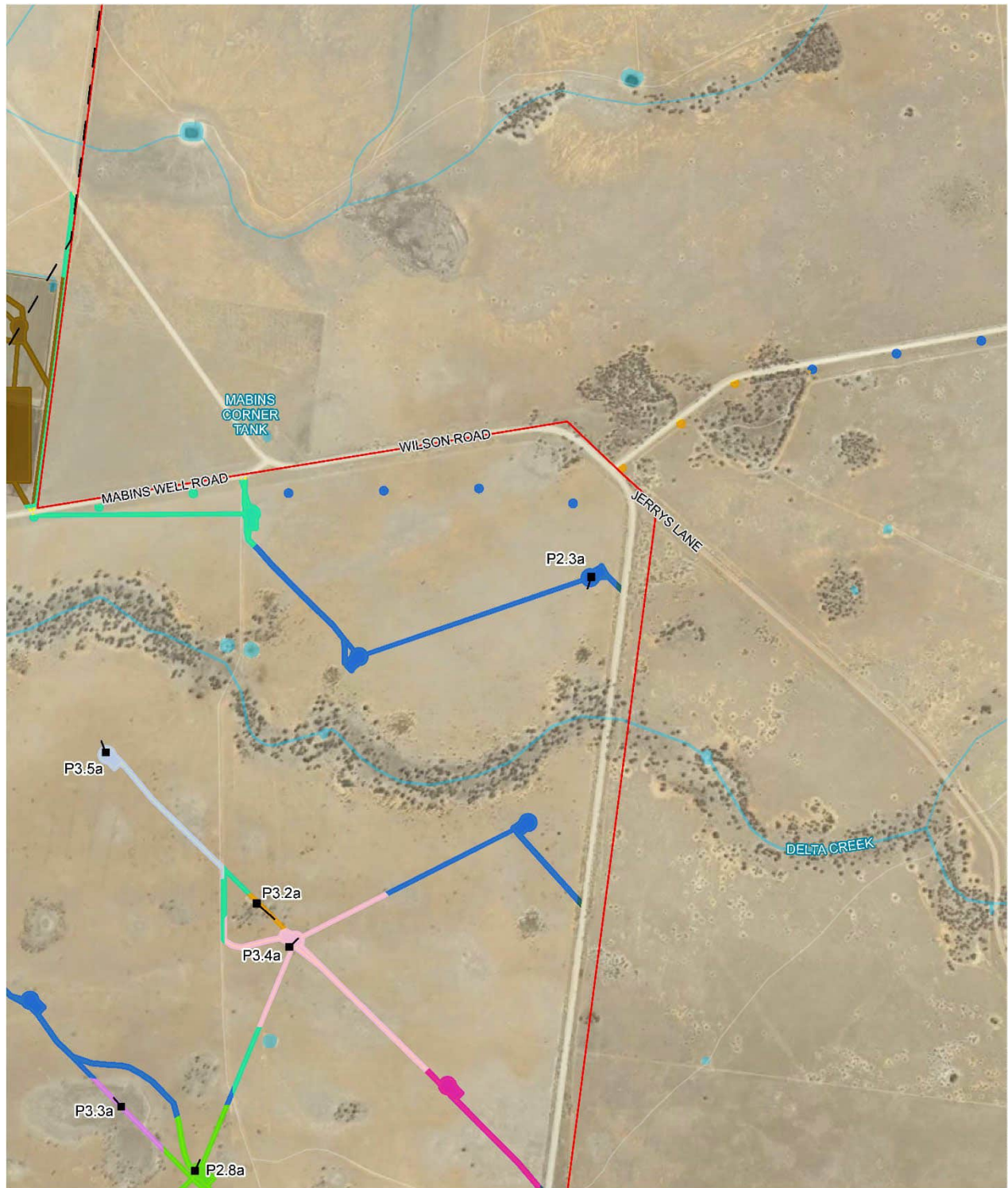
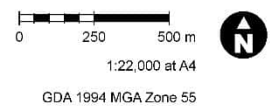


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 6 of 27)



- Disturbance footprint PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion
- Road
- Waterways
- Moderate - good
- PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- Moderate - good grassy



Data sources
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 7 of 27)




- ▭ Disturbance footprint
- ▭ Road
- ▭ Waterways
- PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion
- Moderate - good
- PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- ▭ Moderate - good grassy

0 250 500 m

1:22,000 at A4

GDA 1994 MGA Zone 55



Data sources

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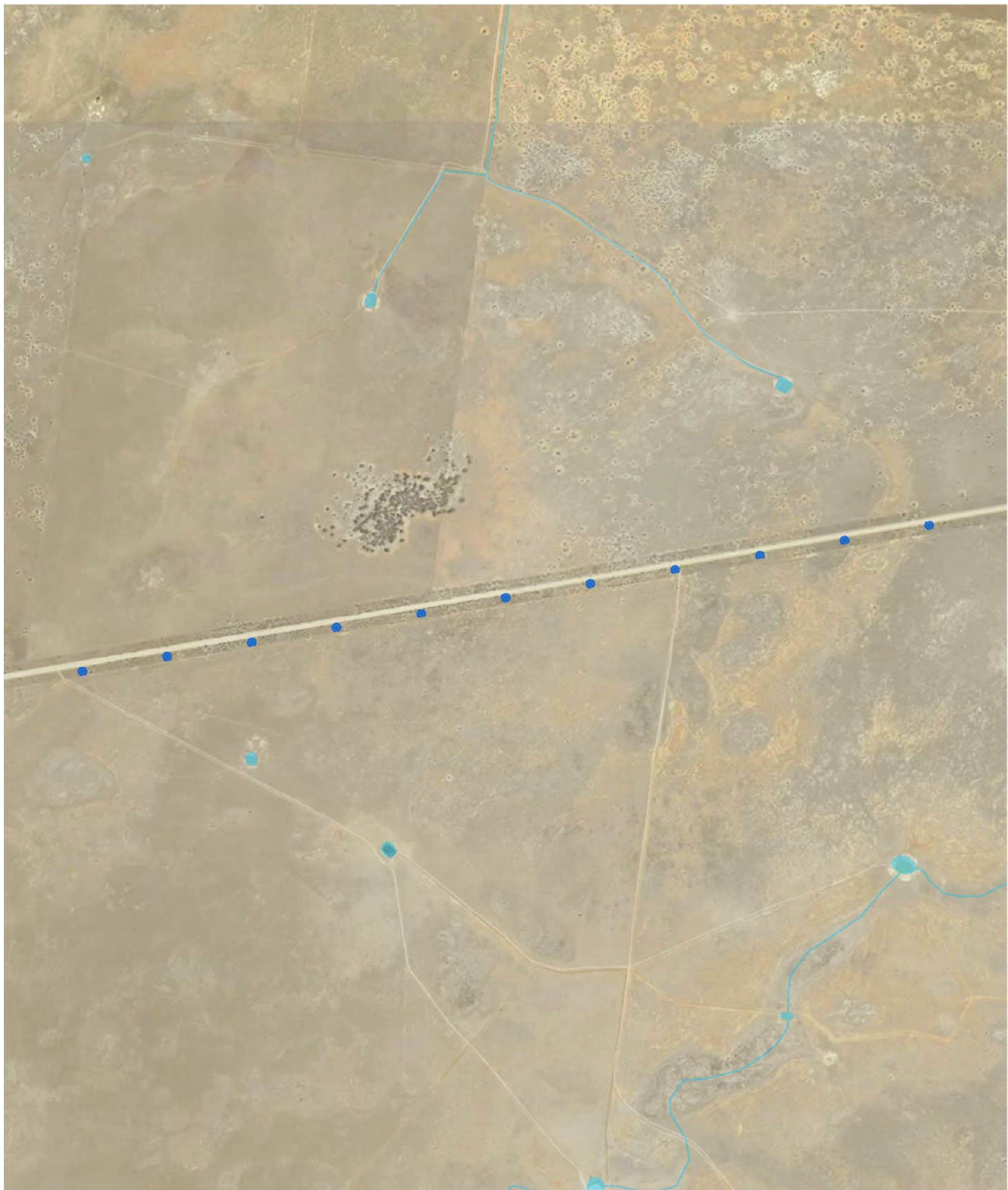



Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 8 of 27)



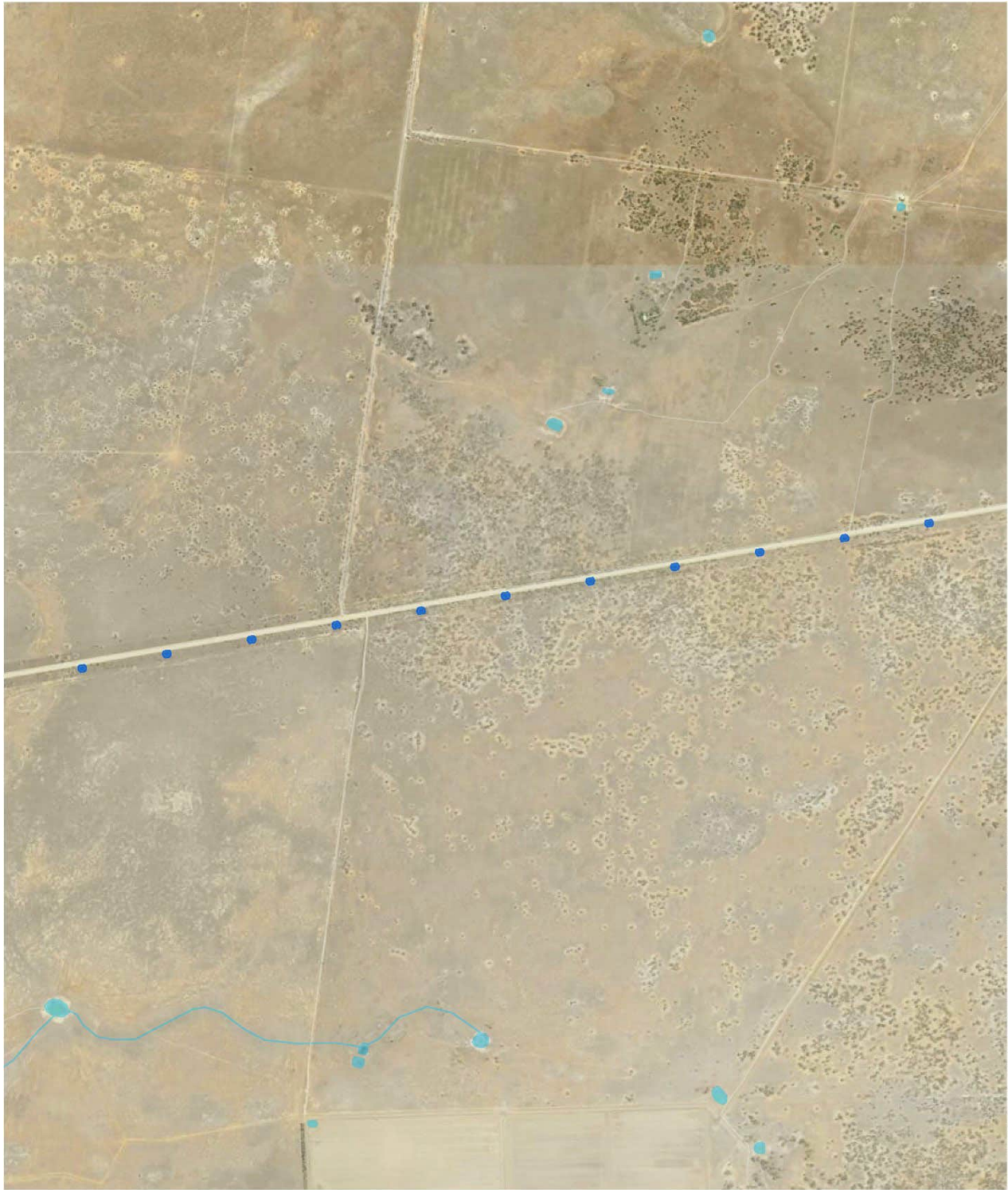
▬ Disturbance footprint PCT 26: Weeping Myall open woodland of the Riverina
▬ Road Bioregion and NSW South Western Slopes Bioregion
▬ Waterways ■ Moderate - good grassy

0 250 500 m 
 1:22,000 at A4
 GDA 1994 MGA Zone 55



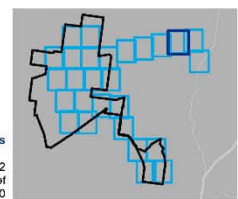
Data sources
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 9 of 27)



■ Disturbance footprint **PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion**
— Road
— Waterways ■ Moderate - good grassy

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 10 of 27)



▭ Disturbance footprint PCT 26: Weeping Myall open woodland of the Riverina
▭ Road Bioregion and NSW South Western Slopes Bioregion
▭ Waterways ▭ Moderate - good grassy

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
 © Department of
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 11 of 27)



- Disturbance footprint
 - Road
 - Waterways
 - Moderate - good grassy
 - Moderate - good
- PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion**
- 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)**

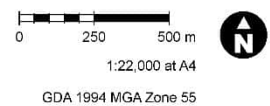
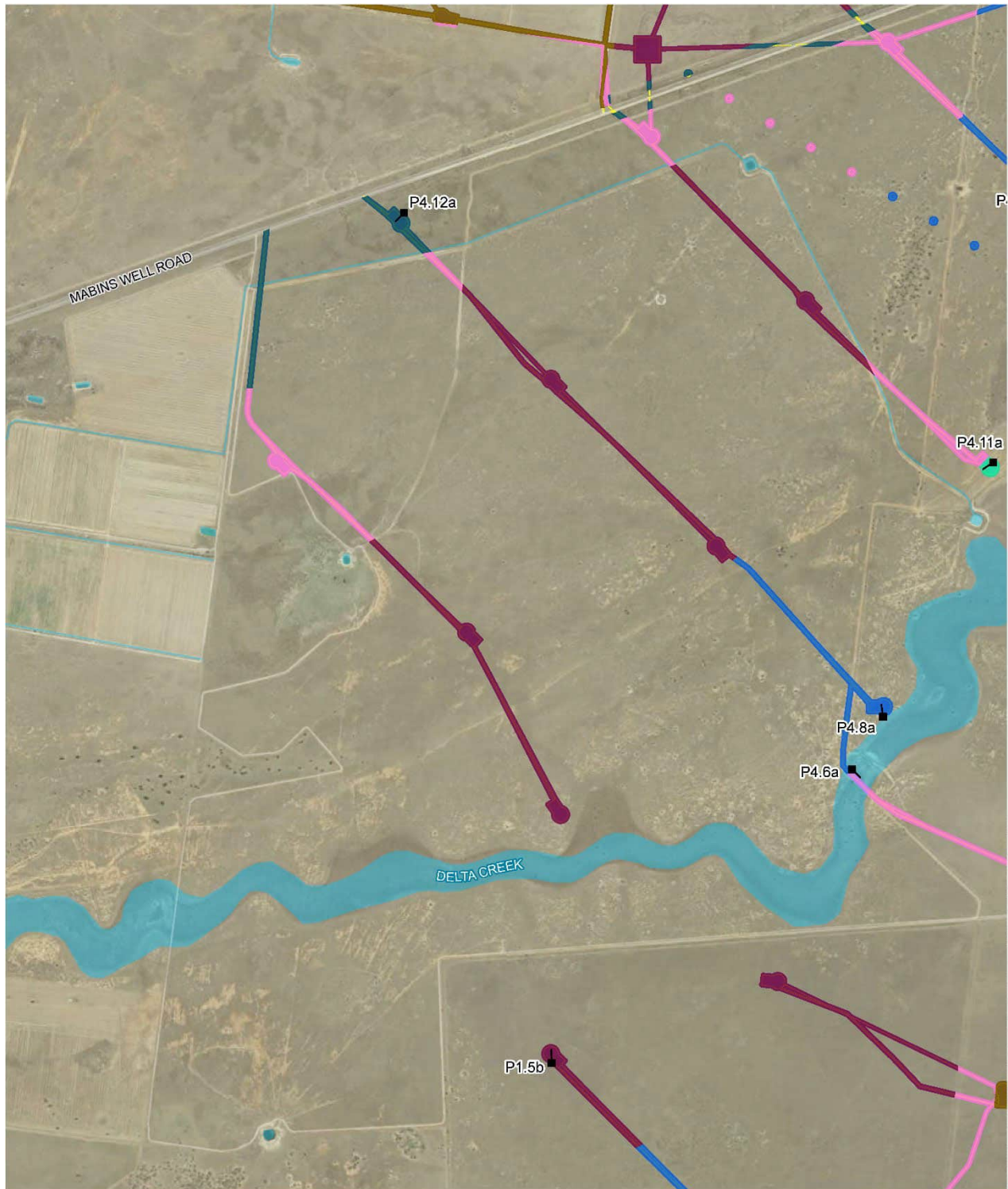


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 12 of 27)



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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 13 of 27)

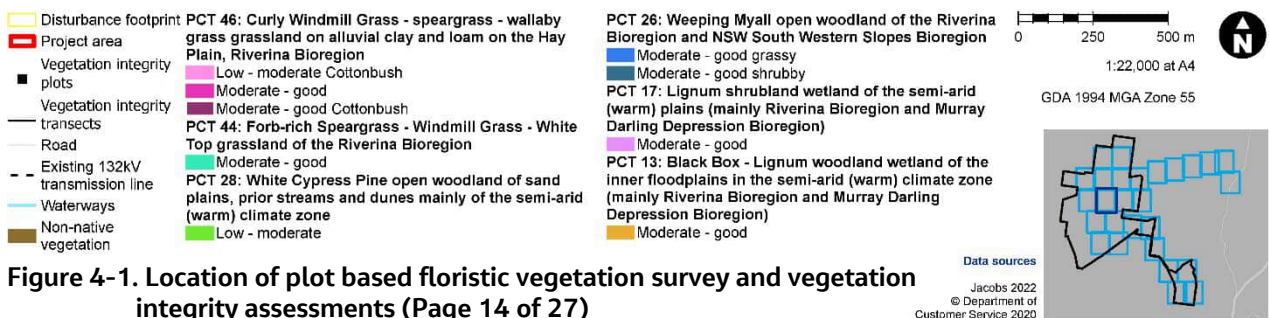
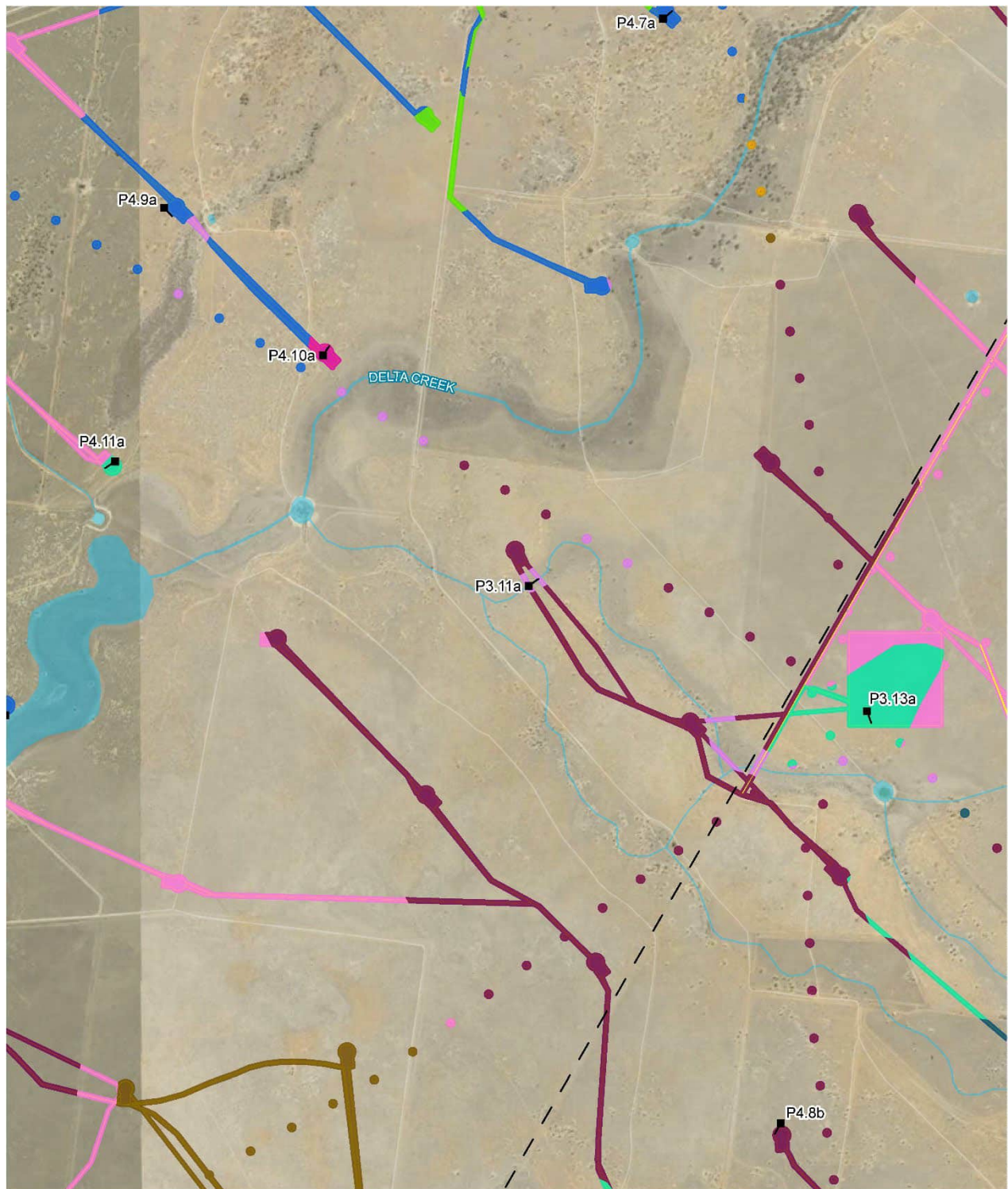


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 14 of 27)

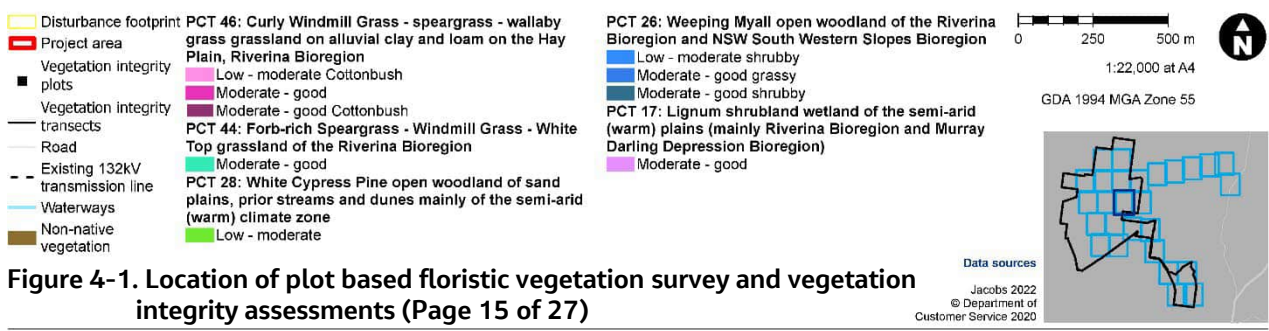
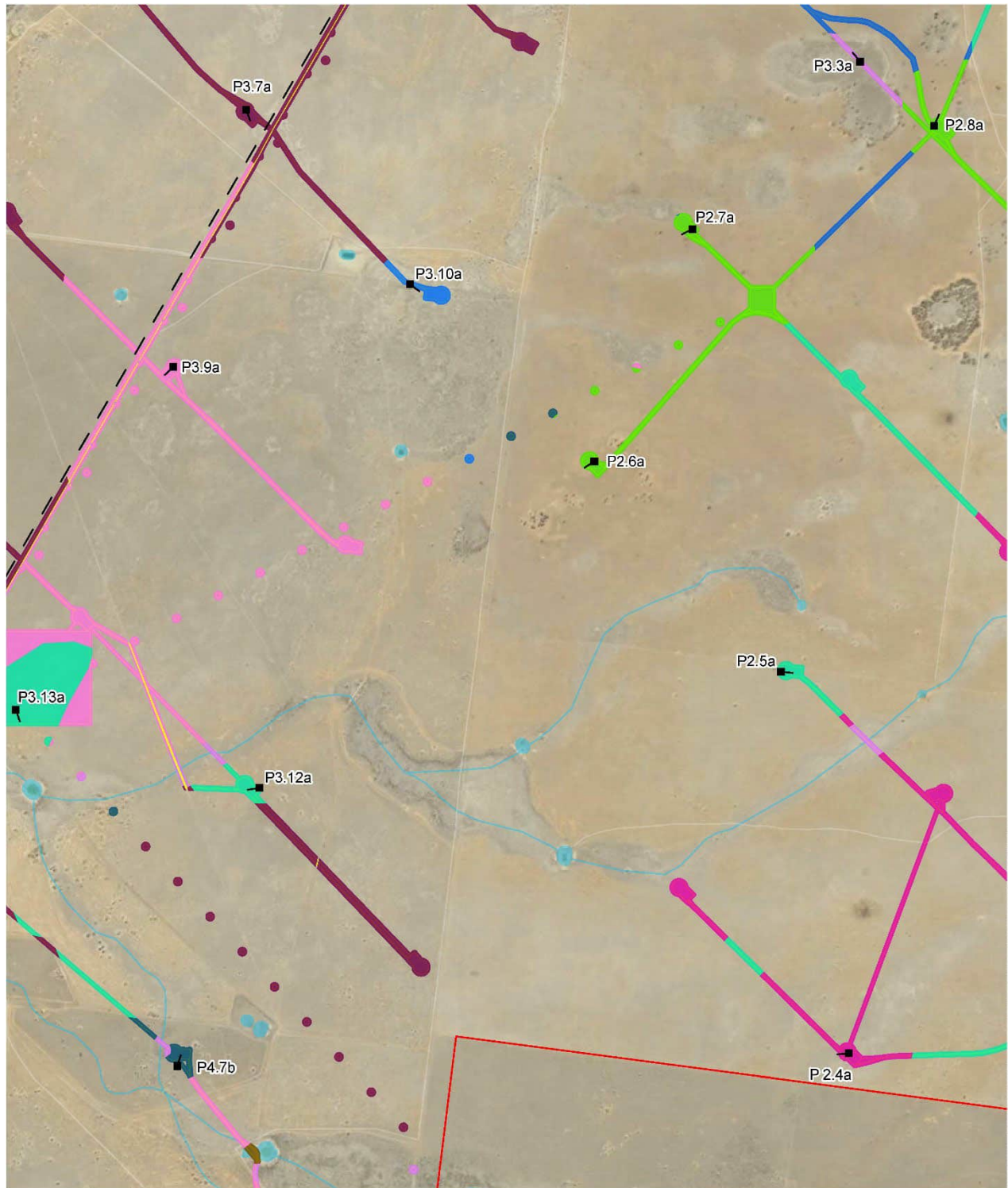


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 15 of 27)

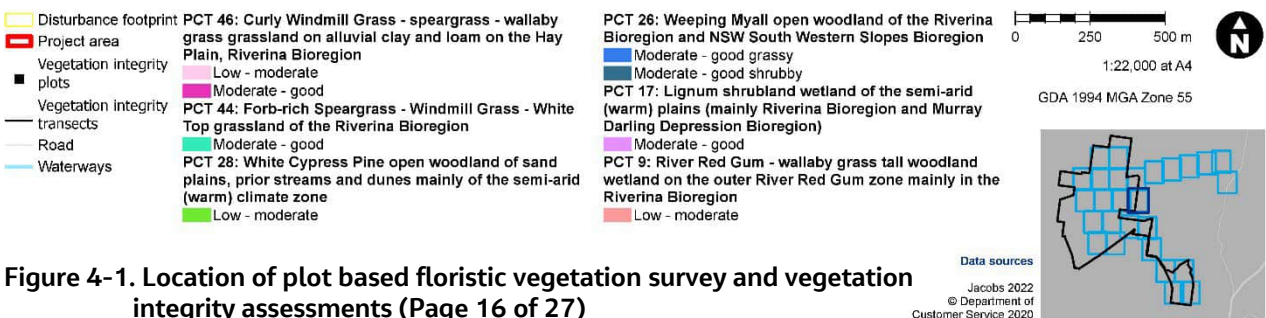
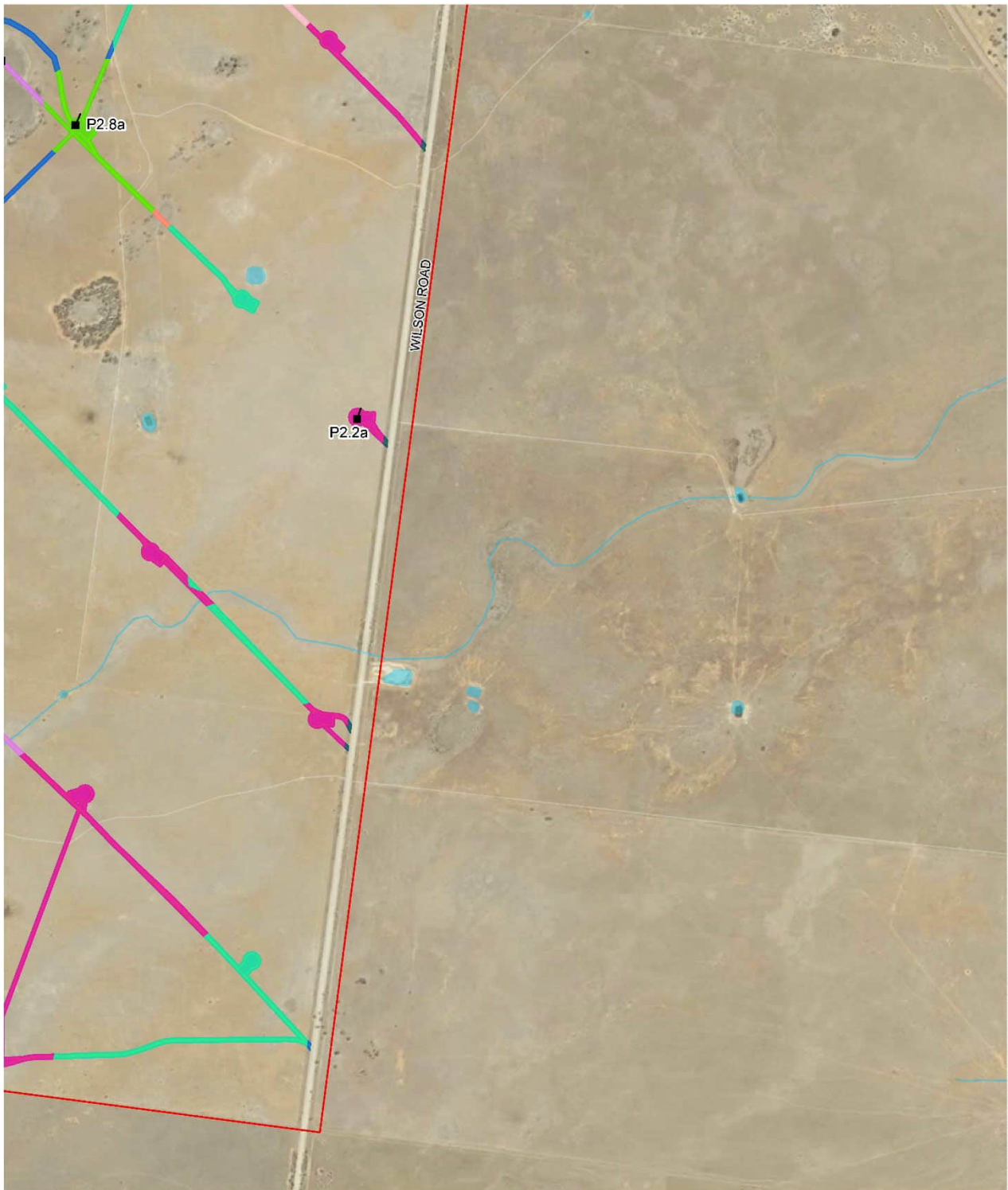


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 16 of 27)

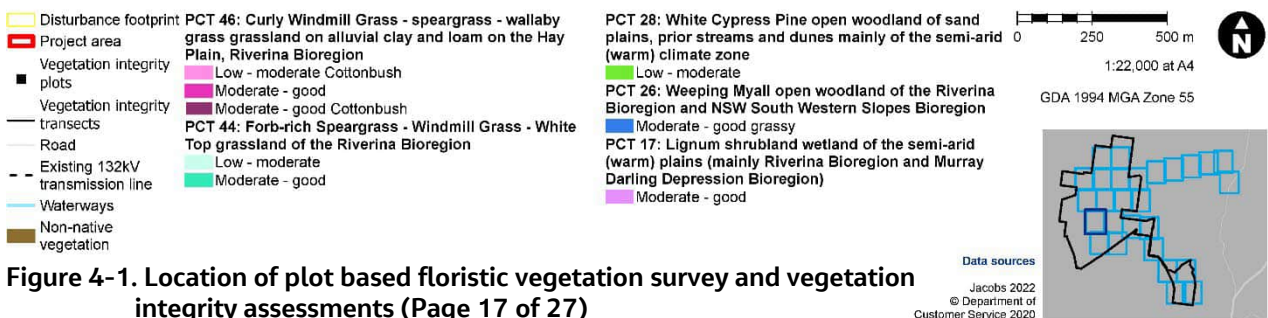
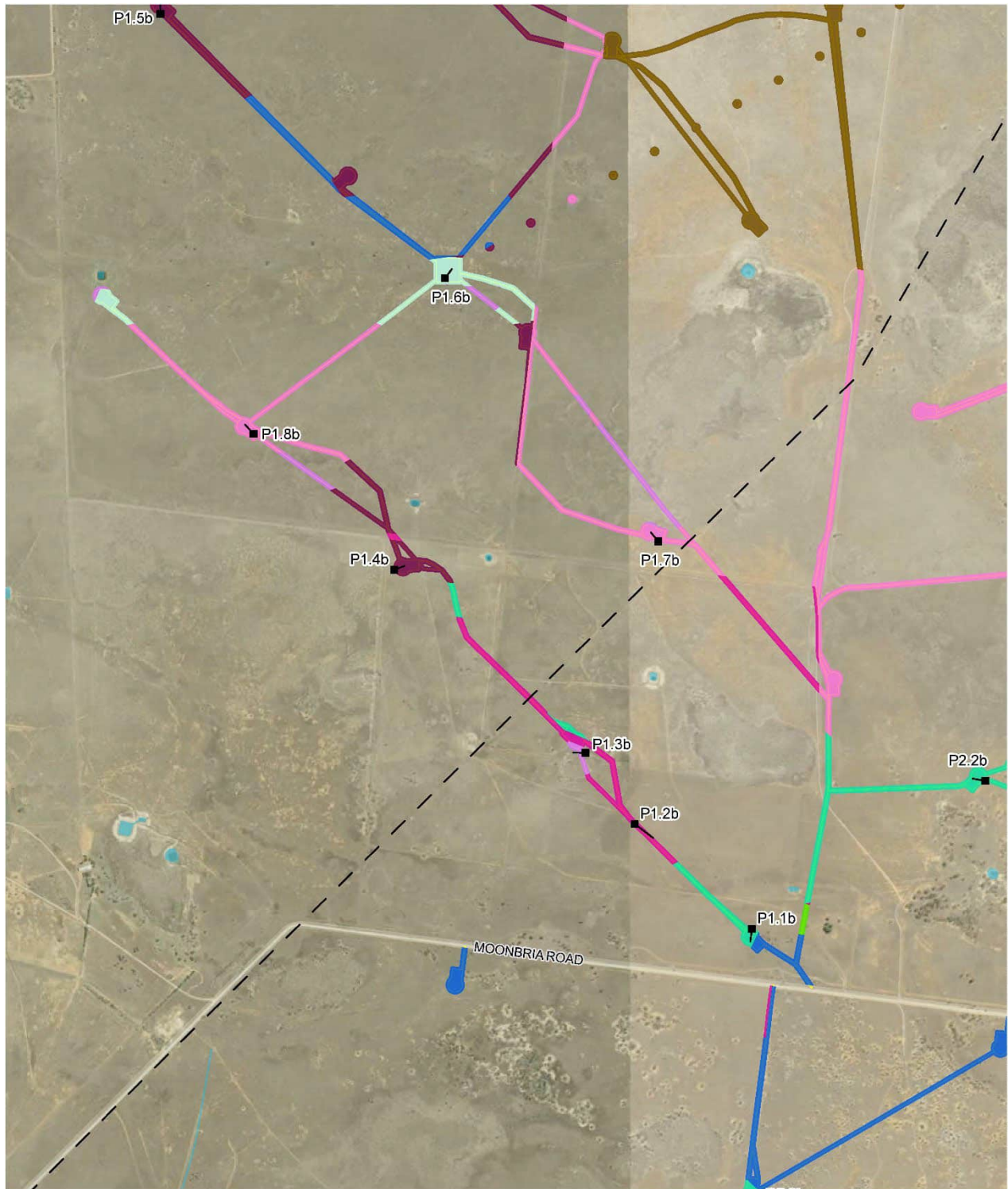


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 17 of 27)

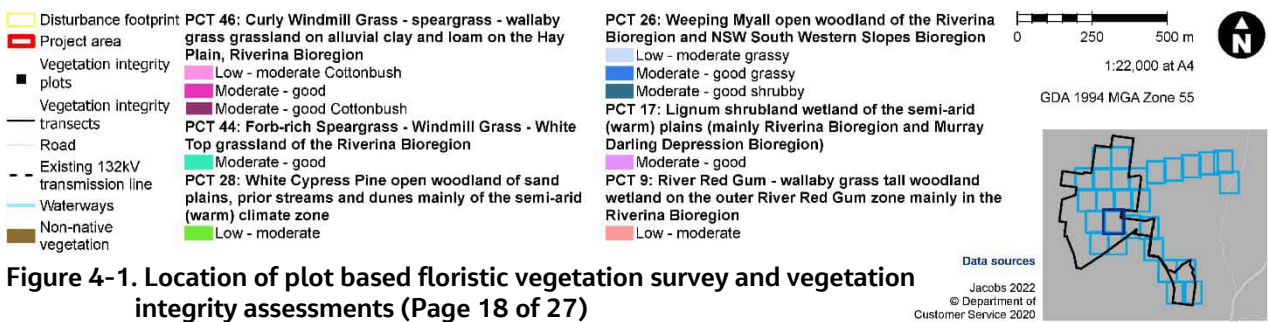
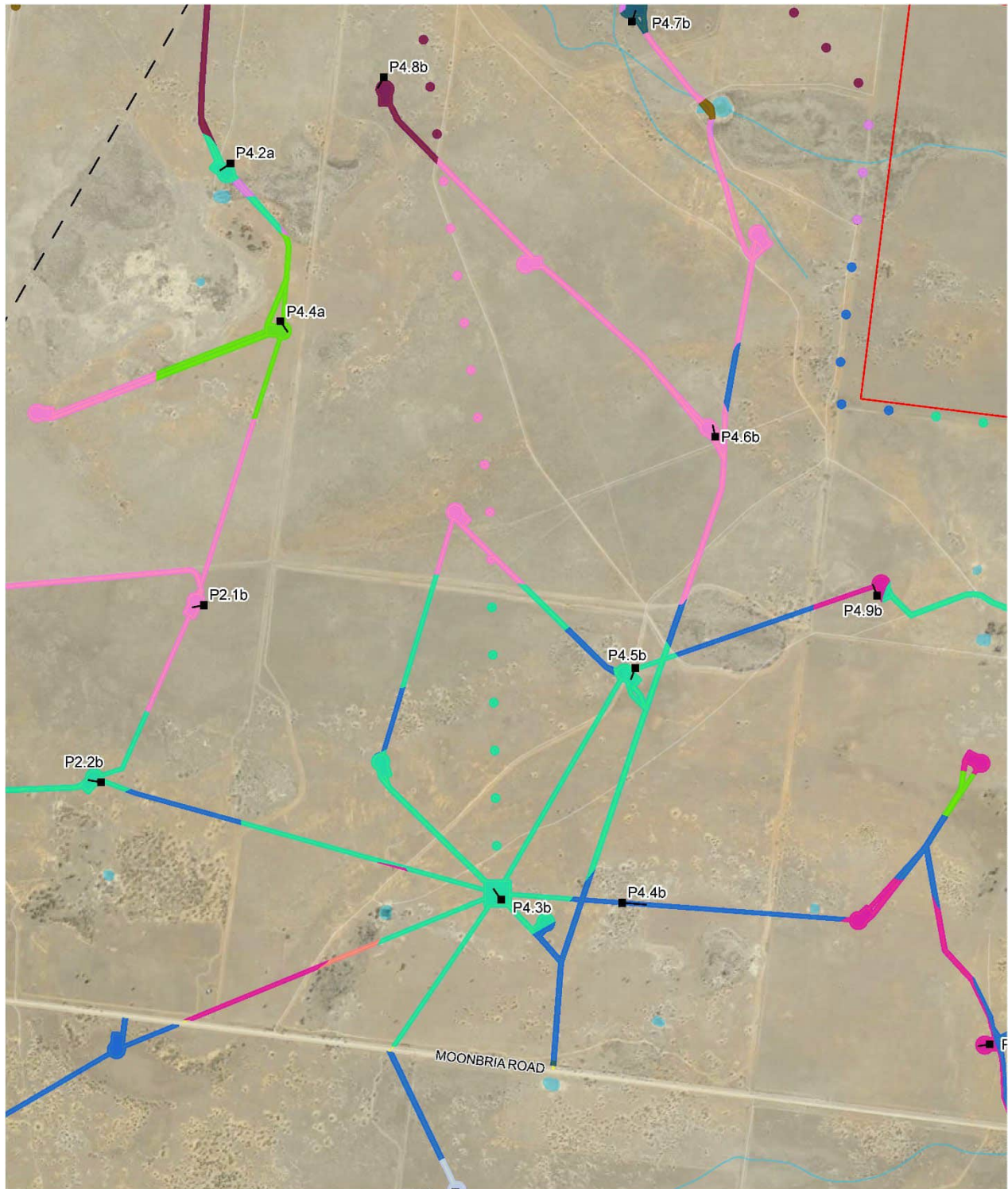
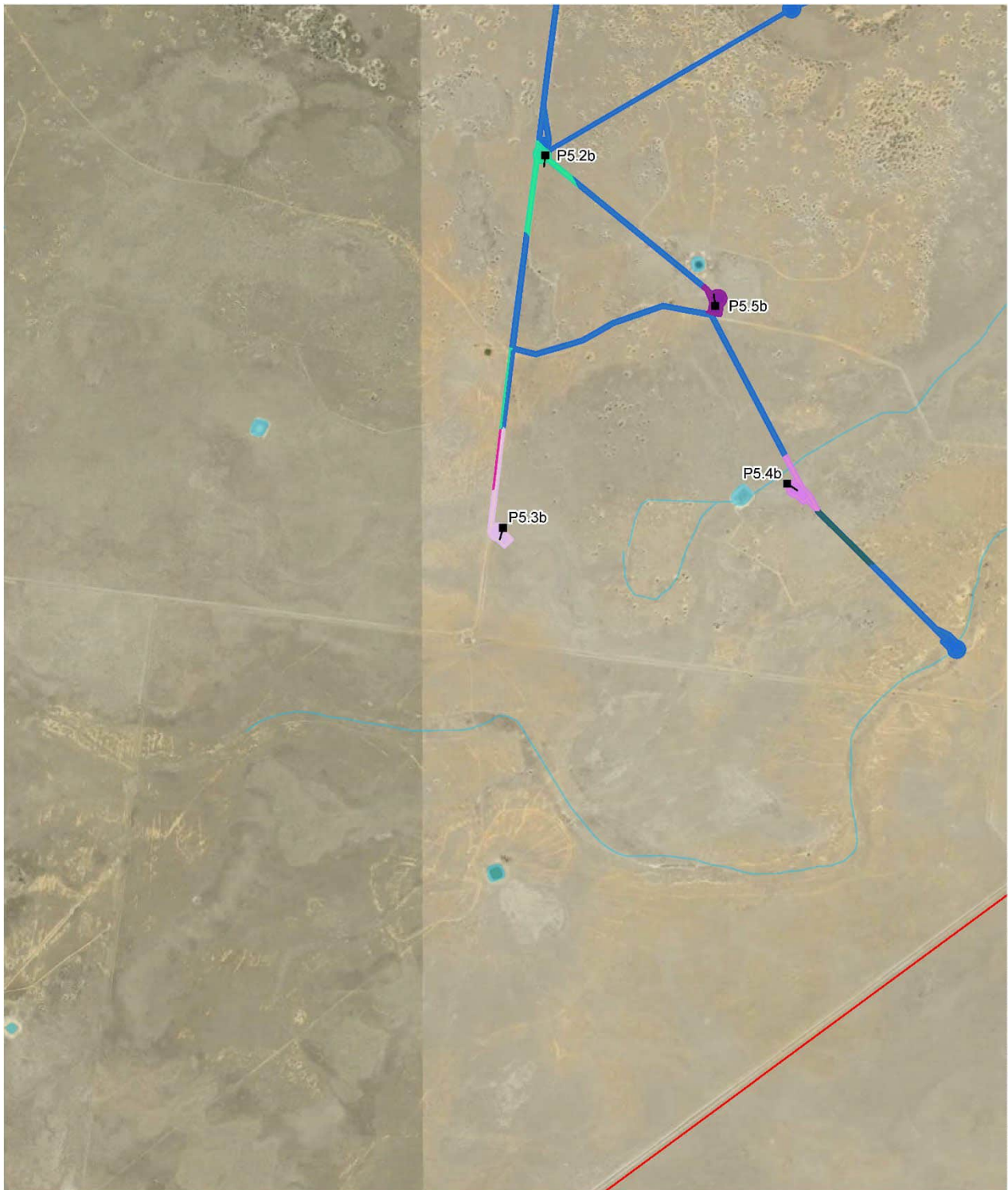


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 18 of 27)



<ul style="list-style-type: none"> Disturbance footprint Project area Vegetation integrity plots Vegetation integrity transects Road Waterways 	<ul style="list-style-type: none"> PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion Moderate - good PCT 45: Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion Low - moderate Moderate - good 	<ul style="list-style-type: none"> PCT 44: Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion Moderate - good PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion Moderate - good grassy Moderate - good shrubby PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) Moderate - good 	<p>0 250 500 m</p> <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> <p>Data sources Jacobs 2022 © Department of Customer Service 2020</p>
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 19 of 27)

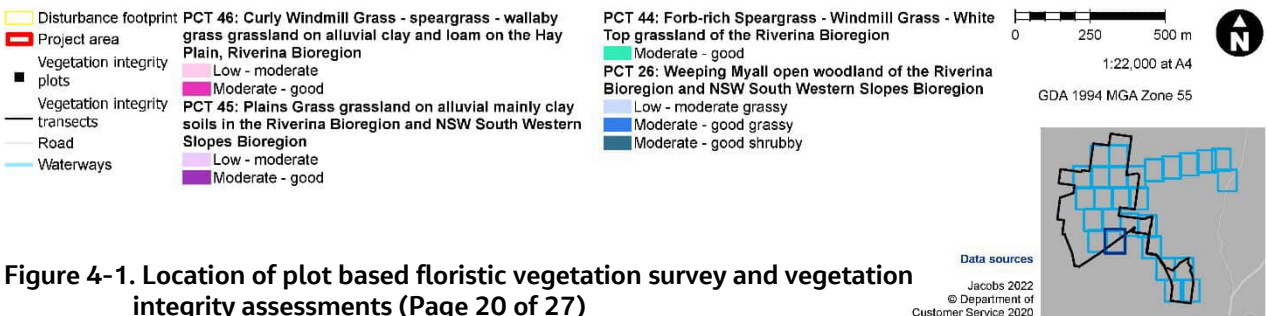
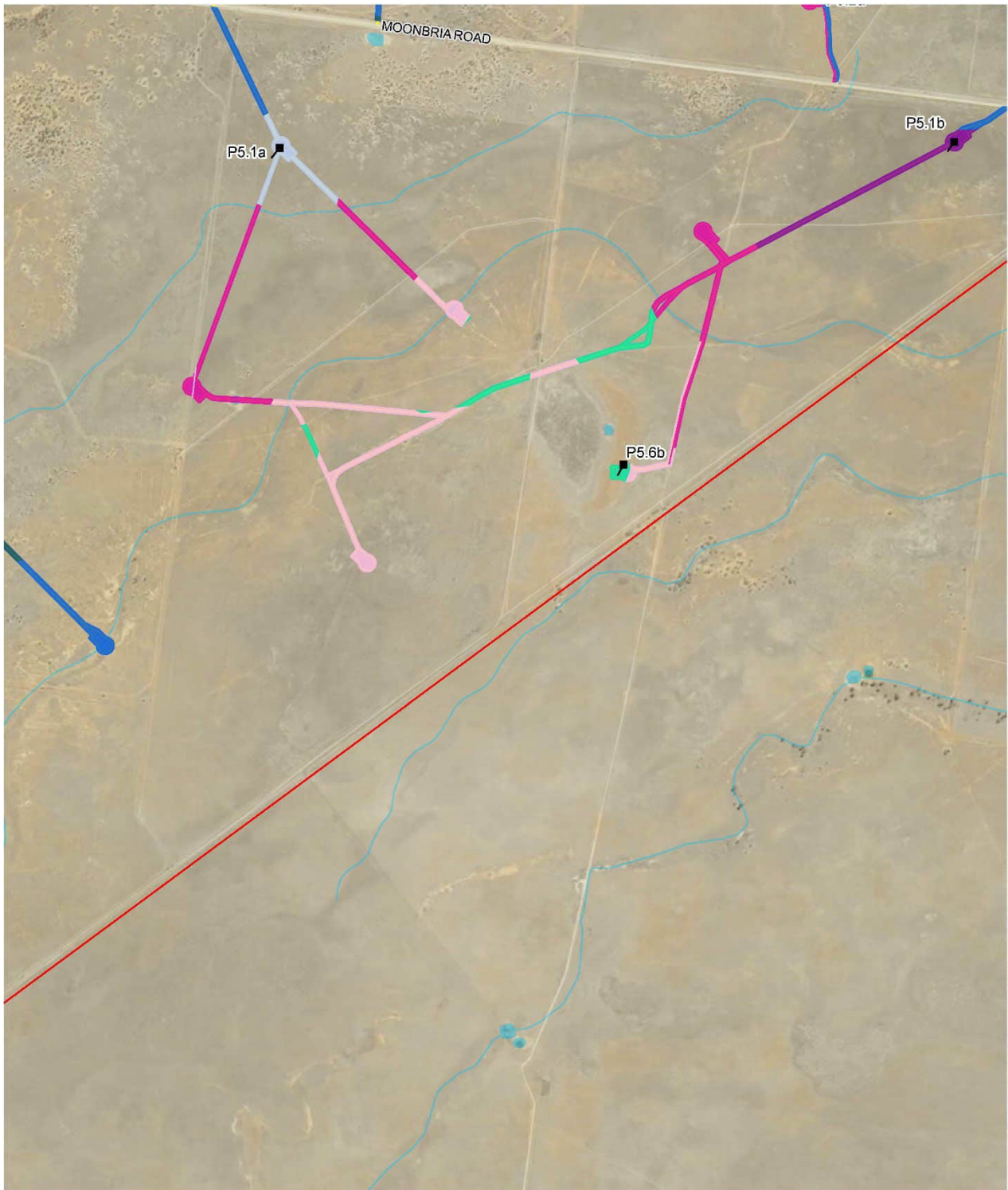
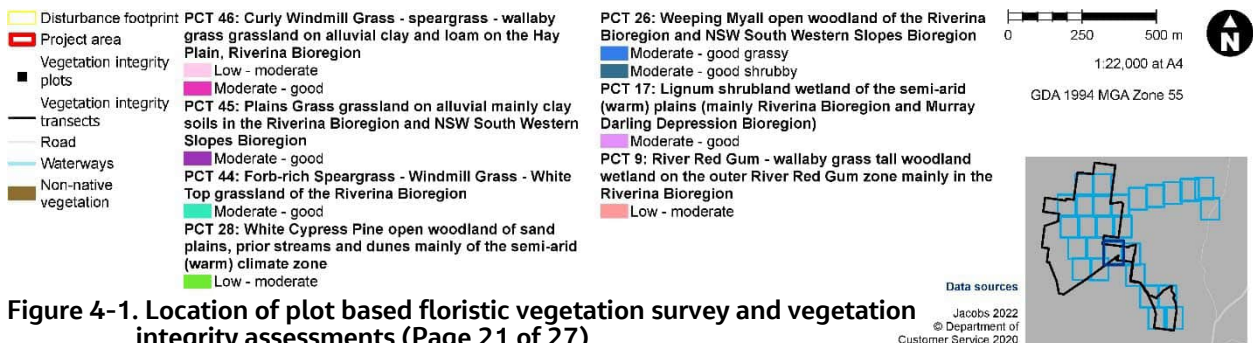
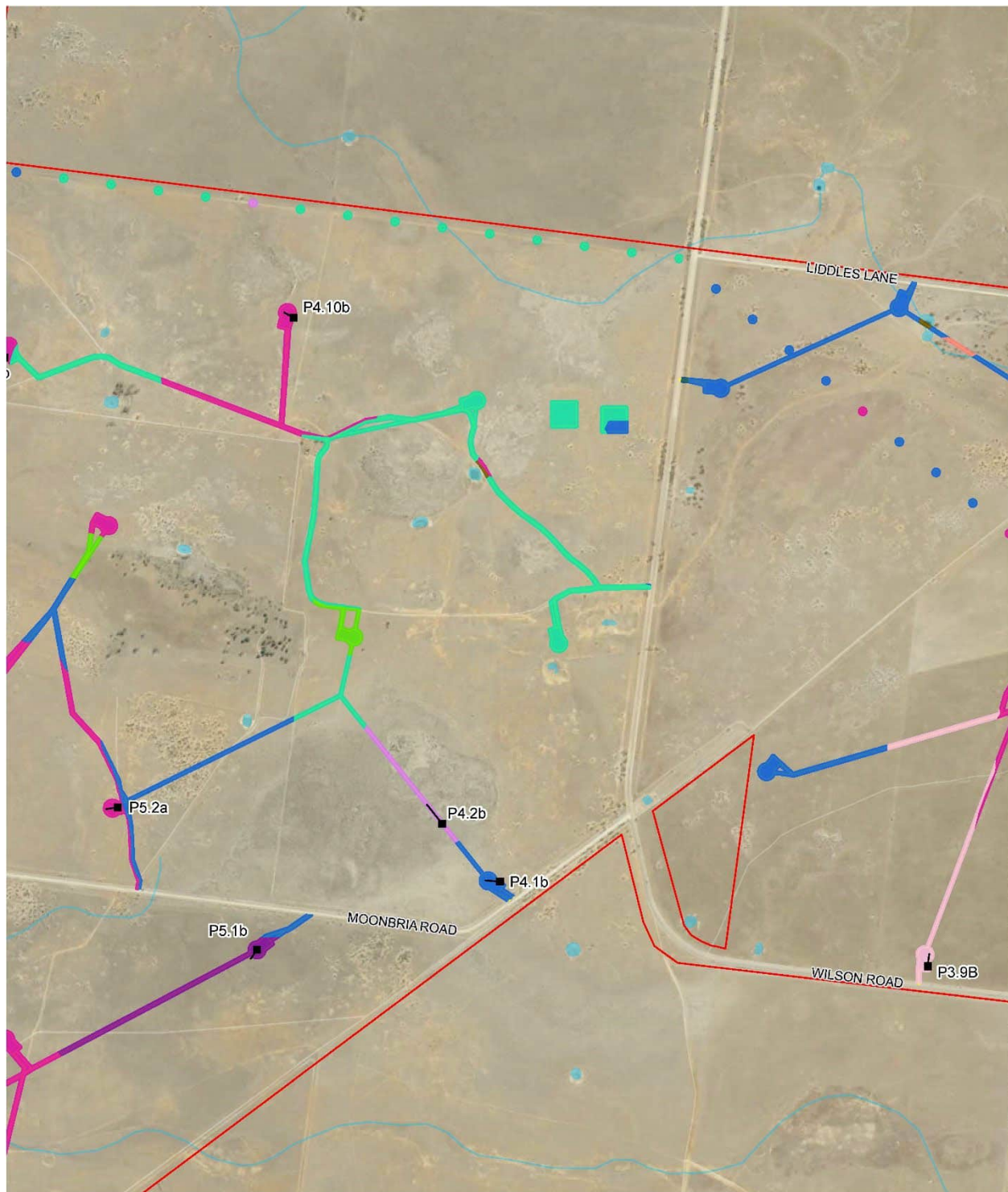


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 20 of 27)



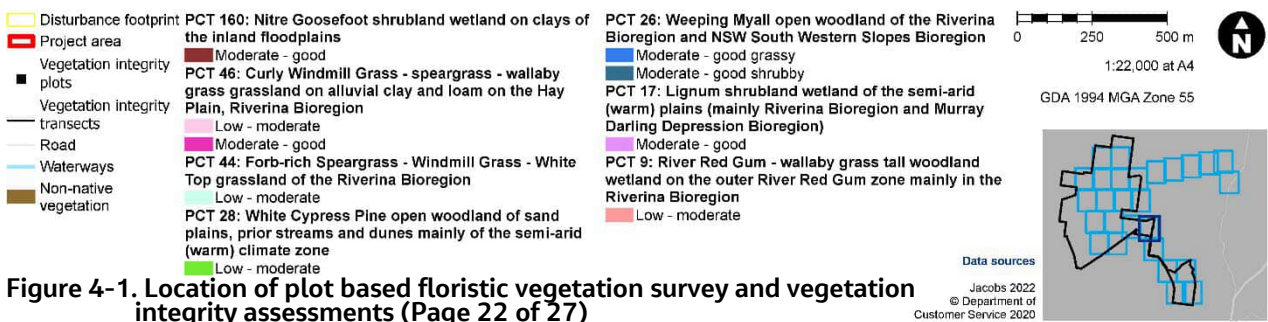
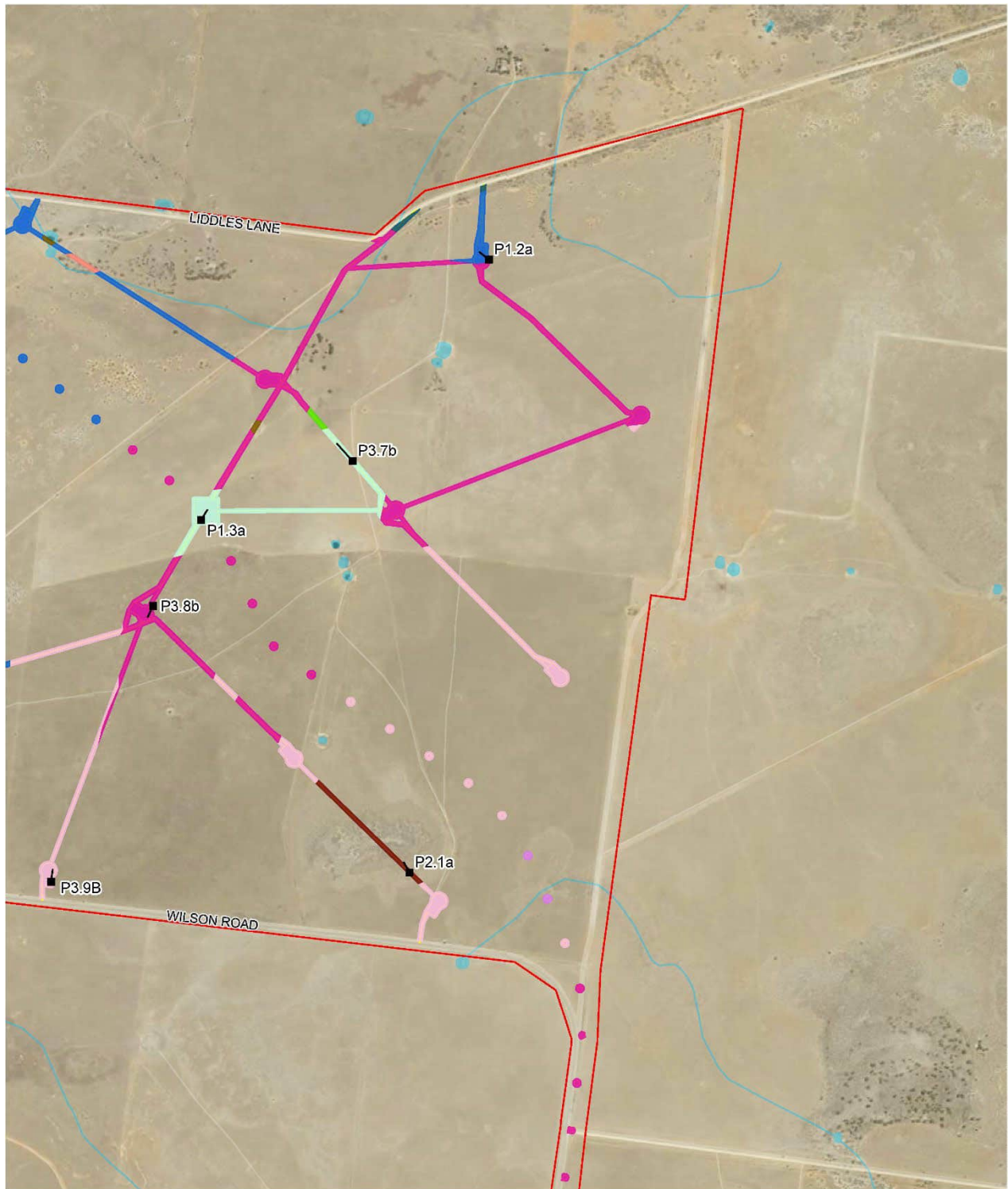
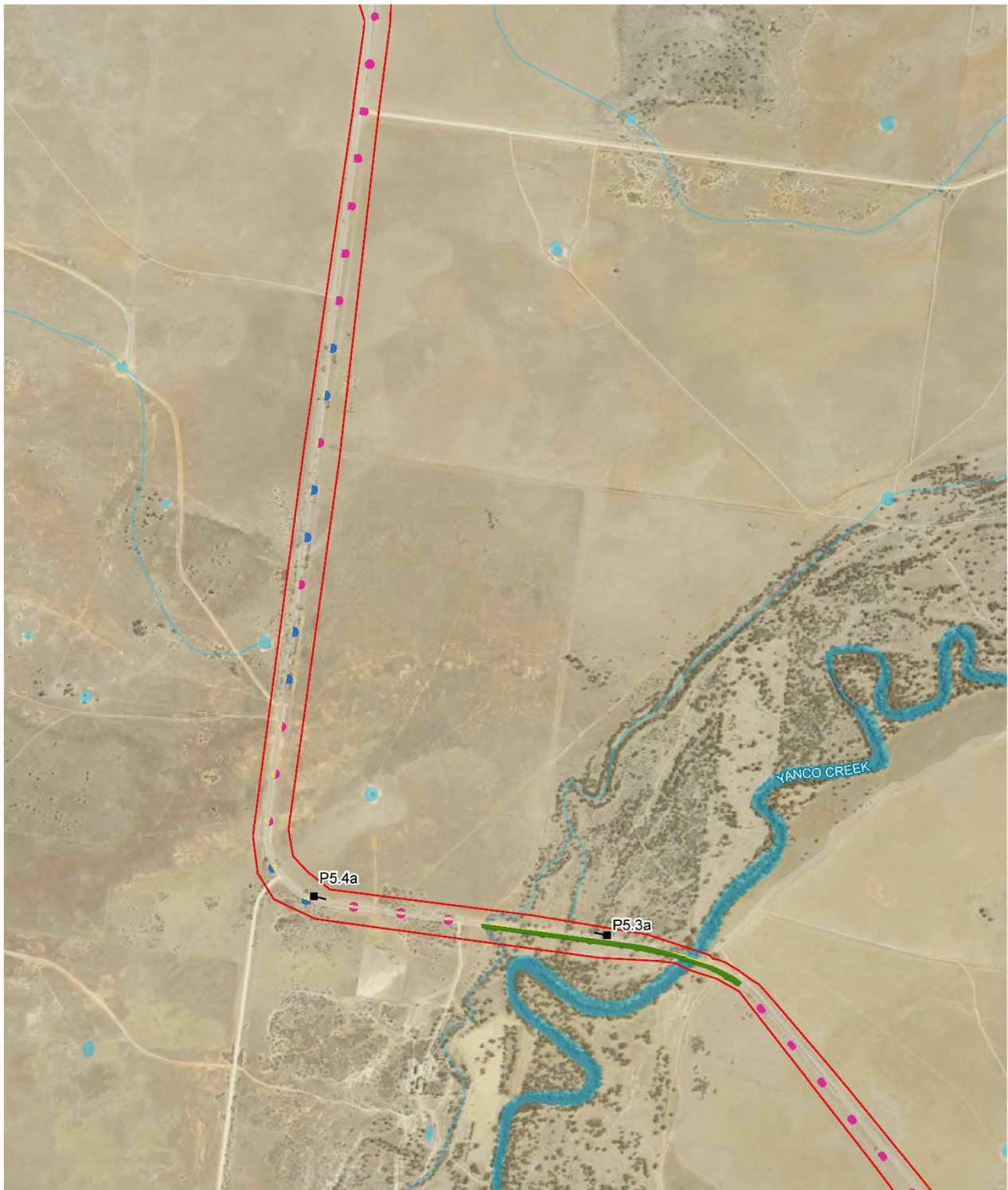
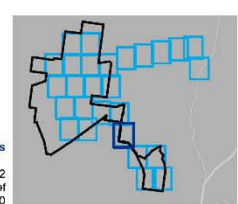
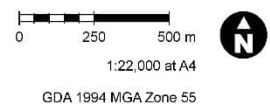


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 22 of 27)



- Disturbance footprint
- Project area
- Vegetation integrity plots
- Vegetation integrity transects
- Road
- Waterways
- PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion
- PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- PCT 7: River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion
- Moderate - good
- Moderate - good grassy
- Low - moderate



Data sources
 Jacobs 2022
 © Department of Customer Service 2020

Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 23 of 27)



- Disturbance footprint
- Project area
- Vegetation integrity plots
- Low - moderate
- Moderate - good
- Vegetation integrity transects
- Road
- Waterways
- Non-native vegetation

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
 © Department of Customer Service 2020

Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 24 of 27)

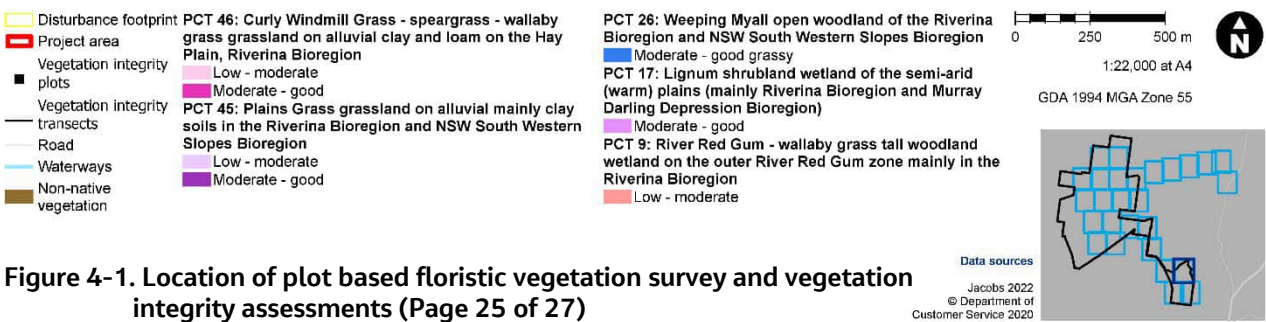
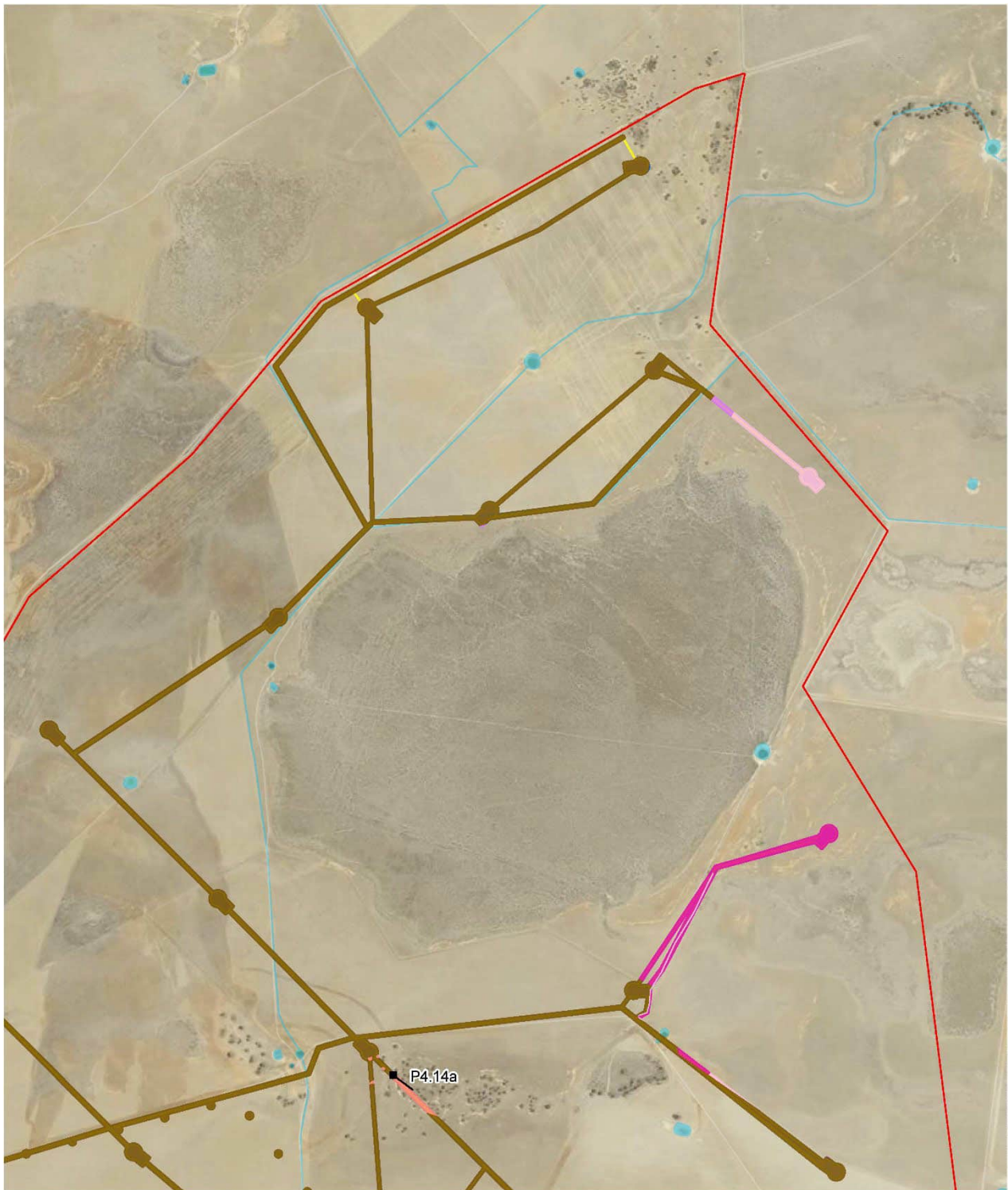
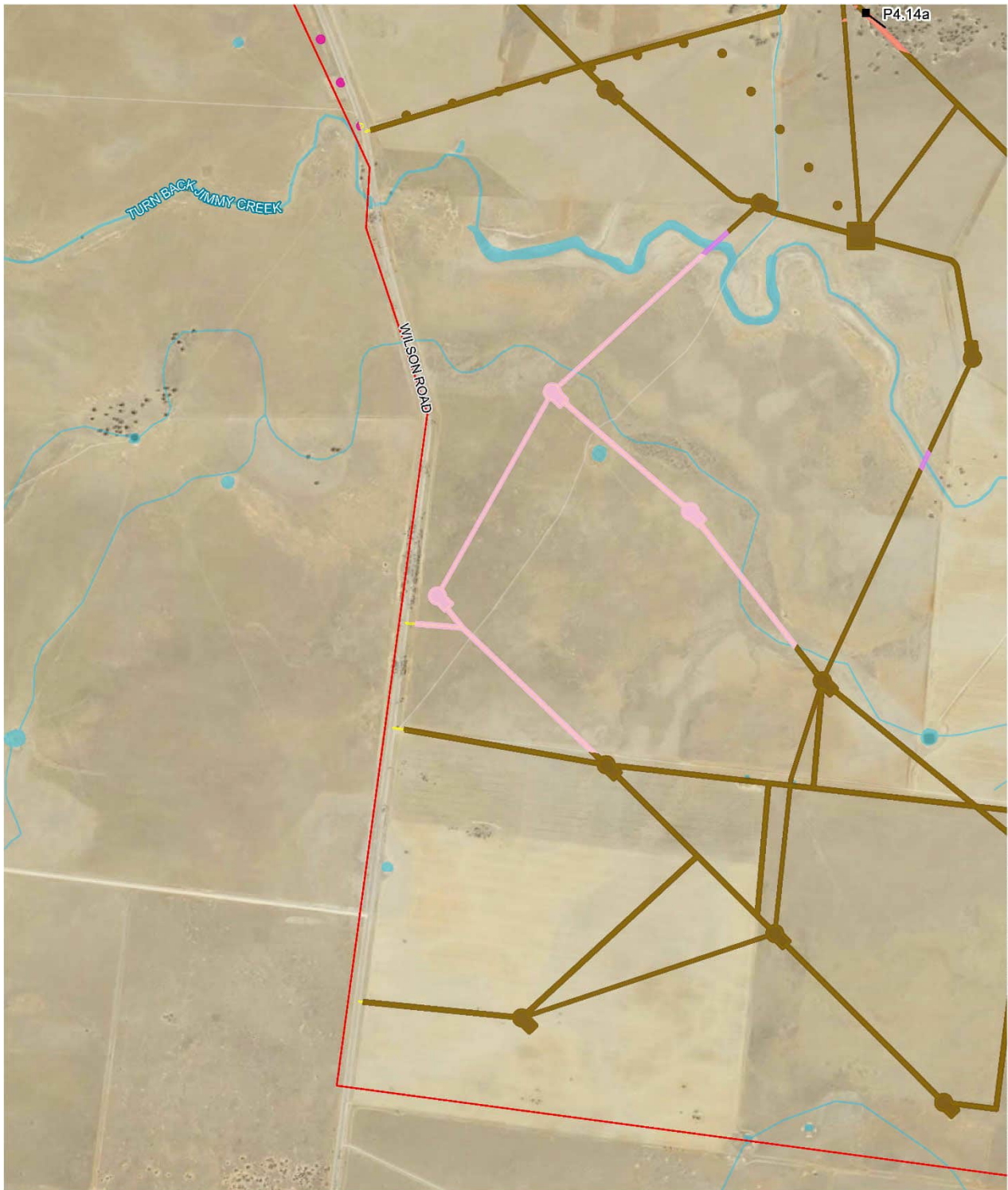
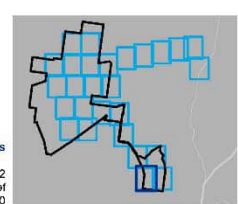


Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 25 of 27)



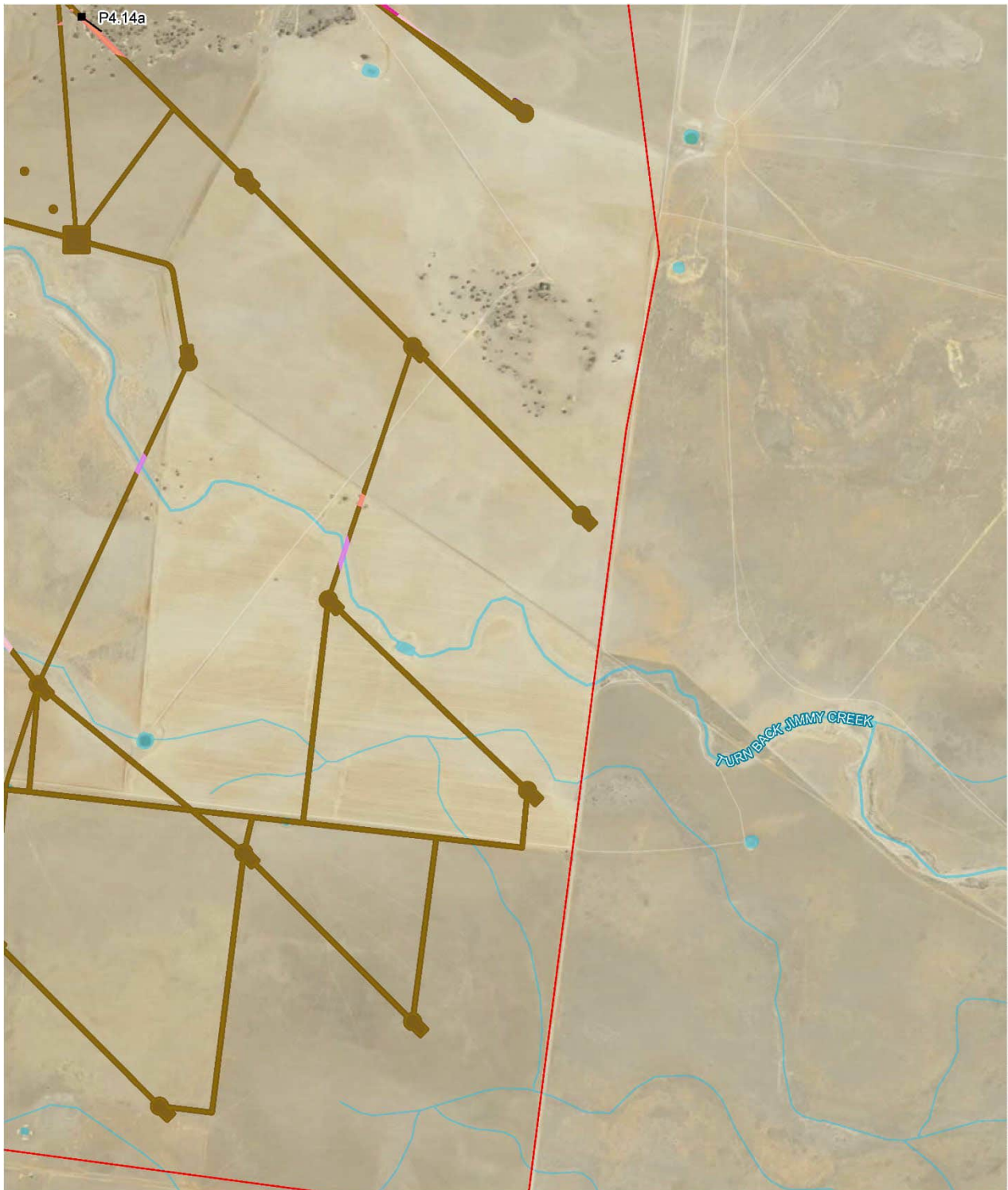
- Disturbance footprint
 - Project area
 - Vegetation integrity plots
 - Vegetation integrity transects
 - Road
 - Waterways
 - Non-native vegetation
- PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion
 - Low - moderate
 - Moderate - good
 - PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
 - Moderate - good
 - PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion
 - Low - moderate

0 250 500 m
1:22,000 at A4
GDA 1994 MGA Zone 55



Data sources
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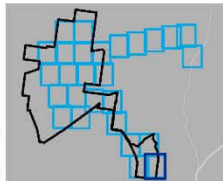
Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 26 of 27)



<ul style="list-style-type: none"> Disturbance footprint Project area Vegetation integrity plots Vegetation integrity transects Road Waterways Non-native vegetation 	<ul style="list-style-type: none"> PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion Low - moderate Moderate - good PCT 45: Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion Moderate - good 	<ul style="list-style-type: none"> PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) Moderate - good PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion Low - moderate 	<ul style="list-style-type: none"> Scale: 0, 250, 500 m 1:22,000 at A4 GDA 1994 MGA Zone 55
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Figure 4-1. Location of plot based floristic vegetation survey and vegetation integrity assessments (Page 27 of 27)

Data sources
 Jacobs 2022
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4.4 Plant community types

The State Vegetation Type Map: Riverina Region Version v1.2 - VIS_ID 4469 (DPIE, 2016) was used to determine the baseline vegetation classification for allocating PCTs. It was not used to provide accurate polygon boundaries.

The Project area predominantly comprises large areas of native grassland and open Weeping Myall (*Acacia pendula*) woodland in a flat landscape. In low lying areas there are occurrences of Lignum (*Duma florulenta*) and Nitre (*Chenopodium nitrariaceum*) swamps, River Red Gum (*Eucalyptus camaldulensis*) and Black Box (*Eucalyptus largiflorens*) along drainage lines and creeks. There are also White Cypress Pine (*Callitris glaucophylla*) on sandhills as scattered paddock trees.

This BDAR describes PCTs in terms of their floristic composition, geological substrate, and relevant regional vegetation classification.

A total of 10 PCTs were identified within the study area. PCTs are listed **Table 4-2** and PCT mapping is shown in **Figure 4-2**. PCTs vary in condition and patch sizes across the Project area. Descriptions of the vegetation that occurs in the study area are provided in the following sections matched to the most likely PCT as described in the BioNet Vegetation Classification database.

In some cases, the vegetation on the study area does not strictly meet the definition of a PCT as per the BioNet Vegetation Classification database so the vegetation has been allocated to the PCT with which it most closely aligns. The mapping provided in this BDAR is supported by on ground observations and quantitative data. Vegetation integrity plot data is provided in **Appendix C**.

Table 4-2. Plant community types identified in the disturbance footprint

Plant community type name	Vegetation formation (Keith 2004)	Vegetation class (Keith 2004)	Area (ha) in disturbance footprint
River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)	Forested Wetlands	Inland Riverine Forests	1.1
River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)	Forested Wetlands	Inland Riverine Forests	0.22
Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)	Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands	0.69
Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)	Freshwater Wetlands	Inland Floodplain Swamps	1.86
Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26)	Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	31.09
White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT 28)	Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	10.28
Forb-rich Speargrass - Windmill Grass – White Top grassland of the Riverina Bioregion (PCT 44)	Grasslands	Riverine Plain Grasslands	36.14
Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45)	Grasslands	Riverine Plain Grasslands	2.23

Plant community type name	Vegetation formation (Keith 2004)	Vegetation class (Keith 2004)	Area (ha) in disturbance footprint
Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46)	Grasslands	Riverine Plain Grasslands	89.75
Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT 160)	Freshwater Wetlands	Inland Floodplain Swamps	0.03
Total			173.39

4.4.1 River Red Gum – Warrego Grass – herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)

Vegetation formation: Forested Wetlands

Vegetation class: Inland Riverine Forests

PCT percent cleared: 15%

Associated TEC (EPBC Act and BC Act): No associated TECs

Vegetation zones (condition): Low to Moderate (Zone 1)

Survey effort: Zone 1 - one plot (P5.3a)

Extent in disturbance footprint: Zone 1 - 1.1 ha

River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7) is described in the BioNet Vegetation Classification database as a forested wetland. It consists of tall open forest averaging dominated by River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*) growing to an average of about 20 m high with a canopy cover of about 40%. Shrubs are generally absent but scattered River Cooba (*Acacia stenophylla*) may be present. The ground may contain much leaf litter but also a mid-dense herbaceous ground cover dominated by grasses and forbs. Grasses include Warrego Grass (*Paspalidium jubiflorum*), wheatgrass (*Elymus scaber*), Blown Grass (*Lachnagrostis filiformis*) and wallaby grasses (*Austrodanthonia* spp.). Forbs include *Wahlenbergia fluminalis*, *Senecio quadridentatus*, *Ranunculus inundatus*, *Brachyscome basaltica* var. *gracilis*, *Pratia concolor*, *Rumex brownii*, *Picris squarrosa* and *Centipeda cunninghamii*. Sedges include *Carex tereticaulis*, *Carex inversa*, *Eleocharis acuta* and *Eleocharis pusilla*. Weeds may be common in places and include *Hordeum leporinum*, *Cirsium vulgare*, *Bromus diandrus*, *Echium plantagineum*, *Hypochaeris glabra*, *Lolium perenne*, *Lolium rigidum*, *Medicago polymorpha*, *Vulpia muralis* and *Vulpia myuros*. The floristic composition varies with changes in flooding. Occurs on alluvial brown or grey cracking clay soils or clay loams on the inner floodplains and lining channels including on levees of major river systems. Distributed from the lower slopes along the lower Lachlan and Murrumbidgee Rivers including in the Great Cumbung Swamp and the mid-west to western section of the Murray River in NSW (generally west of Deniliquin) mainly in the Riverina Bioregion. This is the dominant River Red Gum forest between Deniliquin and Swan Hill.

Within the study area, vegetation considered most likely to be representative of the River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7) occurs on the inner floodplains and lining channels including on levees associated with Yanco Creek. This was the only example of this vegetation mapped within study area along the side of Wilson Road and Yanco Creek Bridge crossing (Photo 4-1).

This vegetation is most likely to be representative of PCT 7 for the following reasons:

- On the inner floodplains and lining channels including on levees of major river systems
- Occurs on alluvial brown or grey cracking clay soils or clay loams
- The canopy is dominated by *Eucalyptus camaldulensis*

- Where present, the midstorey shrub layer is sparse.
- The ground cover is generally grassy, but is dominated by annual exotics on the roadside and not representative of the PCT.

The vegetation may vary in composition in proximity to the banks of the Yanco Creek. Parts of the stream vegetation with raised landforms elements have examples of PCT 5 River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion. However the soil is not typically silty loam clay. The river system is dynamic and may change over time due to flooding, river flow regulation.

A summary of the vegetation zones PCT 7 is provided below in **Table 4-3**. This list of species reflects the local variation gathered from 1 plot undertaken within the study area.

Table 4-3. Floristic and structural summary of vegetation zone PCT 7 low to moderate within the study area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus camaldulensis</i>
Midstory (mid-stratum)	<i>Sclerolaena stelligera</i>
Groundcovers (ground stratum)	<i>Rytidosperma</i> spp., <i>Einadia nutans</i>
Exotic species	<i>Medicago truncatula</i> <i>Lolium</i> spp. <i>Marrubium vulgare</i>
High Threat Weeds	None
Threatened plant species	None



Photo 4-1. PCT 7 low to moderate (Zone 1) with *Eucalyptus camaldulensis* on eastern side of Wilson Road (Plot 5.3a)

4.4.2 River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)

Vegetation formation: Forested Wetlands

Vegetation class: Inland Riverine Forests

PCT percent cleared: 50%

Associated TEC (EPBC Act and BC Act): No associated TECs

Vegetation zones (condition): Low to Moderate (Zone 2)

Survey effort: Zone 2 - one plot (P4.14a)

Extent in disturbance footprint: Zone 2- 0.22 ha

River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9) is described in the BioNet Vegetation Classification database as a forested wetland. It consists of a tall woodland to about 18 m high dominated by River Red Gum (*Eucalyptus camaldulensis* subsp. *camaldulensis*) tall woodland. Shrub layer is generally absent. The ground cover may be mid-dense or sparse and is dominated by native grass species especially wallaby grasses such as *Austrodanthonia caespitosa*. Other grass species include snow grass (*Poa labillardierei* var. *labillardierei*), Blown Grass (*Lachnagrostis filiformis*) and *Austrodanthonia duttoniana*. The rush *Juncus flavidus* and sedge *Carex inversa* are common. Forb species include *Wahlenbergia fluminalis*, *Dichondra repens*, *Rumex brownii* and *Oxalis perennans*. Exotic weed species are very common include *Bromus* spp., *Vulpia* spp., *Lolium* spp., *Trifolium* spp., *Cirsium vulgare*, *Hypochaeris radicata*, *Hypochaeris glabra* and *Sonchus oleraceus*. Occurs on grey and brown clay and loam soils on higher ground on the edge of the River Red Gum zone on floodplains of the Murray, Murrumbidgee and Lachlan Rivers in the lower slopes sub-region of the NSW South Western Slopes but mainly in the Riverina Bioregion extending to Victoria.

Within the study area, vegetation considered most likely to be representative of the River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)

occurs on higher ground on the edge of the River Red Gum zone of the floodplains Yanco Creek and Delta Creek (**Photo 4-2**). There are numerous scattered examples of this community in this landscape, that are generally infrequently flooded with signs of severe Eucalypt dieback. Large patches are heavily infested by exotic species such as annual grasses (*Lolium* spp. and *Hordeum* spp.) in the ground layer, particularly at locations adjacent cropping land. Smaller patches have numerous dying or dead trees that are ecotonal with PCT 17 or grassland and Acacia Woodland (PCT 46, PCT 26) and were too small to sample.

This vegetation is most likely to be representative of PCT 9 for the following reasons:

- Grey and brown clay and loam soils on higher ground on the edge of the River Red Gum zone on floodplains of the Murray and Murrumbidgee Rivers in the NSW South Western Slopes and Riverina Bioregions
- The canopy is dominated by *Eucalyptus camaldulensis*
- Where present, the midstorey shrub layer is sparse
- The ground cover is generally grassy, but is dominated by annual exotics and not representative of the PCT.

The vegetation may vary in composition depending on land use type and ecotonal influence. Parts of this community is similar to River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 11) However, patches are not dominated by Lignum in the shrub layer and part of drainage depressions and flood-outs of major water courses on the floodplains along western sections of Murray, Murrumbidgee and Lachlan Rivers.

A summary of the vegetation zone PCT 9 low to moderate is provided below in **Table 4-4**. This list of species reflects the local variation gathered from 1 plot undertaken within the study area.

Table 4-4. Floristic and structural summary of vegetation zone PCT 9 low to moderate within the study area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus camaldulensis</i>
Midstory (mid-stratum)	<i>Sclerolaena muricata</i> <i>Atriplex semibaccata</i> <i>Chenopodium nitrariaceum</i>
Groundcovers (ground stratum)	<i>Austrostipa aristiglumis</i>
Exotic species	<i>Marrubium vulgare</i> <i>Lolium</i> spp. <i>Hordeum</i> spp. <i>Arctotheca calendula</i>
High Threat Weeds	<i>Lycium ferocissimum</i>
Threatened plant species	None



Photo 4-2. PCT 9 low to moderate (Zone 2) with *Eucalyptus camaldulensis* in patch isolated by cropping land (Plot 4.14a)

4.4.3 Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)

Vegetation formation: Semi-arid Woodlands (Grassy sub-formation)

Vegetation class: Inland Floodplain Woodlands

Classification confidence level from VIS: 3-Medium

PCT percent cleared: 57%

Associated TEC (EPBC Act and BC Act): No associated TECs

Vegetation zones (condition):

- Moderate to Good (Zone 3)
- Low to Moderate (Zone 4).

Survey effort:

- Zone 3 - two plots (P3.2a and P3.6a)
- Zone 4- one plot (P3.3b)

Extent in disturbance footprint:

- Zone 3 - 0.58 ha
- Zone 4 - 0.11 ha.

The Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13) is described in the BioNet Vegetation Classification database as a semi-arid Woodlands (Grassy sub-formation). This PCT occurs as a woodland, open forest or open woodland averaging about 15 metres high and 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 (*Rytidosperma* spp.).

PCT 13 occurs on clay or clay-loam, often gilgaied, soils on inner floodplains and on alluvial plains mostly in depressions that are frequently flooded. It is a widespread community along rivers in south-western NSW including the Murray, Wakool, lower Darling, Lachlan, Murrumbidgee Rivers and Willandra Creek. PCT 13 requires intermittent flooding for seed germination and successional stages are influenced by intensity of grazing. This community has been extensively cleared in eastern areas such as near Lake Cargelligo on the Lachlan River and east of Deniliquin on the Murray River. Threatened by further clearing for agricultural development, weed invasion, altered flooding regimes and in some places rising saline water tables.

This PCT occurs as moderate to good condition patches along the Delta Creek and drainage depressions and low to good condition patches in areas with a disturbed understorey dominated by *Lycium ferocissimum* (Photo 4-3 and Photo 4-4).

Within the study area, this vegetation is most likely to be representative of PCT 13 for the following reasons:

- On inner floodplains and on alluvial plains mostly in depressions that are frequently flooded.
- The canopy is dominated by *Eucalyptus largiflorens*
- Sparse to dense stands of *Duma florulenta*, *Chenopodium nitrariaceum*, *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.).
- The ground cover generally has forbs and native grasses.

A summary of the vegetation zones PCT 13 low to moderate and moderate to good are given below in **Table 4-5**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-5. Floristic and structural summary of vegetation zones PCT 13 moderate to good and low to moderate within the study area

Vegetation layer	Dominant species	
	PCT 13 moderate to good	PCT 13 low to moderate
Tree canopy (upper stratum)	<i>Eucalyptus largiflorens</i>	<i>Eucalyptus largiflorens</i>
Midstory (mid-stratum)	<i>Sclerolaena muricata</i> <i>Chenopodium nitrariaceum</i> <i>Atriplex semibaccata</i> <i>Duma florulenta</i>	<i>Atriplex leptocarpa</i> <i>Einadia nutans</i> <i>Maireana microphylla</i>
Groundcovers (ground stratum)	<i>Eleocharis acuta</i> <i>Marsilea drummondii</i> <i>Enteropogon ramosus</i> <i>Alternanthera denticulata</i> <i>Chloris truncata</i> <i>Walwhalleya proluta</i> <i>Eragrostis spp.</i>	<i>Austrostipa nodosa</i>
Exotic species	<i>Marrubium vulgare</i> <i>Lolium spp.</i> <i>Hordeum spp.</i> <i>Arctotheca calendula</i>	<i>Medicago polymorpha</i> <i>Hordeum leporinum</i>
High Threat Weeds	<i>Lycium ferocissimum</i>	<i>Lycium ferocissimum</i>
Threatened plant species	None	None



Photo 4-3. PCT 13 moderate to good (Zone 3) with *Eucalyptus largiflorens* in drainage depression (Plot 3.2a)



Photo 4-4. PCT 13 low to moderate (Zone 4) with *Eucalyptus largiflorens* in patch near PCT 44 (Plot 3.3b)

4.4.4 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)

Vegetation formation: Freshwater Wetlands

Vegetation class: Inland Floodplain Shrublands

Classification confidence level from VIS: 2-High

PCT percent cleared: 63%

Associated TEC (EPBC Act and BC Act): No associated TECs

Vegetation zones (condition): Moderate to Good (Zone 5)

Survey effort: Zone 5 - six plots (P1.3b, P3.3a, P3.11a, P4.6a, P4.2b, P5.4b)

Extent in disturbance footprint: Zone 5 – 1.86 ha

Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17) is described in the BioNet Vegetation Classification database as an open shrubland, usually up to 2 metres high, dominated by Lignum (*Duma 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. The ground cover species include 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*.

This PCT 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. Although very widespread it tends to have a consistent floristic composition which grades into Black Box or River Red Gum woodlands near major rivers and into Bladder Saltbush or other chenopod shrublands on higher ground. Large areas of Lignum have been

cleared for cropping in the middle-western and eastern parts of its range including in the Lowbidgee region on the Murrumbidgee River floodplain. Some stands remain in the west. This community is becoming increasingly threatened by clearing and altered flooding regimes due to irrigation developments. Reduced flooding is leading to the dieback of *Lignum* in some areas.

Within the study area, vegetation considered most likely to be representative of the PCT17 occurs along treeless drainage lines, depressions and dried creeks associated with Delta Creek and Turn Back Jimmy Creek. This PCT occurs as moderate to good condition patches with minimal exotic species occurrences, except annual grass weeds (**Photo 4-3** and **Photo 4-4**).

This vegetation is most likely to be representative of PCT 17 for the following reasons:

- In river channels and depressions on floodplains subject to regular flooding.
- Open shrubland usually up to 2 m high dominated by *Lignum*
- 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
- Sparse to dense stands of *Duma florulenta*, *Chenopodium nitrariaceum*, *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.).
- The ground cover generally includes small shrubs such as Roly Poly (*Sclerolaena muricata* var. *muricata*), and *Salsola* spp., *Marsilea drummondii*, *Juncus flavidus*, *Rumex tenax*, *Einadia nutans* subsp. *nutans*. Grass species include *Walwhalleya proluata* and *Enteropogon ramosus*.

This community mostly intergrades with PCT 13 along the same drainage line associated with Delta Creek and is sometimes fringed by *Eucalyptus largiflorens* in depressions, as well as *Eucalyptus camaldulensis*. This community has similarities to PCT 160 which may often have a mixed shrub cover of *Chenopodium nitrariaceum*. PCT 160 was generally allocated to patches where *Chenopodium nitrariaceum* was most dominant and with minor occurrences of *Duma florulenta*.

A summary of the vegetation zone PCT 17 moderate to good is given below in **Table 4-6**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-6. Floristic and structural summary of vegetation zones PCT 17 moderate to good within the study area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Eucalyptus largiflorens</i>
Midstory (mid-stratum)	<i>Duma florulenta</i> <i>Chenopodium nitrariaceum</i> <i>Sclerolaena muricata</i> <i>Atriplex semibaccata</i> <i>Dissocarpus paradoxus</i> <i>Atriplex leptocarpa</i>
Groundcovers (ground stratum)	<i>Rytidosperma caespitosum</i> <i>Enteropogon ramosus</i> <i>Rytidosperma</i> spp. <i>Chloris truncata</i> <i>Sporobolus caroli</i> <i>Walwhalleya proluta</i> <i>Austrostipa scabra</i> <i>Vittadinia gracilis</i>
Exotic species	<i>Marrubium vulgare</i> <i>Lolium</i> spp. <i>Hordeum</i> spp. <i>Arctotheca calendula</i>
High Threat Weeds	<i>Lycium ferocissimum</i>
Threatened plant species	None



Photo 4-5. PCT 17 moderate to good (Zone 5) patch in large depression (Plot 3.3a)

4.4.5 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26)

Vegetation formation: Semi-arid Woodlands (Grassy sub-formation)

Vegetation class: Riverine Plain Woodlands

Classification confidence level from VIS: 2-High

PCT percent cleared: 90%

Associated TEC (EPBC Act and BC Act): Weeping Myall Woodland (listed endangered under the EPBC Act) and Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (listed endangered under the BC Act)

Vegetation zones (condition):

- Moderate-Good_grassy (Zone 6)
- Low-Moderate_grassy (Zone 7)
- Moderate-Good_shrubby (Zone 8)
- Low-Moderate_shrubby (Zone 9).

Survey effort:

- Zone 6 - 10 plots (P1.2a, P2.3a, P2.8b, P4.1a, P4.1b, P4.3a, P4.4b, P4.7a, P4.8a, P4.9a)
- Zone 7 - two plots (P3.5a, P5.1a)
- Zone 8 - three plots (P4.7b, P4.12a, P5.2a)
- Zone 9 - one plot (P3.10a).

Extent in disturbance footprint:

- Zone 6 - 27 ha

- Zone 7 - 1.4 ha
- Zone 8 - 2.1 ha
- Zone 9 - 0.59.

Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26) is described in the BioNet Vegetation Classification database as a mid-high open woodland up to 8 m high dominated by Weeping Myall (*Acacia pendula*). Other tree species include Belah (*Casuarina cristata*), while Black Box (*Eucalyptus largiflorens*) and River Red Gum (*Eucalyptus camaldulensis*) may occur in depressions. Chenopod shrubs may be common or absent. They include *Rhagodia spinescens*, *Maireana decalvans*, *Atriplex nummularia*, *Chenopodium nitrariaceum*, *Hakea leucoptera*, *Santalum lanceolatum*, *Exocarpos aphyllus* and *Maireana aphylla*. The ground cover may be dense or sparse depending on rainfall. It is dominated by grass species such as *Austrodanthonia caespitosa*, *Austrodanthonia setacea*, *Austrostipa aristiglumis*, *Austrostipa scabra*, *Austrostipa nodosa* and *Sporobolus caroli*. Saltbush species include *Atriplex spinibractea*, *Atriplex leptocarpa* and *Atriplex semibaccata*. Forb species include *Alternanthera denticulata*, *Myriocephalus rhizocephalus*, *Centipeda cunninghamii*, *Rhodanthe corymbiflora* and *Vittadinia cuneata* var. *cuneata*. Occurs on brown clays or loam soils on alluvial plains mainly in the Riverina and NSW South-western Slopes Bioregions of south-western NSW. Apparently extinct in Victoria.

Within the study area, this community is considered most likely to be representative of the Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26). This PCT occurs on both red-brown and grey clay soils in landscape and intergrades with all PCTs within the study area. There were some instances of broad ecotones where PCT transitions into sandhills and soils comprised a sandy clay or had a thin layer of fine sand on the surface.

In addition to known patches of natural grasslands, it's possible that PCT26 dominated the plains landscape prior to land clearing and overgrazing by European settlement and many patches now occur as native derived grassland which correspond strongly with PCT 44 and PCT 46. Existing natural grassland and remnant woodland can be floristically similar and boundaries are difficult to delineate in a large landscape. Some evidence suggests that these communities are heavily influenced by rainfall, and decrease in rainfall over the winter and spring growing seasons has potential to facilitate the invasion of *Acacia pendula* into natural grasslands (McDougall, 2008). Site observations of sheep grazing on *Acacia pendula* indicates that some small trees may not reach full size or maturity and/or maintain a short stunted growth with continual pruning from livestock. Some patches showed evidence of a low open shrubland structure comprising small *Acacia pendula*. However, there were many examples of established patches of mature *Acacia pendula* that had grown above sheep grazing height and were reproducing. During survey in August 2022, there were numerous observations of *Acacia pendula* trees with severe dieback throughout the landscape, potentially associated with an unknown caterpillar. This dieback was not evident during previous vegetation surveys.

Mapping of ecotones between grassland and woodland followed the guidance of the Native Vegetation Interim Type Standard ('the Standard') (Sivertsen 2009). The overstorey structure varied widely between patches of acacia woodland and occurred as either a woodland or open woodland, generally with a 10% foliage cover. Ground surveys to map woodland incorporated well separated trees up to 100 metres apart. If any trees in a patch exceeded this measure, the vegetation was classed as a grassland with a low density mosaic of *Acacia* trees and assigned to a grassland PCT.

This PCT has been assigned to four vegetation zones on the basis of a predominant grassy or shrubby understorey, comprising moderate-good_grassy (Zone 6), low-moderate_grassy (Zone 7), moderate-good_shrubby (Zone 8) and low-moderate_shrubby (Zone 9). See **Photo 4-6**, **Photo 4-7**, **Photo 4-8** and **Photo 4-9**. These two variants were considered a result of different land uses and grazing pressure. The most common variant had an grassy groundlayer with shrubslargely absent and occurred on both red-brown and grey clay exposed to livestock grazing and was most often observed with very large, fenced paddocks. The shrubby midstorey variant was less common and occurred mostly as roadside vegetation or travelling stock routes on red-brown and grey clay that was generally more intact with less grazing pressure and contained a greater cover of shrubs, particularly *Atriplex* spp, and more closely represented remnant or intact Myall woodland.

This vegetation is most likely to be representative of PCT 26 for the following reasons:

- Occurs on red-brown clays or loamy soils on alluvial plains mainly in the Riverina

- The canopy is dominated by *Acacia pendula* as a woodland or open woodland, or occasionally as a low shrubland
- Chenopod shrubs may be common or absent. They include *Rhagodia spinescens*, *Maireana decalvans*, *Atriplex nummularia*, *Chenopodium nitrariaceum* and *Maireana aphylla*.
- It is dominated by grass species such as *Rytidosperma* spp., *Austrostipa aristiglumis*, *Austrostipa scabra*, *Austrostipa nodosa* and *Sporobolus caroli*. Saltbush species include *Atriplex leptocarpa* and *Atriplex semibaccata*. Forb species include *Alternanthera denticulata*, *Centipeda cunninghamii*, *Rhodanthe corymbiflora* and *Vittadinia cuneata* var. *cuneata*.

A summary of the vegetation zones for PCT 26 are given below in **Table 4-7**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-7. Floristic and structural summary of vegetation zones of PCT 26 within the study area

Vegetation layer	Dominant species			
	Moderate-Good_grassy (Zone 6)	Low-Moderate_grassy (Zone 7)	Moderate-Good_shrubby (Zone 8)	Low-Moderate_shrubby (Zone 9)
Tree canopy (upper stratum)	<i>Acacia pendula</i>	<i>Acacia pendula</i>	<i>Acacia pendula</i>	<i>Acacia pendula</i>
Midstory (mid-stratum)	Sparse shrubs at low density comprising <i>Maireana aphylla</i> <i>Sclerolaena muricata</i> <i>Atriplex leptocarpa</i>	<i>Maireana aphylla</i>	<i>Sclerolaena muricata</i> <i>Sclerolaena diacantha</i> <i>Maireana aphylla</i> <i>Duma florulenta</i> <i>Rhagodia spinescens</i>	<i>Sclerolaena muricata</i> <i>Sclerolaena diacantha</i> <i>Maireana aphylla</i> <i>Duma florulenta</i> <i>Maireana pentagona</i> <i>Rhagodia spinescens</i> <i>Dissocarpus paradoxus</i>
Groundcovers (ground stratum)	<i>Enteropogon ramosus</i> <i>Rytidosperma setaceum</i> <i>Rytidosperma caespitosum</i> <i>Austrostipa nodosa</i> <i>Salsola australis</i> <i>Sporobolus caroli</i> <i>Chloris truncata</i> <i>Walwhalleya proluta</i> <i>Calotis scabiosifolia</i> <i>Sida corrugata</i>	<i>Enteropogon ramosus</i> <i>Rytidosperma</i> spp. <i>Austrostipa</i> spp. <i>Sporobolus caroli</i>	<i>Enteropogon ramosus</i> <i>Rytidosperma</i> spp. <i>Austrostipa</i> spp. <i>Sporobolus</i>	<i>Enteropogon ramosus</i> <i>Rytidosperma setaceum</i> <i>Rytidosperma caespitosum</i> <i>Austrostipa aristiglumis</i> <i>Austrostipa nodosa</i> <i>Salsola australis</i> <i>Sporobolus caroli</i> <i>Chloris truncata</i> <i>Walwhalleya proluta</i> <i>Calotis scabiosifolia</i> <i>Sida corrugata</i>
Exotic species	<i>Marrubium vulgare</i> <i>Lolium</i> spp. <i>Hordeum</i> spp. <i>Arctotheca calendula</i>	<i>Lolium</i> spp. <i>Hordeum</i> spp.	<i>Lolium</i> spp. <i>Hordeum</i> spp.	<i>Medicago polymorpha</i> <i>Hordeum leporinum</i>

Biodiversity Development Assessment Report

Vegetation layer	Dominant species			
	Moderate-Good_grassy (Zone 6)	Low-Moderate_grassy (Zone 7)	Moderate-Good_shrubby (Zone 8)	Low-Moderate_shrubby (Zone 9)
High Threat Weeds	<i>Lycium ferocissimum</i>	<i>Lycium ferocissimum</i>	<i>Lycium ferocissimum</i>	<i>Lycium ferocissimum</i>
Threatened plant species	<i>Swainsona murrayana</i>	None	None	None



Photo 4-6. PCT 26 moderate to good_grassy (Zone 6) with *Acacia pendula* on plain south of Mabins Well Road (Plot 4.7a)



Photo 4-7. PCT 26 low to moderate_grassy (Zone 7) with *Acacia pendula* with dieback on plain south of Moonbria Road (Plot 5.1a)



Photo 4-8. PCT 26 moderate to good_shrubby (Zone 8) with *Acacia pendula* on plain south of Mabins Well Road (Plot 4.12a)



Photo 4-9. PCT 26 low to moderate_shrubby (Zone 9) with *Acacia pendula* and dense understorey of *Sclerolaena muricata* on plain south of Mabins Well Road (Plot 3.10a)

4.4.6 White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28)

Vegetation formation: Semi-arid Woodlands (Shrubby sub-formation)

Vegetation class: Riverine Sandhill Woodlands

Classification confidence level from VIS: 2-High

PCT percent cleared: 73%

Associated TEC (EPBC Act and BC Act): Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions

Vegetation zones: Low to Moderate (Zone 10)

Survey effort: Zone 10 - seven plots (P2.6a, P2.7a, P2.8a, P3.1b, P3.6b, P4.4a, P4.5a)

Extent in disturbance footprint: Zone 10 - 10.28 ha

White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28) is described in the BioNet Vegetation Classification database as an 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 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 tetragonoides*, *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 and this condition was commonly noted in the Project area.

Native grass species include *Austrostipa scabra* subsp. *scabra*, *Austroanthonia caespitosa*, *Aristida behriana*, *Enneapogon nigricans* and *Paspalidium constrictum*. Exotic species include *Schismus barbatus*, *Brassica tournefortii* and *Medicago polymorpha*. Occurs on sandy loam soils on prior streams, source bordering sand dunes and sand plains in south-western NSW.

Within the study area, this community is considered most likely to be representative of the White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28) see **Photo 4-10**. This PCT occurs on red-brown sandy loam soils in landscape and generally intergrades with PCT 26 and PCT 44 within the study area. This community mainly occurs on sandhills and sandy rises, often as a derived grassland with scattered *Callitris glaucophylla*. Historical land clearing and ongoing livestock grazing have degraded these communities in the landscape. There are occurrences of patches with an established tree and shrub layers (e.g. *Hakea leucoptera* and *Alectryon oleifolius* subsp. *canescens*) in the landscape on sandhills to the north and south of Mabins Well Road west of Wilsons Road. Sometimes these patches are fenced to protect from grazing and provides representative evidence of PCT 28 in the landscape.

PCT 28 has similarities to Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplain (PCT19) and both are source bordering dunes. However, as noted above, the landscape has evidence of patches with established tree and shrub layers indicative of PCT28. Whereas, PCT19, generally has a less diverse and different composition tree and shrub layers.

This PCT has been assigned to one vegetation zones comprising low to moderate (Zone 10). This vegetation is most likely to be representative of PCT 28 for the following reasons:

- Occurs on sandy loam soils on prior streams, source bordering sand dunes and sand plains
- The community is an open woodland or derived grassland comprising *Callitris glaucophylla*, with evidence of other trees and shrubs in the landscape such as *Hakea leucoptera*, *Hakea tephrosperma* and *Alectryon oleifolius* subsp. *canescens*.

Biodiversity Development Assessment Report

- Common chenopod shrub species include *Maireana enchylaenoides* and *Rhagodia spinescens*, and *Sclerolaena diacantha*
- Native grass species include *Austrostipa scabra* subsp. *scabra* and *Rytidosperma caespitosa*.

A summary of the vegetation zone low to moderate (Zone 10) for PCT 28 is given below in **Table 4-8**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-8. Floristic and structural summary of vegetation zones of PCT 28 within the study area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	<i>Callitris glaucophylla</i>
Midstory (mid-stratum)	<i>Sclerolaena birchii</i> <i>Hakea tephrosperma</i>
Groundcovers (ground stratum)	<i>Austrostipa scabra</i> <i>Sida corrugata</i> <i>Enteropogon ramosus</i> <i>Crassula colorata</i> <i>Rytidosperma</i> spp. <i>Eragrostis</i> spp.
Exotic species	<i>Marrubium vulgare</i> <i>Lolium</i> spp. <i>Hordeum</i> spp. <i>Arctotheca calendula</i>
High Threat Weeds	<i>Lycium ferocissimum</i>
Threatened plant species	None



Photo 4-10. PCT 28 low to moderate (Zone 10) with *Callitris glaucophylla* on sandhill south of Mabins Well Road and west of Wilsons Road (Plot 2.7a)

4.4.7 Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT 44)

Vegetation formation: Grasslands

Vegetation class: Riverine Plain Grasslands

Classification confidence level from VIS: 2-High

PCT percent cleared: 73%

Associated TEC (EPBC Act and BC Act): Some patches meet Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act)

Vegetation zones (condition):

- Moderate-Good (Zone 11)
- Low-Moderate (Zone 12).

Survey effort:

- Zone 11 - 14 plots (P1.1b, P2.2b, P2.3b, P2.5a, P2.5b, P3.1a, P3.12a, P3.13a, P4.2a, P4.3b, P4.5b, P4.11a, P5.2b, P5.6b)
- Zone 12 - four plot (P1.3a, 1.6b, P3.2b, P3.7b).

Extent in disturbance footprint:

- Zone 11 – 32.99 ha
- Zone 12 – 3.15 ha.

Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT 44) is described in the BioNet Vegetation Classification database as an open to closed grasslands usually about 0.3 m high composed of speargrass (*Austrostipa nodosa*), Windmill Grass (*Chloris truncata*) and Whitetop Wallaby Grass (*Austrodanthonia caespitosa*) with forbs including a range of daisies such as *Leucochrysum molle* and *Calotis scabiosifolia* and legumes such as *Swainsona* spp. The bluebush species *Maireana pentagona* and *Maireana excavata* are often present as scattered low shrubs. Occurs on grey-cracking clays and red-brown clays often including scalds on the plains of the southern part of the Riverine Plain Bioregion from Urana in the east to Deniliquin in the west and to the north. A number of threatened plant species such as *Swainsona plagiotropis*, *Leptorhynchos scaber*, *Sclerolaena napiformis* and *Lepidium monoplacoides* have been recorded in this community.

Within the study area, this vegetation aligns with the description of the *Stipa nodosa*-*Chloris truncata*-*Danthonia caespitosa* Jerilderie area (Community 1) as described by Benson, Ashby and Porteners (1997). This vegetation is considered most likely to be representative of the Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT 44) and occurs across the entire Project area on grassland plain.

This PCT occurs on red-brown clay, sometimes grey-brown clay in the plains and intergrades regularly with Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46) and Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26). The clay soil colour transitions from red-brown to grey cracking clay at ecotones between PCT 44 and PCT 46. Patches of PCT 44 are generally drier at a slightly higher rises on the plain than PCT 46 with different species composition, often more diverse forb species depending on land use history and commonly has more bare ground and scalded surfaces.

PCT 44 represents the best examples of natural grasslands in the landscape, with some patches having high species richness in the ground layer and most patches meet the listing of Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act). In addition to known patches of natural grasslands, other patches likely represent derived native grassland of PCT 26 and these communities regularly integrated between open grassland to open grassland with a mosaic of *Acacia pendula*, open woodland or woodland structures. Given the similarities of grassland floristics, it was difficult to delineate the

boundaries between natural grassland and possible derived native grassland. Therefore both grassland types were assigned to PCT 44. The analysis of key diagnostic characteristics for grassland patches listed as Natural Grasslands of the Murray Valley Plains provides insight into which patches are likely to be natural grassland based on plant species that are absent or infrequent in natural grasslands and represent derived grassland of historical *Acacia pendula* or chenopod shrublands (Threatened Species Scientific Committee, 2012).

At some locations PCT44 also integrated with White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28). These patches often represented broad transitional zones between clay and sandy plains, particularly at locations where PCT28 was represented as a derived native grassland. At most occurrences, PCT 44 had red-brown clay with a thin layer of wind blown sand on the surface.

Mapping of ecotones between grassland and woodland followed the guidance of the Native Vegetation Interim Type Standard ('the Standard') (Sivertsen 2009). Ground surveys of open woodland used mapping of well separated trees up to 100 m apart to represent 10% foliage cover. If any trees in a patch exceeded this measure, the vegetation was classed as a grassland with a mosaic of *Acacia* trees and assigned to a grassland PCT.

This PCT has been assigned to two vegetation zones comprising moderate-good (Zone 11), low-moderate (Zone 12), see **Photo 4-11** and **Photo 4-12**. PCT 44 Zone 11 generally comprised >15 native species supporting a moderate to high diversity of native forbs. PCT 44 Zone 12 was assigned in patches with 15 or less native species supporting a low to moderate diversity of native forbs. The cover and abundance of exotic plant species (including exotic annuals) and grazing pressure in patches was also taken into account when assigning a condition class. The results of the VI scores for each plot was also reviewed to reflect the correct condition class.

This vegetation is most likely to be representative of PCT 44 for the following reasons:

- open to closed grasslands, occurring on grey-cracking clays and red-brown clays often including scalds on the plains of the southern part of the Riverine Plain Bioregion
- Commonly composed of *Austrostipa nodosa*, *Chloris truncata* and *Rytidosperma* spp. with forbs including a range of daisies such as *Leucochrysum molle* and *Calotis scabiosifolia* and legumes such as *Swainsona* spp. The bluebush species *Maireana pentagona* and *Maireana excavata* are often present as scattered low shrubs.

A summary of the vegetation zones for PCT 44 are given below in **Table 4-9**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-9. Floristic and structural summary of PCT 44 within the study area

Vegetation layer	Dominant species	
	Moderate to good (Zone 11)	Low to moderate (Zone 12)
Tree canopy (upper stratum)	Occasional <i>Acacia pendula</i>	Occasional <i>Acacia pendula</i>
Midstory (mid-stratum)	Very low density of shrubs <i>Maireana aphylla</i> <i>Maireana excavata</i> <i>Atriplex semibaccata</i> <i>Maireana pentagona</i> <i>Atriplex leptocarpa</i>	Very low density of shrubs <i>Maireana aphylla</i> <i>Maireana microcarpa</i> <i>Atriplex leptocarpa</i>
Groundcovers (ground stratum)	<i>Austrostipa nodosa</i> <i>Chloris truncata</i> <i>Rytidosperma</i> spp. <i>Enteropogon ramosus</i> <i>Calotis scabiosifolia</i> <i>Leucochrysum molle</i> <i>Chrysocephalum apiculatum</i> <i>Rhodanthe corymbiflora</i> <i>Salsola australis</i> <i>Vittadinia cuneata</i>	<i>Austrostipa nodosa</i> <i>Chloris truncata</i> <i>Rytidosperma</i> spp. <i>Enteropogon ramosus</i> <i>Crassula colorata</i> <i>Sporobolus caroli</i> <i>Vittadinia cuneata</i> <i>Rhodanthe corymbiflora</i>

Vegetation layer	Dominant species	
	Moderate to good (Zone 11)	Low to moderate (Zone 12)
	<i>Sporobolus caroli</i> <i>Erodium crinitum</i> <i>Tricoryne elatior</i> <i>Vittadinia dissecta</i> <i>Crassula colorata</i>	
Exotic species	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>
High Threat Weeds	None	<i>Xanthium spinosum</i>
Threatened plant species confirmed	<i>Swainsona murrayana</i> <i>Swainsona sericea</i>	<i>Swainsona murrayana</i> <i>Swainsona sericea</i>



Photo 4-11. PCT 44 moderate to good (Zone 11) open grassland dominated by *Austrostipa nodosa*, and *Rytidosperma* spp. and diversity of forbs with signs of surface scalding, west of Wilson Road (Plot 4.2a)



Photo 4-12. PCT 44 low to moderate (Zone 12) open grassland dominated by *Austrostipa nodosa*, *Enteropogon ramosus* and *Chloris truncata*, north east of Wilsons Road and north of Yanco Creek (Plot 1.3a)

4.4.8 Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45)

Vegetation formation: Grasslands

Vegetation class: Riverine Plain Grasslands

Classification confidence level from VIS: 2-High

PCT percent cleared: 60%

Associated TEC (EPBC Act and BC Act): Some patches meet Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act)

Vegetation zones (condition):

- Moderate-Good (Zone 13)
- Low-Moderate (Zone 14).

Survey effort:

- Zone 13 - two plots (P5.1b, P5.5b)
- Zone 14 - one plot (P5.3b).

Extent in disturbance footprint:

- Zone 13 - 1.42 ha
- Zone 12 - 0.81 ha.

Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45) is described in the BioNet Vegetation Classification database as a tussock grassland dominated by the grass species Plains Grass (*Austrostipa aristiglumis*), *Walwhalleya proluta*, *Austrodanthonia duttoniana*, *Enteropogon ramosus*, *Sporobolus caroli* and *Chloris truncata*. Queensland Bluegrass (*Dichanthium sericeum* subsp. *sericeum*) occurs in the north and *Austrodanthonia duttoniana* is more common in the south. Nardoo Nardoo (*Marsilea drummondii*) is common throughout along with forbs such as *Wurmbea dioica* subsp. *dioica*, *Rumex dumosus*, *Arthropodium minus*, *Leptorhynchus squamatus* subsp. *A*, *Crassula decumbens* var. *decumbens*, *Goodenia fascicularis*, *Rhodanthe corymbiflora* and several species of Swainsona. The sedge *Eleocharis pallens* is often present. Lignum (*Muehlenbeckia florulenta*) may occur as scattered shrubs. Weed species are common and at some sites may be dominant. They include Cape Weed (*Arctotheca calendula*), *Hypochaeris glabra*, *Lolium rigidum*, *Trifolium arvense*, *Romulea rosea* var. *australis*, *Echium plantagineum*, *Medicago truncatula* and *Phyla canescens*. Occurs on dark grey, self-mulching clays and clay loam soils in slightly low lying areas of the floodplains and alluvial plains of central NSW extending from the Riverina and Lower Slopes of the NSW SWS Bioregions to north of Warren in the north-central wheatbelt of NSW. Often containing a high proportion of annual exotic species in Spring.

Within the study area, this vegetation aligns with the description of the *Stipa aristiglumis*-*Homopholis proluta* eastern Riverina (Community 3) as described by Benson, Ashby and Porteners (1997). This vegetation is considered most likely to be representative of the Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45) and occurs on the plains with floodplain associations of Yanco Creek.

This PCT occurs on grey clay cracking clay in the plains and intergrades regularly with Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46). Patches of PCT 45 are dominated by *Walwhalleya proluta* and co-dominated by *Enteropogon ramosus* and *Austrostipa aristiglumis*. Patches are generally lower lying generally retaining greater soil moisture in association with floodplain environments near the Yanco Creek and have a higher cover of native grasses which provide self-mulching soils. Whereas, PCT46 is mostly dominated by *Enteropogon ramosus* and is situated between PCT 45 and PCT 44 on very slight rises on the plain.

PCT 45 has succumbed to extensive grazing pressure (i.e. compaction and cow pugging) and intact examples this community are not well represented in the landscape. However, one patch (sampled in P5.1b) does meet the listing of Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act). The analysis of key diagnostic characteristics for grassland patches listed as Natural Grasslands of the Murray Valley Plains (**Section 4.7.2**), provides insight into which patches are likely to be natural grassland based on plant species that are absent or infrequent in natural grasslands and represent derived grassland of historical *Acacia pendula* or chenopod shrublands (Threatened Species Scientific Committee, 2012).

This PCT has been assigned to two vegetation zones comprising moderate-good (Zone 13), low-moderate (Zone 14), see **Photo 4-13** and **Photo 4-14**. PCT 45 Zone 13 generally comprised >15 native species supporting a moderate to high diversity of native forbs. PCT 45 Zone 13 was assigned in patches with 15 or less native species supporting a low to moderate diversity of native forbs. The cover and abundance of exotic plant species (including exotic annuals) and grazing pressure in patches was also taken into account when assigning a condition class. The results of the VI scores for each plot was also reviewed to reflect the correct condition class.

This vegetation is most likely to be representative of PCT 45 for the following reasons:

- Tussock grassland dominated by the grass species *Walwhalleya proluta*, and co-dominated by *Enteropogon ramosus* and *Austrostipa aristiglumis* on dark grey, self-mulching clays and clay loam soils in slightly low lying areas of the floodplains and alluvial plains of central NSW extending from the Riverina
- Occasionally with a scattered shrub layer composed of *Duma florulenta* and *Chenopodium nitrariaceum*
- Often composed of *Marsilea drummondii* with forbs such as *Wurmbea dioica* subsp. *dioica*, *Rumex dumosus*, *Arthropodium minus*, *Leptorhynchus squamatus* subsp. *A*, *Crassula decumbens* var. *decumbens*, *Goodenia fascicularis*, *Rhodanthe corymbiflora* and several species of Swainsona.

A summary of the vegetation zones for PCT 45 are given below in **Table 4-10**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-10. Floristic and structural summary of PCT 45 within the study area

Vegetation layer	Dominant species	
	Moderate to good (Zone 13)	Low to moderate (Zone 14)
Tree canopy (upper stratum)	None	None
Midstorey (mid-stratum)	<i>Maireana aphylla</i> <i>Maireana excavata</i> <i>Atriplex semibaccata</i> <i>Maireana pentagona</i> <i>Chenopodium nitrariaceum</i>	<i>Maireana aphylla</i> <i>Sclerolaena muricata</i> <i>Atriplex semibaccata</i> <i>Duma florulenta</i>
Groundcovers (ground stratum)	<i>Walwhalleya proluta</i> <i>Austrostipa aristiglumis</i> <i>Rytidosperma</i> spp. <i>Enteropogon ramosus</i> <i>Calotis scabiosifolia</i> <i>Chrysocephalum apiculatum</i> <i>Rhodanthe corymbiflora</i> <i>Vittadinia cuneata</i> <i>Sporobolus caroli</i>	<i>Walwhalleya proluta</i> <i>Austrostipa aristiglumis</i> <i>Rytidosperma</i> spp. <i>Enteropogon ramosus</i> <i>Crassula colorata</i> <i>Sporobolus caroli</i> <i>Vittadinia cuneata</i> <i>Rhodanthe corymbiflora</i>
Exotic species	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>
High Threat Weeds	None	<i>Xanthium spinosum</i>
Threatened plant species confirmed	None	None



Photo 4-13. PCT 45 moderate to good (Zone 13) open grassland dominated by species *Walwhalleya proluta*, and co-dominated by *Enteropogon ramosus* and *Austrostipa aristiglumis*, west of Wilson Road and south of Moonbria Lane (Plot 5.1b)

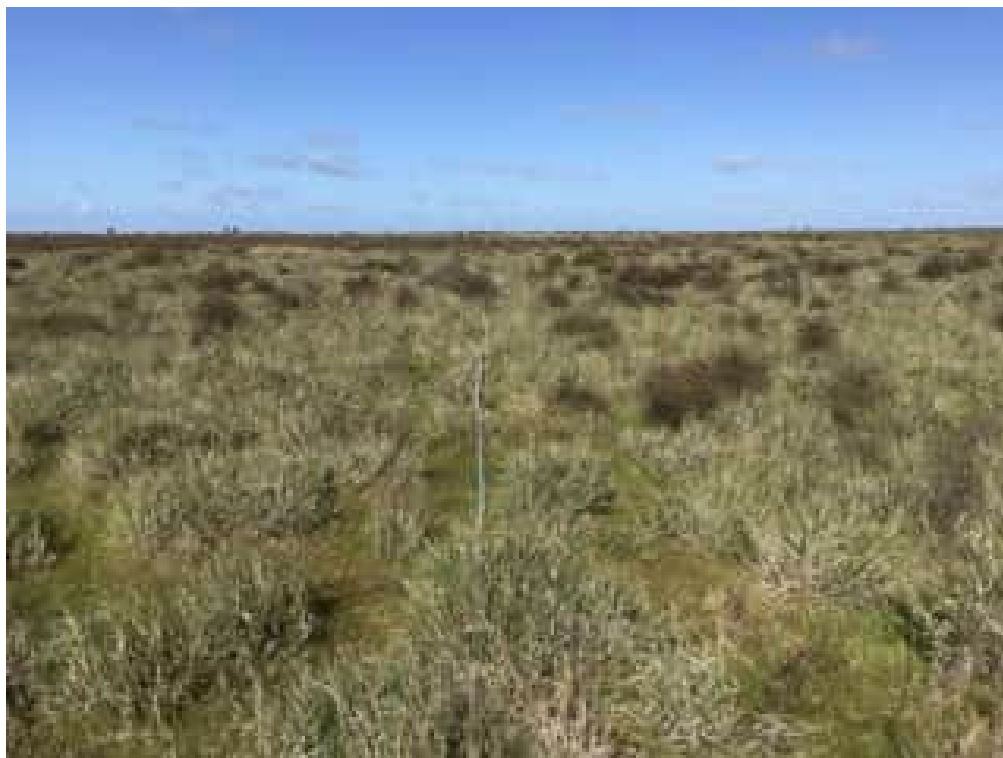


Photo 4-14. PCT 45 low to moderate (Zone 14) open grassland dominated by species *Walwhalleya prolata*, and co-dominated by *Enteropogon ramosus* and *Austrostipa aristiglumis*, west of Wilson Road and south of Moonbria Lane (Plot 5.3b)

4.4.9 Curly Windmill Grass – speargrass – wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46)

Vegetation formation: Grasslands

Vegetation class: Riverine Plain Grasslands

Classification confidence level from VIS: 2-High

PCT percent cleared: 20%

Associated TEC (EPBC Act and BC Act): Some patches meet Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act)

Vegetation zones (condition):

- Moderate-Good (Zone 15)
- Low-Moderate (Zone 16).
- Moderate-Good_Cottonbush (Zone 17)
- Low-Moderate_Cottonbush (Zone 18)

Survey effort:

- Zone 15 - 10 plots (P1.2b, P2.2b, P2.4a, P2.4b, P3.5b, P3.8b, P4.9b, P4.10a, P4.10b, P5.2a)
- Zone 16 - five plot (P2.6b, 2.7b, P3.4a, P3.9b P4.13a)
- Zone 17 - five plots (P1.7b, P1.8b, P2.1b, P3.9a, P4.6b)
- Zone 18 - six plots (P1.4b, P1.5b, P3.4b, P3.7a, P3.8a, P4.8b).

Extent in disturbance footprint:

- Zone 15 – 31.29 ha
- Zone 16 – 13.32 ha
- Zone 17 – 22.63 ha
- Zone 18 – 22.51 ha.

Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46) is described in the BioNet Vegetation Classification database as an open to closed tussock grassland generally about 0.3 m high dominated by Curly Windmill Grass (*Enteropogon ramosus*), corkscrew grass (*Austrostipa nodosa* and/or *Austrostipa scabra*) and a number of wallaby grass species (*Austrodanthonia* spp.) with a range of forbs including *Rhodanthe corymbiflora*, *Crassula colorata* var. *acuminata*, *Erodium crinitum*, *Oxalis perennans*, *Sida trichopoda*, *Sida corrugata*, *Goodenia pusilliflora*, *Goodenia fascicularis*, *Calotis scabiosifolia* var. *scabiosifolia*, *Calocephalus sonderi*, *Bulbine semibarbata* and *Daucus glochidiatus* form G. A very sparse shrub layer may be present including *Sclerolaena stelligera*, *Maireana excavata* and *Maireana aphylla*. 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 in the Riverina Bioregion.

Within the study area, this vegetation aligns with the description of the *Enteropogon ramosus*-*Stipa nodosa*-*Danthonia* in the Hay area (Community 4) as described by Benson, Ashby and Porteners (1997). This vegetation is considered most likely to be representative of the Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46) and is the most common PCT across the entire Project area on grassland plain.

This PCT occurs on brown to grey clays in the plains and intergrades regularly with Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT 44), Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 45) and Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT 26). The clay soil colour transitions from red-brown to grey cracking clay at ecotones between PCT 44 and PCT 46. Patches of PCT 46 generally occur between PCT 44 (slight rises) and PCT 45 (lower lying) and are floristically similar to PCT 45, but have less forb diversity than PCT 44 depending on land use history and commonly have self mulching clay soil due to the high cover of native grass species.

PCT 46 represents examples of natural grasslands in the landscape and most patches meet the listing of Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act). In addition to known patches of natural grasslands, other patches likely represent derived native grassland of PCT 26 and these communities regularly integrated between open grassland to open grassland with a mosaic of *Acacia pendula*, open woodland or woodland structures. Given the similarities of grassland floristics, it was difficult to delineate the boundaries between natural grassland and possible derived native grassland. Therefore both grassland types were assigned to PCT 46. The analysis of key diagnostic characteristics for grassland patches listed as Natural Grasslands of the Murray Valley Plains (**Section 4.7.2**), provides insight into which patches are likely to be natural grassland based on plant species that are absent or infrequent in natural grasslands and represent derived grassland of historical *Acacia pendula* or chenopod shrublands (Threatened Species Scientific Committee, 2012).

Mapping of ecotones between grassland and woodland followed the guidance of the Native Vegetation Interim Type Standard ('the Standard') (Sivertsen 2009). Ground surveys of open woodland used mapping of well separated trees up to 100 m apart to represent 10% foliage cover. If any trees in a patch exceeded this measure, the vegetation was classed as a grassland with a mosaic of *Acacia* trees and assigned to a grassland PCT.

This PCT has been assigned to one variant with two condition classes (Moderate-Good_Cottonbush (Zone 17) and Low-Moderate_Cottonbush (Zone 18) with an observable low shrub cover of Cottonbush (*Maireana aphylla*). This PCT 46 cottonbush variant has similarities to Cotton Bush open shrubland of the semi-arid (warm) zone (PCT 164) both having a dominating shrub cover composed of *Maireana aphylla*. However PCT 164 is likely derived from a chenopod shrubland comprising *Atriplex vesicaria* prior to European settlement and land use change. The PCT 46 cottonbush variant has typical species composition of PCT 46 commonly dominated by a grassy layer with *Enteropogon ramosus* which is not in the description of PCT 164. It's possible that this variant has undergone selective grazing pressure that has allowed *Maireana aphylla* to

persist as a low shrub layer. This local variant is most common in the west and north west of the Project area in very large fenced paddocks. *Maireana aphylla* becomes less common in PCT 46 in the southern parts of the Project area.

PCT 46 also integrates with Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17) in the Project area on the edges of depressions and drainage lines.

This PCT has been assigned to four vegetation zones comprising Moderate-Good (Zone 15), Low-Moderate (Zone 16), Moderate-Good_Cottonbush (Zone 17) and Low-Moderate_Cottonbush (Zone 18), see **Photo 4-11** and **Photo 4-12**. PCT 46 Zone 15 and Zone 17 generally comprised >15 native species supporting a moderate to high diversity of native forbs. PCT 46 Zone 16 and Zone 18 was assigned in patches with 15 or less native species supporting a low to moderate diversity of native forbs. The cover and abundance of exotic plant species (including exotic annuals) and grazing pressure in patches was also taken into account when assigning a condition class. The results of the VI scores for each plot was also reviewed to reflect the correct condition class.

This vegetation is most likely to be representative of PCT 46 for the following reasons:

- Open to closed tussock grassland occurring 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 in the Riverina Bioregion
- Commonly composed of *Enteropogon ramosus*, *Austrostipa nodosa* and/or *Austrostipa scabra* and *Rytidosperma* spp. with a range of forbs including *Rhodanthe corymbiflora*, *Crassula colorata*, *Erodium crinitum*, *Oxalis perennans*, *Sida trichopoda*, *Sida corrugata*, *Goodenia pusilliflora*, *Goodenia fascicularis*, *Calotis scabiosifolia* var. *scabiosifolia*, and *Calocephalus sonderi*
- A very sparse shrub layer may be present including *Sclerolaena stelligera*, *Maireana excavata* and *Maireana aphylla*.

A summary of the vegetation zones for PCT 46 are given below in **Table 4-11**. This list of species reflects the local variation gathered from multiple floristic plots undertaken within the study area.

Table 4-11. Floristic and structural summary of PCT 46 within the study area

Vegetation layer	Dominant species			
	Moderate-Good (Zone 15)	Low-Moderate (Zone 16)	Moderate-Good_cottonbush (Zone 17)	Low-Moderate_cottonbush (Zone 18)
Tree canopy (upper stratum)	Occasional <i>Acacia pendula</i>	Occasional <i>Acacia pendula</i>	Occasional <i>Acacia pendula</i>	Occasional <i>Acacia pendula</i>
Midstory (mid-stratum)	<i>Maireana aphylla</i> <i>Maireana excavata</i> <i>Sclerolaena muricata</i> <i>Atriplex leptocarpa</i> <i>Atriplex semibaccata</i>	<i>Maireana aphylla</i>	<i>Sclerolaena muricata</i> <i>Sclerolaena diacantha</i> <i>Maireana aphylla</i>	<i>Sclerolaena muricata</i> <i>Sclerolaena diacantha</i> <i>Maireana aphylla</i> <i>Maireana pentagona</i>
Groundcovers (ground stratum)	<i>Enteropogon ramosus</i> <i>Walwhalleya proluta</i> <i>Rytidosperma setaceum</i> <i>Rytidosperma caespitosum</i> <i>Leiocarpa panaetioides</i> <i>Austrostipa nodosa</i> <i>Austrostipa scabra</i>	<i>Enteropogon ramosus</i> <i>Rytidosperma</i> spp. <i>Austrostipa</i> spp. <i>Sporobolus caroli</i> <i>Leiocarpa panaetioides</i>	<i>Enteropogon ramosus</i> <i>Walwhalleya proluta</i> <i>Rytidosperma setaceum</i> <i>Rytidosperma caespitosum</i> <i>Leiocarpa panaetioides</i> <i>Austrostipa nodosa</i> <i>Austrostipa scabra</i> <i>Leucochrysum molle</i>	<i>Enteropogon ramosus</i> <i>Rytidosperma setaceum</i> <i>Rytidosperma caespitosum</i> <i>Austrostipa nodosa</i> <i>Sporobolus caroli</i> <i>Chloris truncata</i> <i>Walwhalleya proluta</i> <i>Calotis scabiosifolia</i> <i>Sida corrugata</i>

Biodiversity Development Assessment Report

Vegetation layer	Dominant species			
	Moderate-Good (Zone 15)	Low-Moderate (Zone 16)	Moderate-Good_cottonbush (Zone 17)	Low-Moderate_cottonbush (Zone 18)
	<i>Leucochrysum molle</i> <i>Salsola australis</i> <i>Sporobolus caroli</i> <i>Chloris truncata</i> <i>Calotis scabiosifolia</i> <i>Sida corrugata</i>		<i>Vittadinia dissecta</i> <i>Sporobolus caroli</i> <i>Chloris truncata</i> <i>Calotis scabiosifolia</i> <i>Sida corrugata</i>	
Exotic species	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>	<i>Lolium rigidum</i> <i>Hordeum leporinum</i> <i>Medicago polymorpha</i>
High Threat Weeds	<i>Lycium ferocissimum</i>	<i>Xanthium spinosum</i>	None	<i>Xanthium spinosum</i>
Threatened plant species	<i>Swainsona murrayana</i> <i>Swainsona sericea</i>	<i>Swainsona murrayana</i> <i>Swainsona sericea</i>	<i>Swainsona murrayana</i> <i>Swainsona sericea</i>	<i>Swainsona murrayana</i> <i>Swainsona sericea</i>



Photo 4-15. PCT 46 moderate to good (Zone 15) open grassland dominated by *Enteropogon ramosus* west of Wilson Road (Plot 2.2a)



Photo 4-16. PCT 46 low to moderate (Zone 16) open grassland dominated by *Enteropogon ramosus* west of Wilson Road (Plot 3.4a)



Photo 4-17. PCT 46 moderate to good_cottonbush (Zone 17) open grassland dominated by *Enteropogon ramosus*, *Leiocarpa panaetioides* and low shrub cover of *Maireana aphylla* south of Mabins Well Road (Plot 3.8a)



Photo 4-18. PCT 46 low to moderate_cottonbush (Zone 18) open grassland dominated by *Enteropogon ramosus* and high cover of annual exotic species with a low shrub cover of *Maireana aphylla* south of Mabins Well Road (Plot 3.9a)

4.4.10 Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160)

Vegetation formation: Freshwater Wetlands

Vegetation class: Inland Floodplain Shrublands

Classification confidence level from VIS: 3-Medium

PCT percent cleared: 28%

Associated TEC (EPBC Act and BC Act): No associated TECs

Vegetation zones (condition): Moderate to Good (Zone 19)

Survey effort: one plot (P2.1a)

Extent in disturbance footprint: 0.03 ha

Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160) is described in the BioNet Vegetation Classification database as a tall shrubland to two metres high, dominated by Nitre Goosefoot (*Chenopodium nitrariaceum*) often with Black Roly Poly (*Sclerolaena muricata*). Low shrubs include *Sclerolaena stelligera*, Soft Horns (*Malacocera tricornis*) and *Atriplex semibaccata*; forb species include *Omphalolappula concava*, *Harmsiodoxa blennodioides* and *Oxalis perennans*. Tall shrubs of Cooba (*Acacia salicina*) and River Cooba (*Acacia stenophylla*) may be present. Occurs on cracking clay or sandy clay soils in lake beds, low lying plains, drainage depressions and alluvial plains subject to flooding in the arid and semi-arid zones of far western NSW. Widespread but usually found in discrete stands. In some places this community may be derived from a previous Old Man Saltbush shrubland as it generally occurs in highly disturbed sites. Grades into Lignum communities in wetter sites where drainage is impaired.

Within the study area, this community is considered most likely to be representative of the PCT 160 along drainage lines or depressions on low lying plains. This PCT occurs as moderate to good condition patches with

minimal exotic species occurrences, except annual grass weeds (**Photo 4-19**). This community has similarities to PCT 160 which may often have a mixed shrub cover of *Chenopodium nitrariaceum*. PCT 160 was generally allocated to patches where *Chenopodium nitrariaceum* was most dominant and with minor occurrences of *Duma florulenta*.

PCT 160 integrates with Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT 46) in the Project area on the edges of depressions and drainage lines.

This vegetation is most likely to be representative of PCT 160 for the following reasons:

- Tall shrubland to two metres high, dominated by *Chenopodium nitrariaceum* often with *Sclerolaena muricata*
- Low shrubs include *Sclerolaena stelligera* and *Atriplex semibaccata*
- Occurs on cracking clay or sandy clay soils in low lying plains, drainage depressions and alluvial plains subject to flooding in the arid and semi-arid zones.

A summary of the vegetation zone PCT 160 moderate to good is given below in **Table 4-12**. This list of species reflects the local variation gathered from one plot undertaken within the study area.

Table 4-12. Floristic and structural summary of vegetation zones PCT 160 moderate to good within the study area

Vegetation layer	Dominant species
Tree canopy (upper stratum)	None
Midstory (mid-stratum)	<i>Chenopodium nitrariaceum</i> <i>Duma florulenta</i> <i>Sclerolaena muricata</i> <i>Atriplex semibaccata</i> <i>Sclerolaena stelligera</i> <i>Sclerolaena divaricata</i>
Groundcovers (ground stratum)	<i>Rytidosperma caespitosum</i> <i>Enteropogon ramosus</i> <i>Rytidosperma spp.</i> <i>Walwhalleya proluta</i>
Exotic species	<i>Lolium spp.</i> <i>Hordeum spp.</i>
High Threat Weeds	None
Threatened plant species	None



Photo 4-19. PCT 160 moderate to good (Zone 19) low lying depression with a shrub layer dominated by *Chenopodium nitrariaceum* and ground layer dominated by *Enteropogon ramosus* and *Austrostipa aristiglumis*, north of Wilson Road (Plot 2.1a)

4.4.11 Non-native vegetation

A total of 5.58 hectares within the disturbance footprint comprises non-native vegetation assigned to category 2 land that is established on cultivated land and is dominated by annual exotic species. There is also 54.71 hectares of non-native vegetation assigned to category 1 – exempt land. No native plant species were observed at these locations following rapid floristic surveys. This includes, ploughed paddocks, active and derelict cotton farms and associated constructed channels (see Photo 4-20 and Photo 4-21). Such areas are dominated mainly by exotic annual grasses (*Lolium* spp, *Hordeum* spp.) and also comprise a diversity of exotic forbs (*Arctotheca calendula*, *Medicago* spp. and *Hypochaeris* spp.).

Hard bare ground road surfaces in the Project area for project access were not assessed in the BDAR and are classified as category 1 – exempt land on main roads such as Wilson Road, Mabins Well Road, Moonbria Lane and Goolgumbra Road, as well as some internal property access tracks.



Photo 4-20. Non-native vegetation (category 1 exempt land) on active irrigated cotton farm in the north west of the Project area



Photo 4-21. Non-native vegetation (category 2 land) on recently ploughed paddock in the south east of the Project area

4.5 Vegetation zones and vegetation integrity scores.

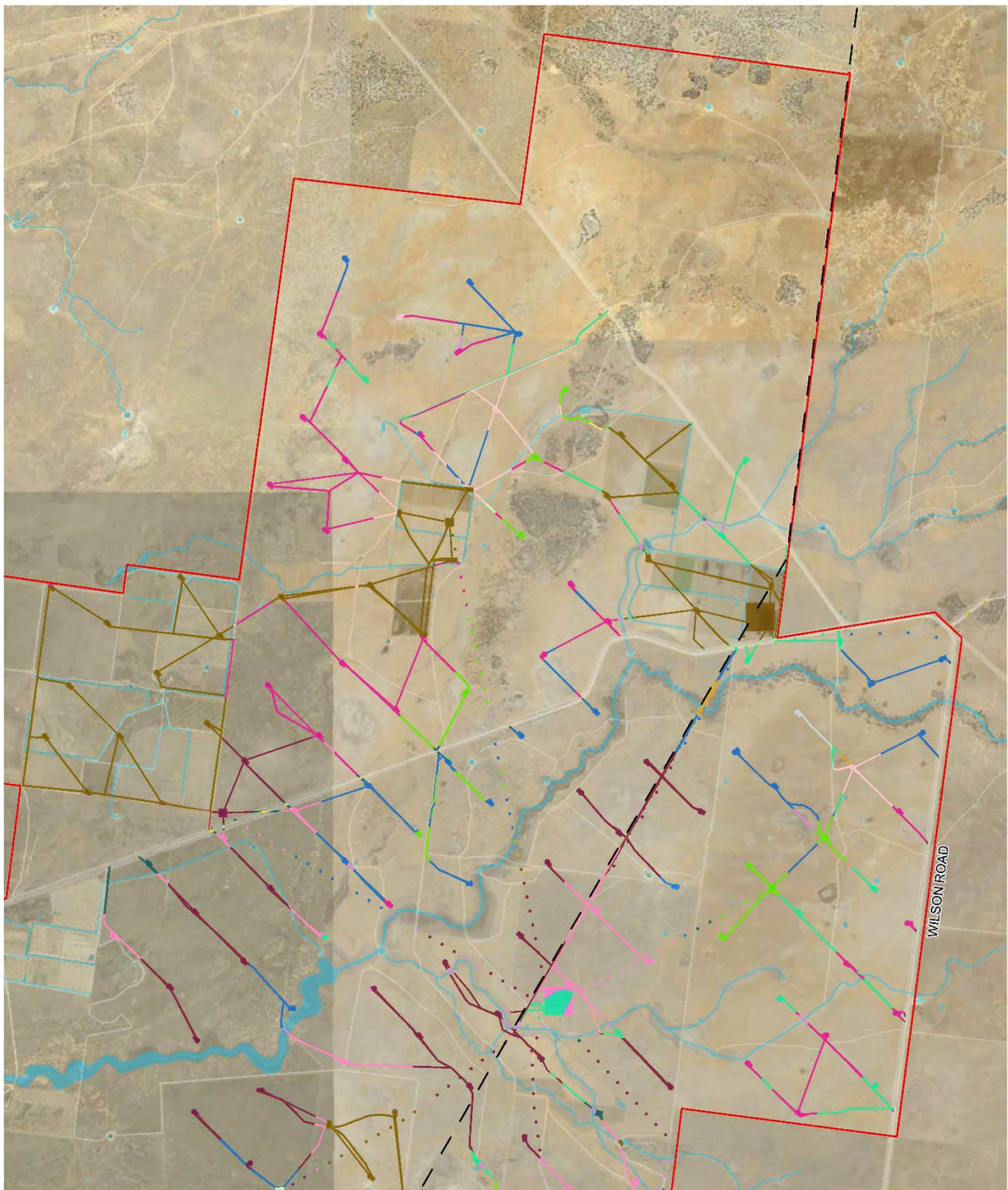
A description of the vegetation zones identified within the disturbance footprint and the corresponding vegetation integrity (VI) score developed from the BAM Calculator is presented in **Table 4-13**. The VI survey plot data is provided in **Appendix C**.

Table 4-13. Vegetation zones directly impacted and vegetation integrity scores

Vegetation zone	Plant community type name	Broad condition class	Area in disturbance footprint (ha)	VI scores			Current VI score
				Composition	Structure	Function	
1	River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)	Low to Moderate	1.10	38.5	31.6	44	37.7
2	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)	Low to Moderate	0.22	22	31.5	52.5	33.1
3	Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)	Moderate to Good	0.58	65.5	67	51.9	61.1
4		Low to Moderate	0.11	85.1	36.5	37.6	48.9
5	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)	Moderate to Good	1.86	95.6	92.4	-	94
6	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26)	Moderate to Good_grassy	27.00	88.1	70.9	20.1	50.1
7		Low to Moderate_grassy	1.40	68.7	40.6	10.6	30.9
8		Moderate to Good_shrubby	2.10	91.4	94.4	64.4	82.2
9		Low to Moderate_shrubby	0.59	90.6	76.8	6.1	34.9
10	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28)	Low to Moderate	10.28	78.4	100	2.9	28.2

Biodiversity Development Assessment Report

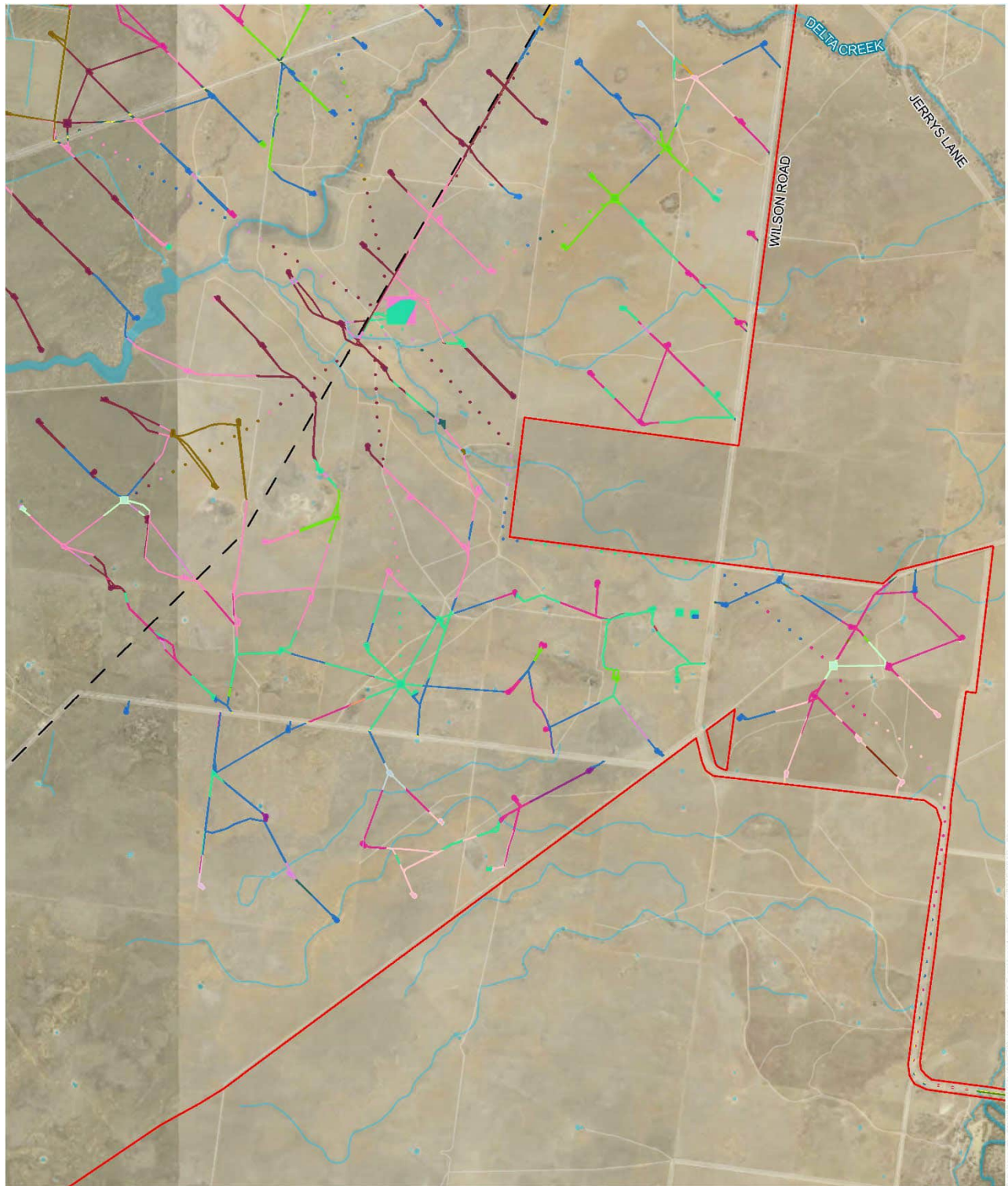
Vegetation zone	Plant community type name	Broad condition class	Area in disturbance footprint (ha)	VI scores			Current VI score
				Composition	Structure	Function	
11	Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT44)	Moderate to Good	32.99	99	99.8	-	99.4
12		Low to Moderate	3.15	73.4	97.2	-	84.5
13	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)	Moderate to Good	1.42	96.5	85.5	-	90.9
14		Low to Moderate	0.81	55.7	84.8	-	68.7
15	Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46)	Moderate to Good	31.29	95.2	89	-	92.1
16		Low to Moderate	13.32	52.1	87	-	67.3
17		Moderate to Good_Cottonbush	23.49	96.2	99.3	-	97.7
18		Low to Moderate_Cottonbush	22.51	73.7	94.2	-	83.3
19	Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160)	Moderate to Good	0.03	94.7	68	-	80.3
Total			173.39				



<p>Disturbance area</p> <p>Project area</p> <p>Road</p> <p>--- Existing 132kV transmission line</p> <p>Waterways</p> <p>Non-native vegetation</p> <p>PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion</p> <p>Low - moderate</p> <p>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)</p> <p>Low - moderate</p> <p>Moderate - good</p>	<p>PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)</p> <p>Moderate - good</p> <p>PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion</p> <p>Low - moderate grassy</p> <p>Low - moderate shrubby</p> <p>Moderate - good grassy</p> <p>Moderate - good shrubby</p> <p>PCT 28: White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone</p> <p>Low - moderate</p>	<p>PCT 44: Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion</p> <p>Low - moderate</p> <p>Moderate - good</p> <p>PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion</p> <p>Low - moderate</p> <p>Low - moderate Cottonbush</p> <p>Moderate - good</p> <p>Moderate - good Cottonbush</p>	<p>0 1 2 km</p> <p>1:74,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> <p>Data sources</p> <p>Jacobs 2022</p> <p>© Department of Customer Service 2020</p>
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Figure 4-2. Map of plant community types and vegetation zones (Page 1 of 4)

Biodiversity Development Assessment Report



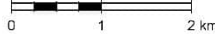

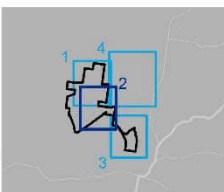
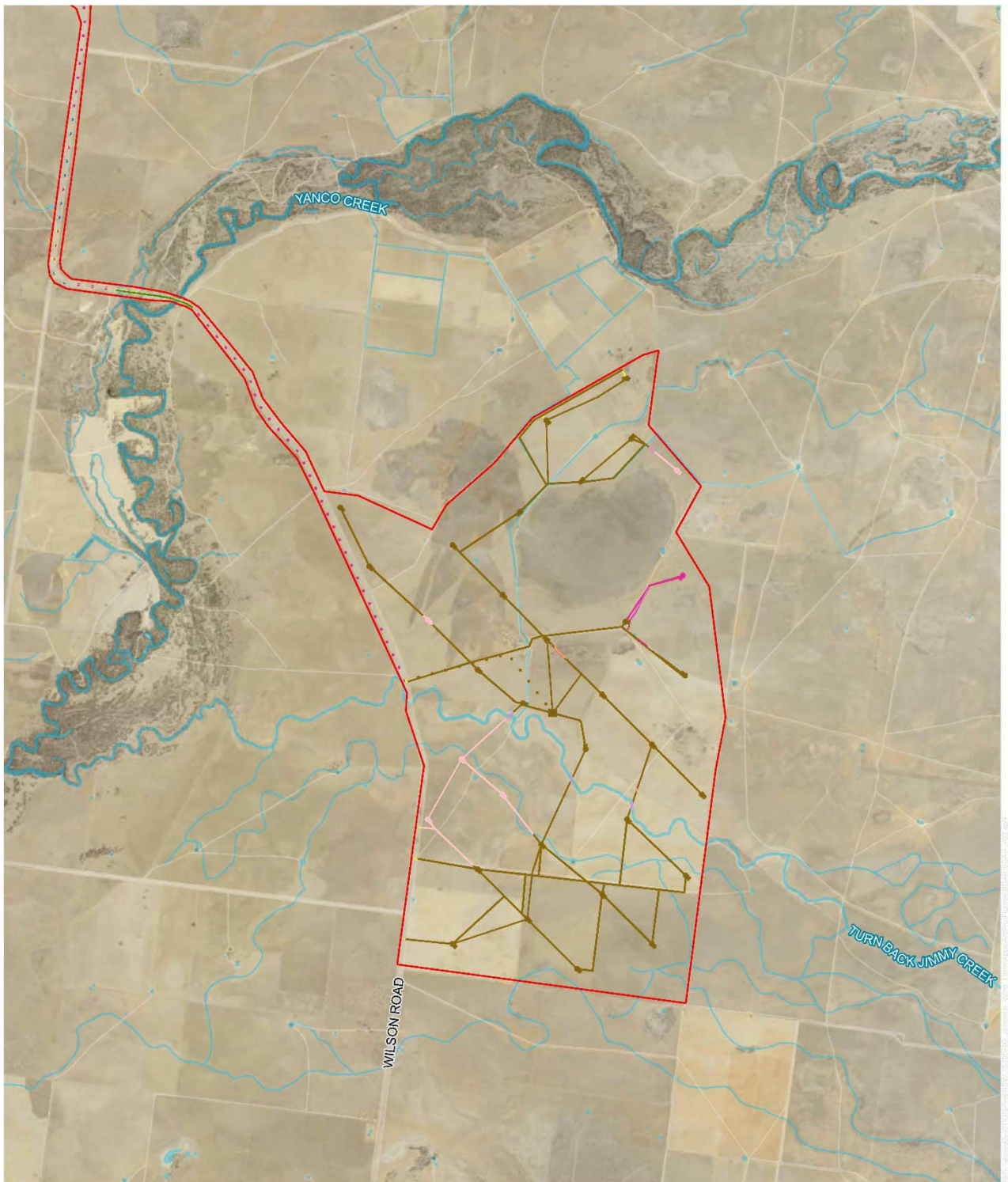
<ul style="list-style-type: none"> Disturbance area Project area Road Existing 132KV transmission line Waterways Non-native vegetation PCT 7: River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion Low - moderate PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion Low - moderate 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) Moderate - good 	<ul style="list-style-type: none"> PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) Moderate - good PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion Low - moderate grassy Low - moderate shrubby Moderate - good grassy Moderate - good shrubby PCT 28: White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone Low - moderate PCT 44: Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion Low - moderate Moderate - good 	<ul style="list-style-type: none"> PCT 45: Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion Low - moderate Moderate - good PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion Low - moderate Moderate - good Cottonbush Moderate - good Moderate - good Cottonbush PCT 160: Nitre Goosefoot shrubland wetland on clays of the inland floodplains Moderate - good 	<div style="text-align: right;">   <p>1:74,000 at A4 GDA 1994 MGA Zone 55</p> </div> <div style="text-align: right; margin-top: 10px;">  <p>Data sources Jacobs 2022 Department of Customer Service 2020</p> </div>
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Figure 4-2. Map of plant community types and vegetation zones (Page 2 of 4)





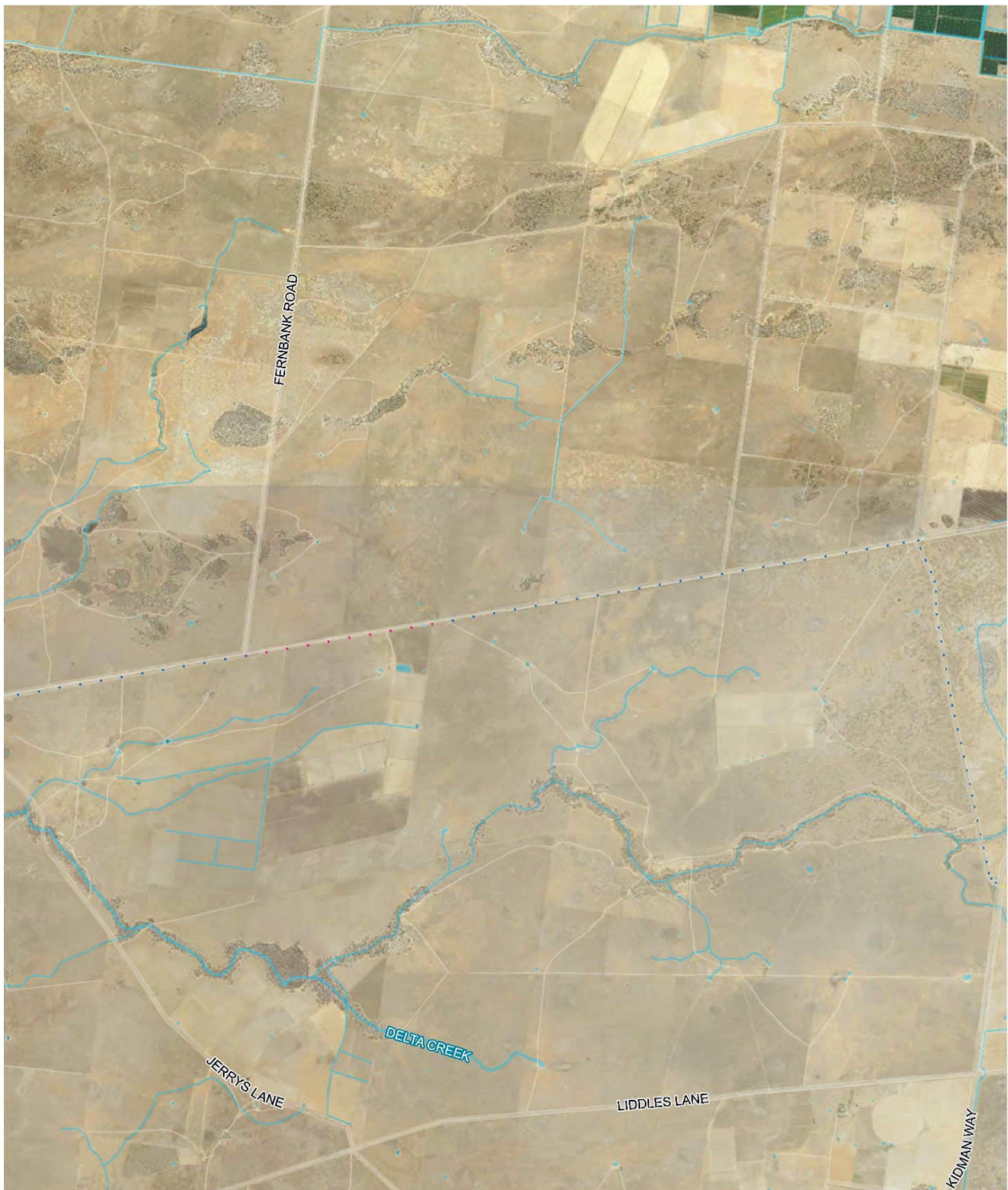
<ul style="list-style-type: none"> Disturbance area Project area Road Waterways Non-native vegetation PCT 7: River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion Low - moderate PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion Low - moderate 	<ul style="list-style-type: none"> PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) Moderate - good PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion Moderate - good grassy PCT 45: Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion Low - moderate Moderate - good PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion Low - moderate Moderate - good 	<div style="text-align: right;">  1:74,000 at A4 GDA 1994 MGA Zone 55 </div> <div style="text-align: right;">  </div>
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Figure 4-2. Map of plant community types and vegetation zones (Page 3 of 4)



- Disturbance area
- Road
- Waterways
- 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)
- Moderate - good
- PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion
- Moderate - good grassy
- PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion
- Moderate - good

0 1 2 km

1:90,000 at A4

GDA 1994 MGA Zone 55

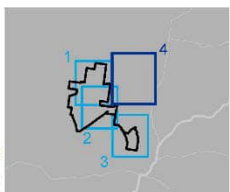


Figure 4-2. Map of plant community types and vegetation zones
(Page 4 of 4)

4.6 Assessment of patch size

A patch is defined in the BAM as an area of intact native vegetation that occurs on the subject land. The patch may extend onto adjoining land beyond the footprint of the development site, and for woody ecosystems, includes native vegetation separated by less than or equal to 100 metres from the next area of intact native vegetation. For non-woody vegetation, this gap is reduced to less than or equal to 30 metres. Patch size for each vegetation zone located in the development site was mapped in accordance with Subsection 4.3.2 of the BAM using the following steps:

1. Identify vegetation zones that will be included in the same patch
2. Identify the boundary of any adjoining intact native vegetation which extends beyond the limit of the development site
3. Digitise each patch in a GIS using separate polygons where multiple patches exist
4. Calculate the area of each patch in hectare in a GIS.

The patch was then allocated to a patch size class (<5 ha, 5–24 ha, 25–100 ha or >100 ha). Patch size class is used as a filter in the BAM-C to predict threatened species likely to occur or use habitat on the development site.

The main barriers that breaks apart native vegetation within the landscape buffer are large paddocks of agricultural cropping land composed of exotic annual plants. There are very large areas of intensive cropping land to the south of Yanco Creek approximately 6 km x 4 km and active and derelict cotton farms in the north and north-west of the Project area. These areas breakup native vegetation cover to the north and south, but native corridors are extensive throughout the landscape composed of a mosaic of native grassland, woodland and shrubland swamps.

4.7 Threatened ecological communities

Four threatened ecological communities (TECs) were confirmed to be present in the study area (refer to **Table 4-14** and **Figure 4-3**) and include the following:

- Natural Grasslands of the Murray Valley Plains listed as critically endangered under the EPBC Act
- Weeping Myall Woodlands listed as endangered under the EPBC Act
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed as endangered under the BC Act
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered under the BC Act.

A summary of the TECs and associated PCTs and area within the disturbance footprint is provided in **Table 4-14**.

Table 4-14. Summary of threatened ecological communities listed under the BC Act and EPBC Act recorded within the disturbance footprint

TEC name	BC Act Status	EPBC Act Status	Risk of SAIL	Associated PCT	Area in disturbance footprint (ha)
BC Act					
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	EEC	-	No	PCT28	10.28
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	EEC	-	No	PCT 26	31.09

TEC name	BC Act Status	EPBC Act Status	Risk of SAIL	Associated PCT	Area in disturbance footprint (ha)
EPBC Act					
Weeping Myall Woodlands	-	EEC	No	PCT 26	29.69
Natural Grasslands of the Murray Valley Plains	-	CEEC	No	PCT44, PCT45, PCT46	88.33

Key: CEEC = critically endangered ecological community, EEC = endangered ecological community

4.7.1 State-listed threatened ecological communities

4.7.1.1 Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions

Vegetation zones in the study area were assessed against the key characteristics in final determination for listing of Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (NSW Scientific Committee, 2011a).

Vegetation zones have been assessed against the key characteristics for this TEC in **Table 4-15**.

In addition to known patches of natural grasslands, it's possible that PCT26 dominated the plains landscape prior to land clearing and overgrazing by European settlement and many patches now occur as native derived grassland which correspond strongly with PCT 44 and PCT 46. Site observations of sheep grazing on *Acacia pendula* indicates that some small trees may not reach full size or maturity and/or maintain a short stunted growth with continual pruning from livestock.

Table 4-15. Vegetation zones in the study area assessed against the key characteristics from the final determination for listing of Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions

Key characteristics	Conformance to the TEC	Vegetation zones within the disturbance footprint			
		Zone 6	Zone 7	Zone 8	Zone 9
NSW occurrences within the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions, and occurs on the eastern parts of alluvial plains of the Murray-Darling river system	The study areas fall within the Riverina bioregion in a flat alluvial landscape between the Murrumbidgee River (to the north) and Murray River (to the south).	Yes	Yes	Yes	Yes
Occurs on red-brown earths and heavy textured grey and brown alluvial soils	The mapped TEC occurs in areas with red-brown and grey clays or loam soils on alluvial plains.	Yes	Yes	Yes	Yes
The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history.	Areas of the mapped TEC comprise a variable overstorey structure with either a woodland or open woodland. There are also some examples of small trees or short stunted trees appearing as a low open shrubland structure affected by livestock grazing.	Yes	Yes	Yes	Yes

Key characteristics	Conformance to the TEC	Vegetation zones within the disturbance footprint			
		Zone 6	Zone 7	Zone 8	Zone 9
The tree layer grows up to a height of about 10 metres and invariably includes <i>Acacia pendula</i> (Weeping Myall or Boree) as one of the dominant species or the only tree species present. The understorey includes an open layer of chenopod shrubs and other woody plant species and an open to continuous groundcover of grasses and herbs	The canopy is dominated by <i>Acacia pendula</i> with a variable shrub layer comprising <i>Rhagodia spinescens</i> , <i>Maireana decalvans</i> , <i>Atriplex nummularia</i> , <i>Chenopodium nitrariaceum</i> and <i>Maireana aphylla</i> . Patches are dominated by grass and herb species such as <i>Rytidosperma</i> spp., <i>Austrostipa aristiglumis</i> , <i>Austrostipa scabra</i> , <i>Austrostipa nodosa</i> and <i>Sporobolus caroli</i> , <i>Alternanthera denticulata</i> , <i>Centipeda cunninghamii</i> , <i>Rhodanthe corymbiflora</i> and <i>Vittadinia cuneata</i> var. <i>cuneata</i> .	Yes	Yes	Yes	Yes
BC Act listed Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions		Yes	Yes	Yes	Yes

4.7.1.2 Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions

Vegetation zones in the study area were assessed against the key characteristics in final determination for listing of Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions (NSW Scientific Committee, 2011).

This TEC has a scattered tree canopy, some patches are treeless with a degraded ground layer as a result of past logging and grazing and generally include exotic annual grasses and forbs.

Table 4-16. Vegetation zones in the study area assessed against the key characteristics from the final determination for listing of Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions

Key characteristics	Conformance to the TEC	Vegetation zones
		Zone 10
NSW occurrences within the Riverina bioregion and the far south-western portion of the NSW South Western Slopes bioregion	The study areas fall within the Riverina bioregion	Yes
Typically occupies red-brown loamy sands with alkaline sub-soils on the alluvial plain of the Murray River and its tributaries, and on parts of the sandplain in south-western NSW.	The mapped TEC occurs in areas with red-brown loamy sands on the alluvial plain between the Murrumbidgee River (to the north) and Murray River (to the south).	Yes
the 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 and scattered patches on sandhills and lunettes within an extensive aeolian sandplain dominated by woodlands of mallee eucalypts or belah.	Areas of the mapped TEC occur on sandhills and sand plains scattered in a landscape with a strong intergradation with flat clay plains with PCT 26, and grasslands PCT 44 and PCT 46	Yes

Key characteristics	Conformance to the TEC	Vegetation zones Zone 10
typically comprises an open tree canopy, dominated by <i>Callitris glaucophylla</i> with a sometimes sparse, but highly variable ground layer dominated by grasses and herbs, sometimes with scattered shrubs and/or small trees.	The community is an open woodland or derived grassland comprising <i>Callitris glaucophylla</i> , with evidence of other trees and shrubs in the landscape such as <i>Hakea leucoptera</i> , <i>Hakea tephrosperma</i> and <i>Alectryon oleifolius</i> subsp. <i>canescens</i> . Common chenopod shrub species include <i>Maireana enchylaenoides</i> and <i>Rhagodia spinescens</i> and <i>Sclerolaena diacantha</i> . Native grass species include <i>Austrostipa scabra</i> and <i>Rytidosperma caespitosa</i> .	Yes
BC Act listed Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions		Yes

4.7.2 EPBC listed threatened ecological communities

4.7.2.1 Natural Grasslands of the Murray Valley Plains

The EPBC Act listed critically endangered Natural Grasslands of the Murray Valley Plains community was confirmed in the study area as meeting the key diagnostics and condition thresholds. This TEC is associated with:

- Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT44)
- Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)
- Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46).

Moderate to good condition vegetation zones for grassland PCTs 44, 45 and 46 were identified in the study area to meet the following key characteristics of the Natural Grasslands of the Murray Valley Plains community based on the Commonwealth Listing Advice on Natural Grasslands of the Murray Valley Plains (Threatened Species Scientific Committee, 2012).

- Distribution is primarily in the Riverina Bioregion and the Wimmera plains of the Murray Darling Depression Bioregion
- It typically occurs on a landscape of flat alluvial lowland plains with heavy-textured grey, brown and red clays. the ecological community ranges from open woodlands to woodlands, generally 4 to 12m high
- The ecological community is typically dominated by a range of perennial grasses and/or forbs or co-dominated by small shrubs. Sites are not necessarily dominated by any particular plant species. Characteristic genera present typically include:
 - For grasses – *Rytidosperma*, *Austrostipa*, *Chloris* and *Enteropogon*
 - For forbs – *Arthropodium*, *Bulbine*, *Calotis*, *Chrysocephalum*, *Minuria*, *Ptilotus*, *Rhodanthe*, *Sida* and *Swainsona*
 - For small shrubs – *Atriplex* and *Maireana*.
- Trees and large shrubs (>1 m tall) are generally absent to sparse, amounting to less than 10% Projective foliage cover for emergent trees or shrubs
- The patch should contain at least as many, preferably more, of the species in Table 1(A) than in Table 1(B) in the Listing Advice on Natural Grasslands of the Murray Valley Plains when assessed at an appropriate time (e.g. late winter-spring and not soon after disturbance such as grazing).

The vegetation integrity assessment and assessment of Natural Grasslands of the Murray Valley Plains is heavily dependent on active ground layer growing seasons and associated rainfall. The past three winter seasons have had above annual rainfall for grassland growing season in the Riverina region. Although late

winter surveys were considered adequate for vegetation assessment, many native annual forb species were still emerging and had not yet flowered and many of these were identified as juveniles or young shoots. The results of Natural Grasslands of the Murray Valley Plains assessment represent the floristic and structural condition of one survey event undertaken in August 2022. Large patches require multiple sample plots to capture representative indicators such as variation in floristic diversity of an entire extent of the patch.

As a result, the assessment of grassland patches against Table 1 of the Listing Advice considers that some grassland may not have been fully representative with species more frequently detected in Natural Grasslands of the Murray Valley Plains. For example, some moderate to good grassland patches contained equal or slightly less species in Table 1(A) (i.e. species in more frequent Natural Grasslands of the Murray Valley Plains) of the Listing Advice. Due to the seasonal variation and uncertainty of detecting all native species over the period 2021-2022, as a precaution all grassland PCTs (44, 45 and 46) assigned to moderate to good condition are considered to meet the key diagnostic characteristics for listing of Natural Grasslands of the Murray Valley Plains.

The grassland patches must also conform with the minimum condition thresholds in the Listing Advice to meet the listing status. Assessment of vegetation in the study area against the minimum condition threshold criteria is outlined in **Table 4-17**. For the purposes of this assessment, given the very large extent and connectivity of native grassland in the landscape, all moderate to good grassland PCTs (44, 45, and 46) are considered to form two patches that area separated by Yanco Creek.

The Listing Advice notes that the larger and more diverse a patch is, the greater the likely biodiversity value and its sustainability. Additionally, patches that link other native vegetation remnants in the landscape are particularly important as wildlife habitat and to the viability of the listed patches of the ecological community into the future. For this reason its important to apply a landscape approach to this assessment.

Table 4-17. Assessment of minimum condition thresholds against moderate to good grassland PCTs to meet EPBC listed of Natural Grasslands of the Murray Valley Plains

Condition Thresholds	Conformance	Vegetation zones			
		PCT 44	PCT45	PCT46	
		Zone 11	Zone 13	Zone 15	Zone 17
The percentage cover of native vascular plants (annual and perennial) in the patch is greater than the percentage cover of perennial exotic species	All vegetation zones have a dominant native plant species cover. No perennial exotic species were observed in the study area, except scattered occurrences of <i>Lycium ferocissimum</i> .	Yes	Yes	Yes	Yes
<p><u>Category A. For patches with high diversity or that are relatively undisturbed</u></p> <p>Ground layer diversity and lack of disturbance:</p> <ul style="list-style-type: none"> ▪ A1. 15 or more native vascular plant species are present in the patch. <p style="text-align: center;">AND</p> <ul style="list-style-type: none"> ▪ A2. The patch contains one or more indicator species in Table 2, characteristic of sites that are relatively undisturbed ▪ A3. The size of the grassland patch is at least 0.04 ha or more in size. 	<p>Zone 11 (PCT44) sampled between 16-29 native species per plot, each with at least one indicator species, and a patch size > 0.04 ha.</p> <p>Zone 13 (PCT45) sampled between 18-20 native species per plot, each with at least one indicator species, and a patch size > 0.04 ha.</p> <p>Zone 15 (PCT46) sampled between 15-25 native species per plot, each with at least one indicator species, and a patch size > 0.04 ha.</p> <p>Zone 17 (PCT46) sampled between 14-22 native species per plot, each with at least one indicator species, and a patch size > 0.04 ha. P1.4b was only plot that sampled <15 native species in Zone 17.</p>	Yes	Yes	Yes	Yes

Condition Thresholds	Conformance	Vegetation zones			
		PCT 44 Zone 11	PCT45 Zone 13	PCT46 Zone 15	Zone 17
<p>Category B. For larger patches that have good ground layer diversity</p> <p>Ground layer diversity:</p> <ul style="list-style-type: none"> ▪ B1. 10 or more native vascular plant species are present in the patch. <p style="text-align: center;">AND</p> <ul style="list-style-type: none"> ▪ B2. The size of the grassland patch is at least 1 ha or more in size. 	<p>Zones 11, 13, 15 and most of 17 meet Category A threshold.</p> <p>P1.4b in Zone 17 sampled 14 native species in a patch > 1ha and meets the Category B threshold.</p>	N/A	N/A	N/A	Yes
EPBC listed Natural Grasslands of the Murray Valley Plains		Yes	Yes	Yes	Yes

4.7.2.2 Weeping Myall Woodland

The EPBC Act listed endangered Weeping Myall Woodland community was confirmed in the study area as meeting the key diagnostics and condition thresholds. This TEC is associated with Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26).

All vegetation zones of PCT 26 were identified in the study area to meet the following description of the Weeping Myall Woodland community based on the EPBC Act Policy Statement 3.17 (DEWHA, 2009):

- Occurs on the inland alluvial plains west of the Great Dividing Range in NSW and QLD. It occurs in the Riverina (IBRA V7, DoE 2012)
- The ecological community generally occurs on flat areas, shallow depressions or gilgais² on raised alluvial plains. These areas are not associated with active drainage channels and are rarely, if ever, flooded. The ecological community occurs on black, brown, red-brown or grey clay or clay loam soils
- The ecological community ranges from open woodlands to woodlands, generally 4 to 12m high. The overstorey is dominated by weeping myall (*Acacia pendula*) trees and in some cases this species may be the only tree canopy species
- The ecological community can naturally occur either as a grassy or a shrubby woodland. However, the understorey often includes an open layer of shrubs over a ground layer which includes a diversity of grasses and forbs.
- The vegetation patches must also conform with the minimum condition thresholds in the Policy Statement 3.17 (DEWHA, 2009) to meet the listing status. Assessment of vegetation in the study area against the minimum condition threshold criteria is outlined in **Table 4-18**.

Table 4-18. Assessment of minimum condition thresholds against PCT26 vegetation zones to meet EPBC listed of Weeping Myall Woodland

Condition Thresholds	Conformance	Vegetation zones			
		Zone 6	Zone 7	Zone 8	Zone 9
The patch of woodland must be at least 0.5 ha (5000 m ²) in size	All patches > 0.5 ha	Yes	Yes	Yes	Yes
The overstorey must have at least 5 per cent tree canopy cover or at least 25 dead or defoliated mature weeping myall trees per hectare	All patches have at least 5 per cent tree canopy cover or at least 25 dead or defoliated mature trees	Yes	Yes	Yes	Yes
The tree canopy must be dominated (at least 50 per cent of trees present) by living, dead or defoliated weeping myall trees, and the patch has more than two layers of regenerating weeping myall present. OR the tallest layer of living, dead or defoliated weeping myall trees is at least 4 m tall and of the vegetative cover (shrub and ground layers) present, 50 per cent is comprised of native species	All vegetation zones and patches are dominated by living, dead or defoliated weeping myall trees, however patches in Zone 7 and Zone 9 (low to moderate condition) do not have than two layers of regenerating weeping myall present. Zone 9 does have weeping myall trees is at least 4 m tall and has 50% vegetation cover comprised of native species. Zone 7 does not have weeping myall trees at least 4 m tall	Yes	No	Yes	Yes
areas of leaf litter and cryptogams (e.g. lichens, mosses) or soil crusts may be evident and acceptable as part of the ground layer of this ecological community.	All vegetation zones this community have areas of leaf litter and cryptogams (e.g. lichens, mosses) or soil crusts as part of the ground layer. Some patches are impacted by compaction from livestock damaging soil crusts.	Yes	Yes	Yes	Yes
EPBC Act listed Weeping Myall Woodlands		Yes	No	Yes	Yes

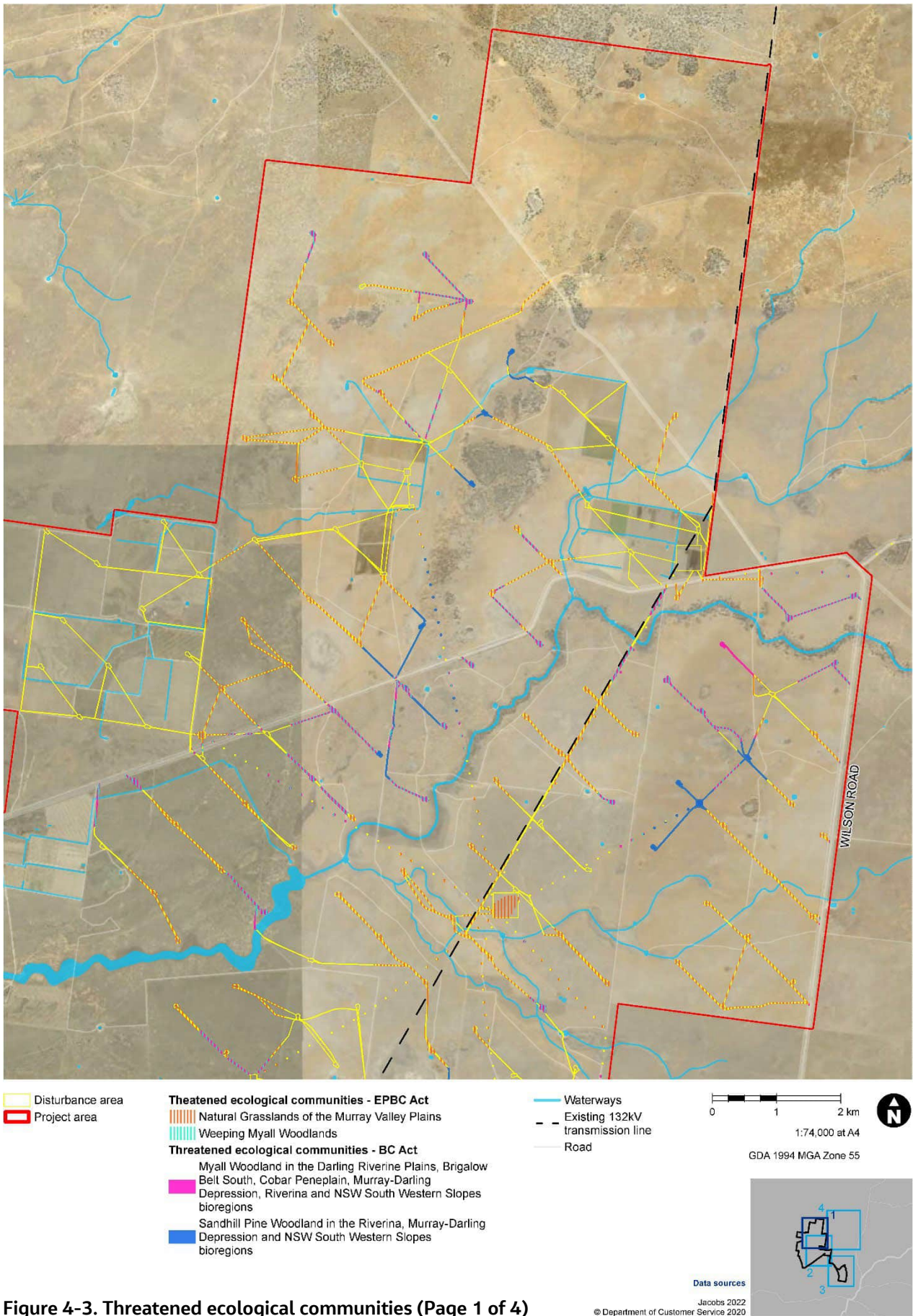


Figure 4-3. Threatened ecological communities (Page 1 of 4)

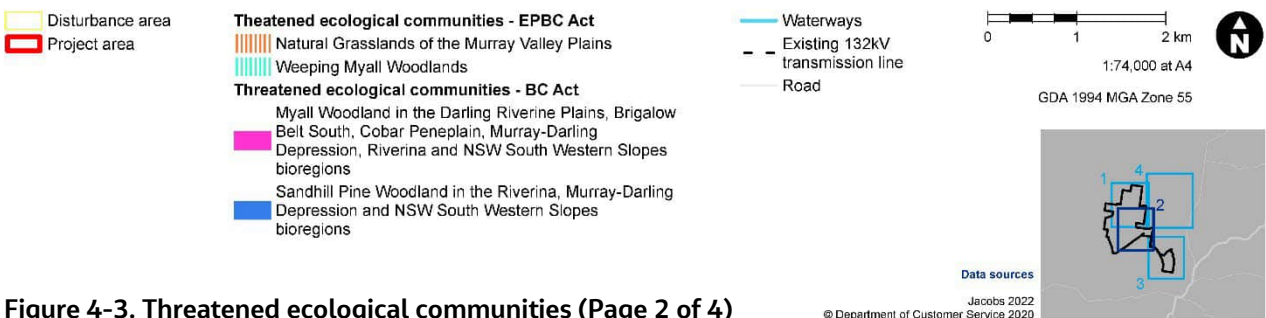
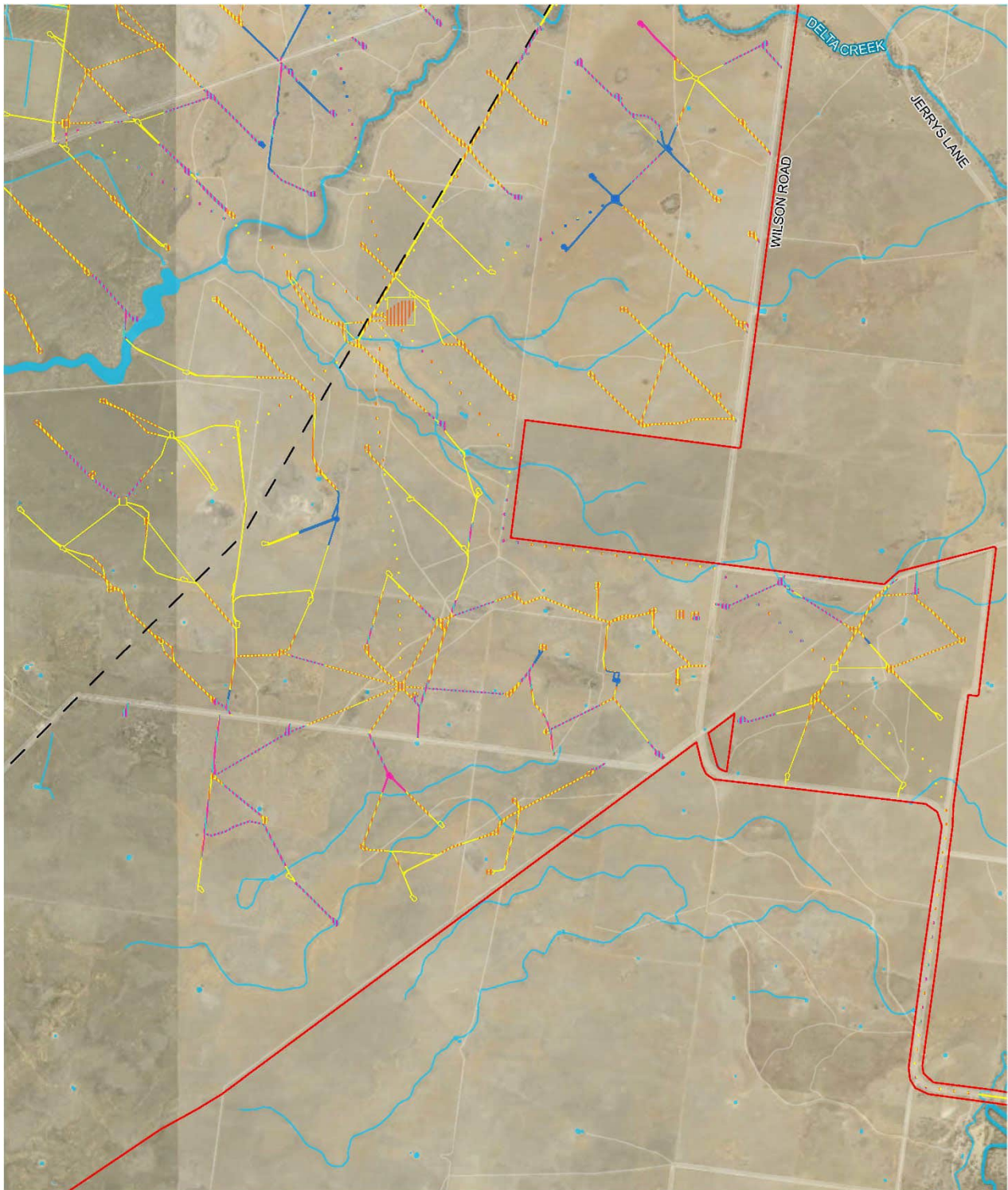


Figure 4-3. Threatened ecological communities (Page 2 of 4)

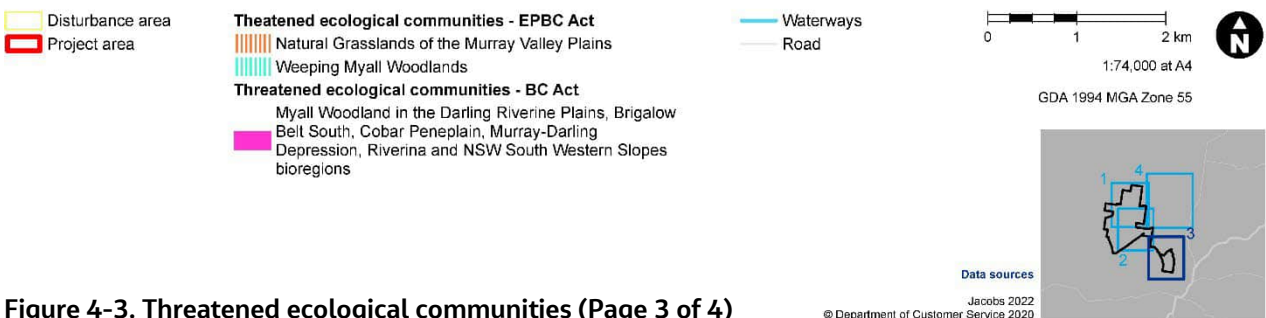
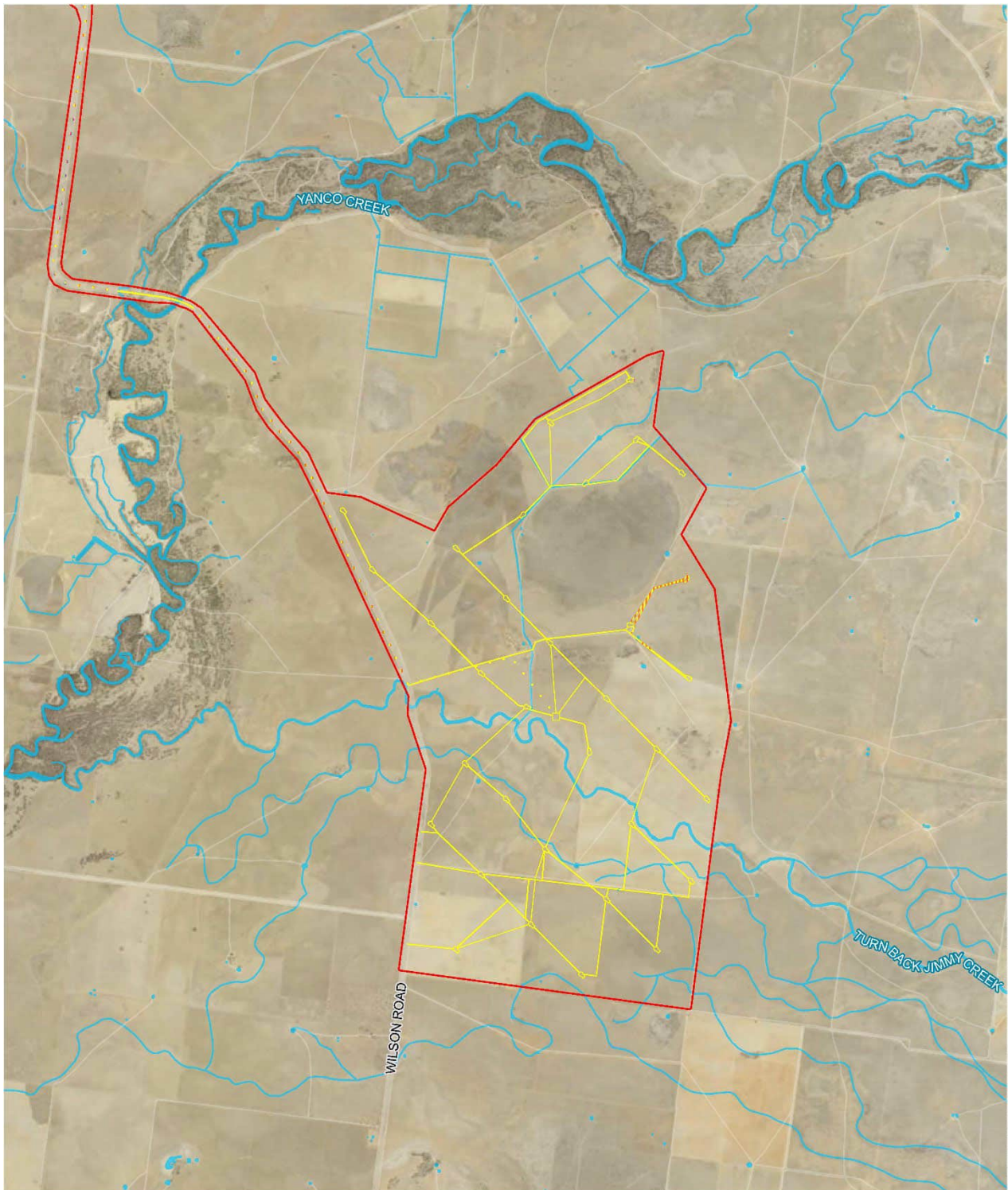


Figure 4-3. Threatened ecological communities (Page 3 of 4)

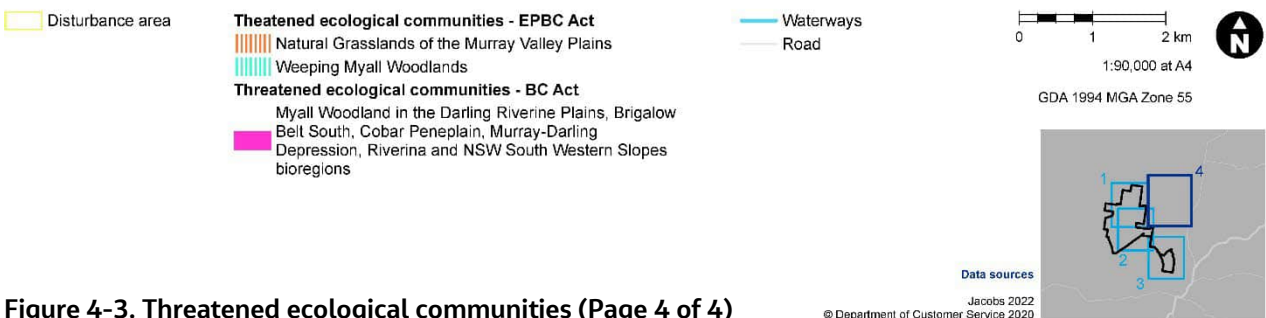
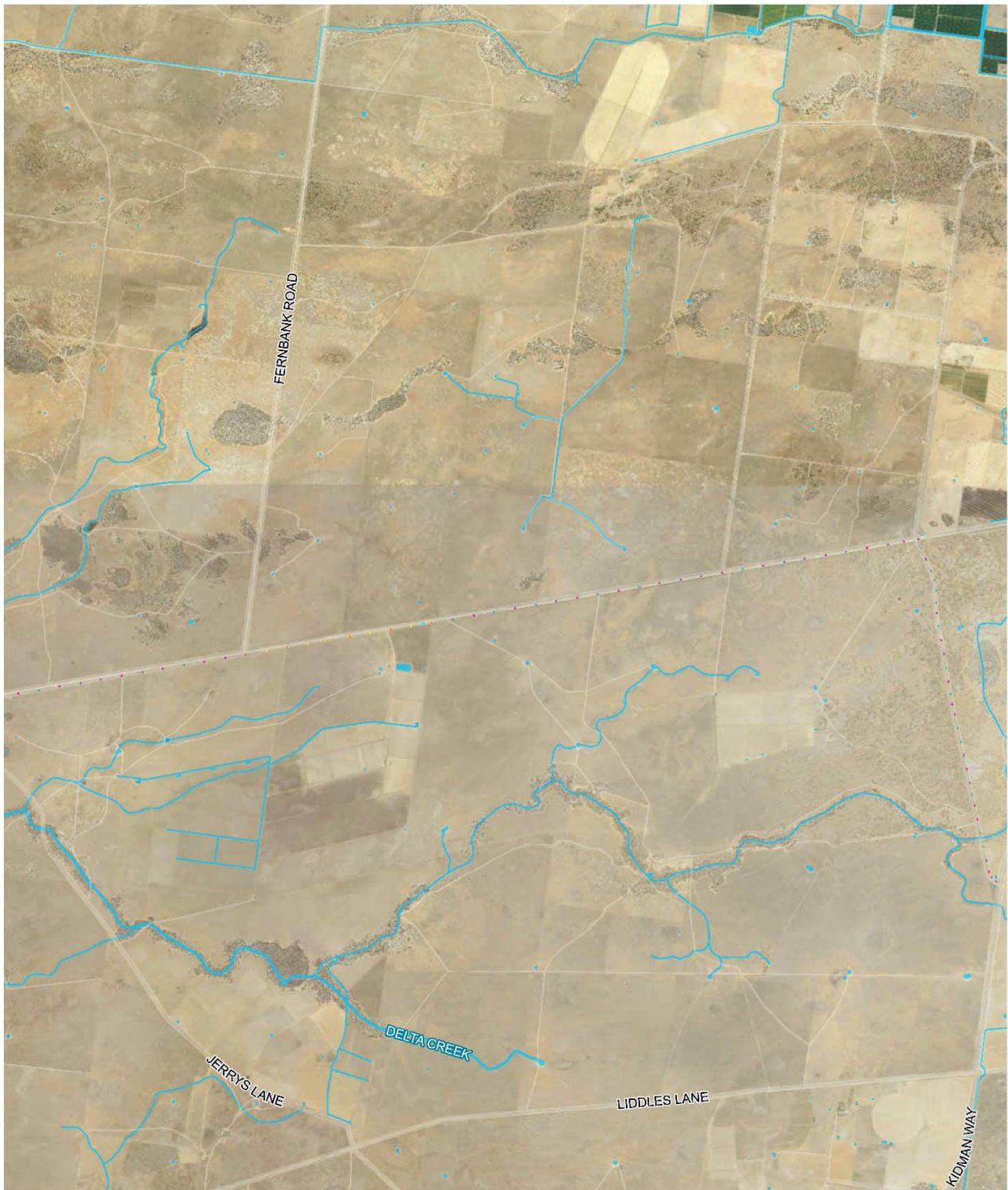


Figure 4-3. Threatened ecological communities (Page 4 of 4)

4.8 Groundwater dependent ecosystems

The level of water dependence of vegetation communities in the study area has been identified using the Atlas of GDE (Bureau of Meteorology (BOM), 2016) and the *Risk Assessment Guidelines for Groundwater Dependant Ecosystems* released by the NSW DPI (Kuginis et al., 2012). The level of groundwater dependence and potential for interaction has been identified for ecological communities in the study area and is listed in **Table 4-19**. Vegetation that is considered to have high potential for groundwater dependence are associated with the presence of River Red Gum, while the grassland communities and Black box dominated woodlands are considered to have low potential for groundwater dependence.

Table 4-19. Level of groundwater dependence of vegetation in Project area

Type of GDE ¹ PCT code	Supplied ecosystem type	GDE potential ²
Aquatic	Watercourse	Low potential GDE - from national assessment
	Floodplain water body	Low potential GDE - from national assessment
	Connector	Low potential GDE - from national assessment
Terrestrial	PCT 7: River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion	High potential GDE - from regional studies
	PCT 9: River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion	High potential GDE - from regional studies
	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)	Low potential GDE - from regional studies
	PCT 26: Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	Low potential GDE - from regional studies
	PCT 28: White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone	Low potential GDE - from regional studies
	PCT 17: Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Low potential GDE - from regional studies
	PCT 44: Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion	Low potential GDE - from regional studies
	PCT 45: Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Low potential GDE - from regional studies
	PCT 46: Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion	Low potential GDE - from regional studies
PCT 160: Nitre Goosefoot shrubland wetland on clays of the inland floodplains	Low potential GDE - from regional studies	

¹GDE type determined using Risk Assessment Guidelines for Groundwater Dependant Ecosystems released by the NSW DPI (Kuginis et al., 2012).²GDE potential as recognised by the Atlas of GDEs (Bureau of Meteorology, 2022).

4.9 Vegetation survey limitations

The field survey provides a limited view into the whole Project area which is comprised of about 33,000 hectares and was generally focused on vegetation and habitat within the study area and subject land.

The diversity of flora species recorded from this Project area should not be seen to be comprehensive, but rather an early indication of the species present at the time of the survey. A period of several seasons or years

is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (orchids or migratory birds) and require specific weather conditions for optimum detection.

Plant species composition and structure is variable within the Project area. The change in ground layer vegetation was observed during regular visits to study area in all seasons between 2021-2022. The timing of late winter surveys for the vegetation integrity assessment was considered best for detecting ground layer species at their optimal life cycle. This advice was endorsed by BCS and is recommended in the Approved Conservation Advice for Natural Grasslands of the Murray Valley Plains (TSSC, 2012).

The vegetation integrity assessment and assessment of Natural Grasslands of the Murray Valley Plains is heavily dependent on active groundlayer growing seasons and associated rainfall. The past three winter seasons have had above annual rainfall for grassland growing season in the Riverina region. Although late winter surveys were considered adequate for vegetation assessment, many native annual forb species were still emerging and had not yet flowered and many of these were identified as juveniles or young shoots. The results of the vegetation integrity and Natural Grasslands of the Murray Valley Plains assessments represent the floristic and structural condition of one survey event.

The conclusions of this report are therefore based upon available data and field survey and reflect the environmental conditions of the Project area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species for the purposes of a preliminary assessment of biodiversity constraints.

The vegetation within the Project area has been assigned to the most likely PCT as they are described in the BioNet Vegetation Classification database. In many cases there are no sharp boundaries defining the transition between PCTs, so the mapping provided in this BDAR is supported by on ground floristic surveys and observations of potential ecotones. Plant communities are naturally variable and the boundaries between different PCTs within the Project area overlap considerably with a gradual transition from one community to another.

A choice must be made to map and assign a PCT to an area in the Project area. As mapping necessitates that a hard boundary is drawn to separate PCTs. Boundaries of PCTs and vegetation zones have been mapped as best as possible based on observations made during the field survey and based on patterns observed on aerial photography. It is likely that the boundaries of PCTs and vegetation zones would change with time and in response to long-term variation in biophysical conditions on the Project area such as rainfall and surface drainage patterns.

During surveys in August 2022, there were numerous observations of *Acacia pendula* trees with severe dieback throughout the landscape, potentially associated with an unknown caterpillar. This dieback was not evident during previous vegetation surveys. The canopy dieback has likely affected the current values for structure in the vegetation integrity assessment.

5. Threatened species

5.1 Habitat assessment

5.1.1 Background research and key information sources

The Biodiversity Assessment Method Calculator (BAM-C) was used to derive an initial list of candidate species for this assessment by entering likely PCTs based on regional vegetation mapping. The results were also supplemented with database searches and review of the Threatened Biodiversity Data Collection (TBDC), to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the locality and Project area. The BioNet and Protected Matters Search Tool (PMST) databases, accessed via the Threatened Biodiversity Data Collection and the PMST, were searched for records of threatened species with a 10 km buffer of the Project area.

The following databases and information sources were reviewed to prepare a list of potential threatened species for survey:

- List of candidate species credit species from the BAM-C
- BioNet – Atlas of NSW Wildlife and Threatened Species Profile Database – searched November 2021
- Department of Agriculture, Water, and the Environment (DAWE) Protected Matters Search Tool (PMST) database – searched November 2021
- Important Area Maps – provided Plains-wanderer important area map as a shapefile by BCS in November 2021.

5.1.2 Threatened species habitat assessment

Once the assessment area had been assessed for landscape context, the PCTs present and vegetation integrity were known, the list of candidate threatened species for assessment was developed. As outlined in Section 5.2.1 of the BAM, the following criteria (a – f) were used to predict the threatened species that require assessment:

- a. the distribution of the species includes the IBRA subregion which the Project area is, in the opinion of the assessor, mostly located within, and
- b. the Project area is within any geographic constraints of the distribution of the species within the IBRA subregion, and
- c. the species is associated with any of the PCTs identified by the assessor under Chapter 5 as occurring within the Project area, and
- d. the native vegetation cover within an landscape buffer 500 m wide surrounding the boundary of the subject site as determined by the assessor in accordance with Subsection 4.3.2 of the BAM is equal to or greater than the minimum class that is required for the species (unless the development is, or is part of, a linear shaped development), and
- e. the patch size which the vegetation zone is part of, as identified in Subsection 5.3.2 of the BAM is equal to or greater than the minimum specified for that species, and
- f. the species is identified as an ecosystem or species credit species in the Threatened Biodiversity Data Collection.

A threatened species was predicted as requiring assessment if that species meets all the criteria a) to f) that are relevant to the species. The BAM-C was used to derive the list of candidate species based on criteria a) to f). If any one of the criteria a) to f) relevant to a species was not met, the Project area was considered not to be suitable habitat for the threatened species and no further assessment was undertaken for that species.

The results of the BioNet search and the Commonwealth PMST search were also used to inform development of the candidate species list to ensure those species that are only listed under the EPBC Act were considered appropriately.

The threatened species habitat suitability assessment is provided in the following sections and **Appendix E**.

5.1.3 Habitat types

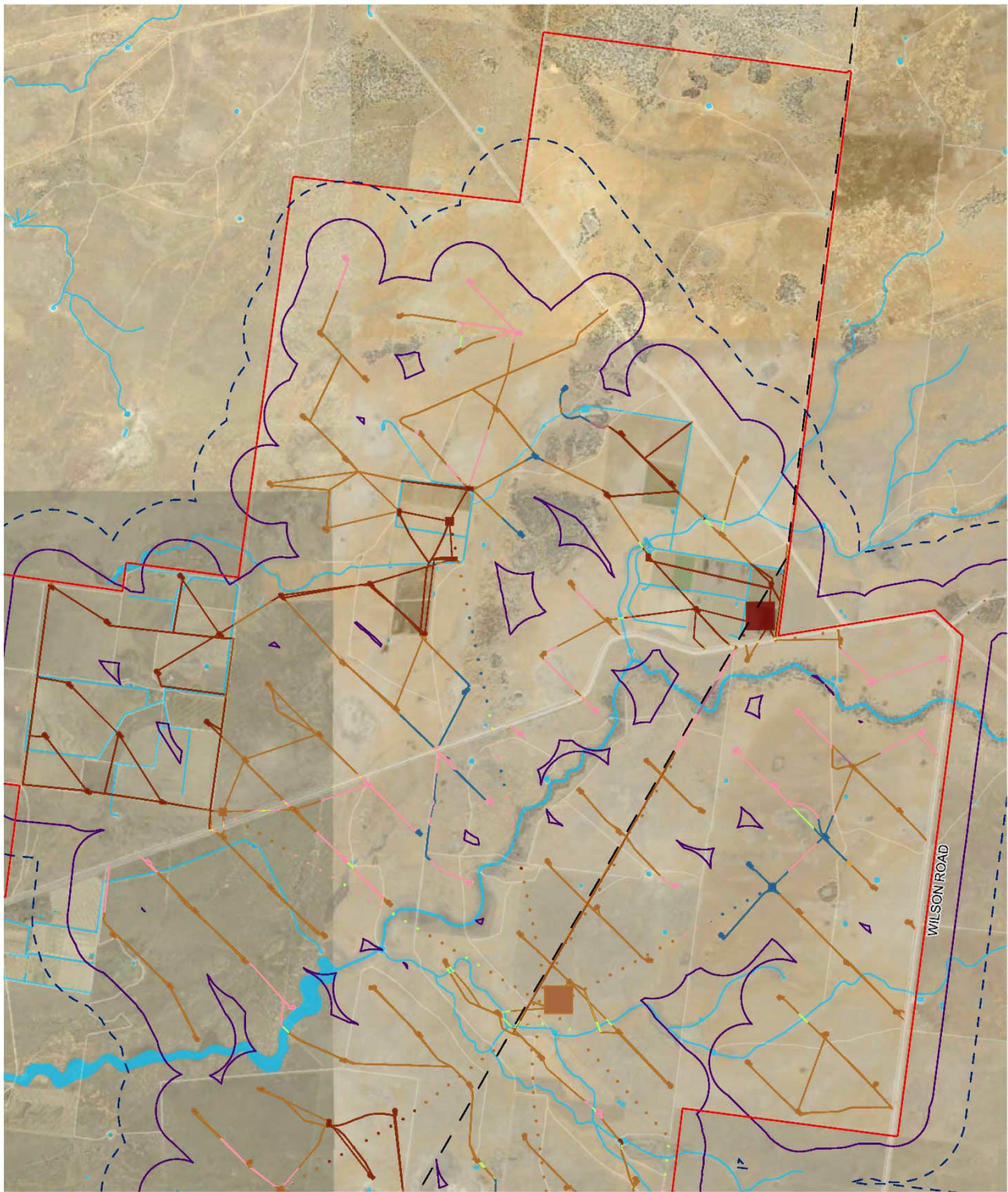
This section describes the process of mapping the habitat types within the landscape buffer and subject land for assessing habitat suitability for threatened species as outlined in Section 5 of the BAM.

The mapping exercise used the native vegetation cover map to refine broad scale habitat types based on vegetation class within the landscape buffer. A landscape assessment approach was applied to the survey methodology to inform the bird utilisation survey, potential nest tree locations in woodland patches within habitat buffers, landscape habitat assessment of Southern Bell Frog and aided in the analysis of bird movements in the landscape to assess prescribed impacts.

The broad habitat types identified within the landscape buffer, are outlined in **Table 5-1**, shows the location of the habitat types within the Project area and broader study area and is illustrated in **Figure 5-1**. Nine vegetation classes (Keith, 2004) recognised as nine broad habitat types were identified within the Project area outlined in **Table 5-1**.

Table 5-1. Extent of broad habitat types within the study area and landscape buffer

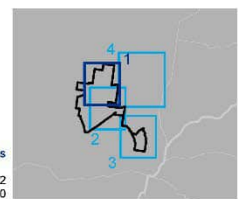
Vegetation formation (Keith, 2004)	Vegetation class (Keith, 2004) / habitat type	Study area (ha)	Extent in landscape buffer (ha)
Forested Wetlands	Inland Riverine Forests	3.74	281
Freshwater Wetlands	Inland Floodplain Shrublands	15.70	1,439
Freshwater Wetlands	Inland Floodplain Swamps	0	637
Semi-arid Woodlands (Grassy sub-formation)	Riverine Plain Woodlands	140.76	5,189
Semi-arid Woodlands (Grassy sub-formation)	Inland Floodplain Woodlands	4.54	755
Semi-arid Woodlands (Shrubby sub-formation)	Riverine Sandhill Woodlands	34.58	798
Grasslands	Riverine Plain Grasslands	494.84	21,562
Arid Shrublands (Chenopod sub-formation)	Riverine Chenopod Shrublands	0	25
Grassy Woodlands	Floodplain Transition Woodlands	0	4



<ul style="list-style-type: none"> Disturbance area Project area Subject land Landscape buffer 500m 	<p>Habitat types (vegetation classes)</p> <ul style="list-style-type: none"> Inland Floodplain Shrublands Inland Floodplain Woodlands Inland Riverine Forests Riverine Plain Grasslands Riverine Plain Woodlands Riverine Sandhill Woodlands Non-native vegetation 	<ul style="list-style-type: none"> Waterways Existing 132kV transmission line 	<p>0 1 2 km</p> <p>1:74,000 at A4</p> <p>GDA 1994 MGA Zone 55</p>
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Figure 5-1 Habitat types and habitat features within the landscape buffer
(Page 1 of 4)

Data sources
Jacobs 2022
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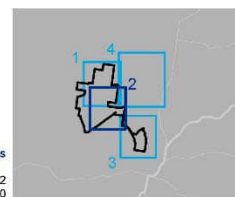
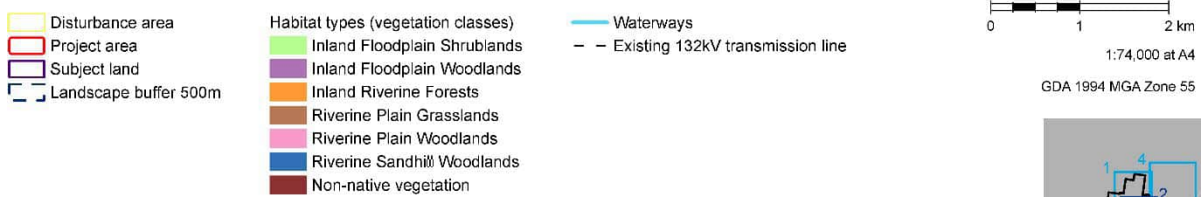
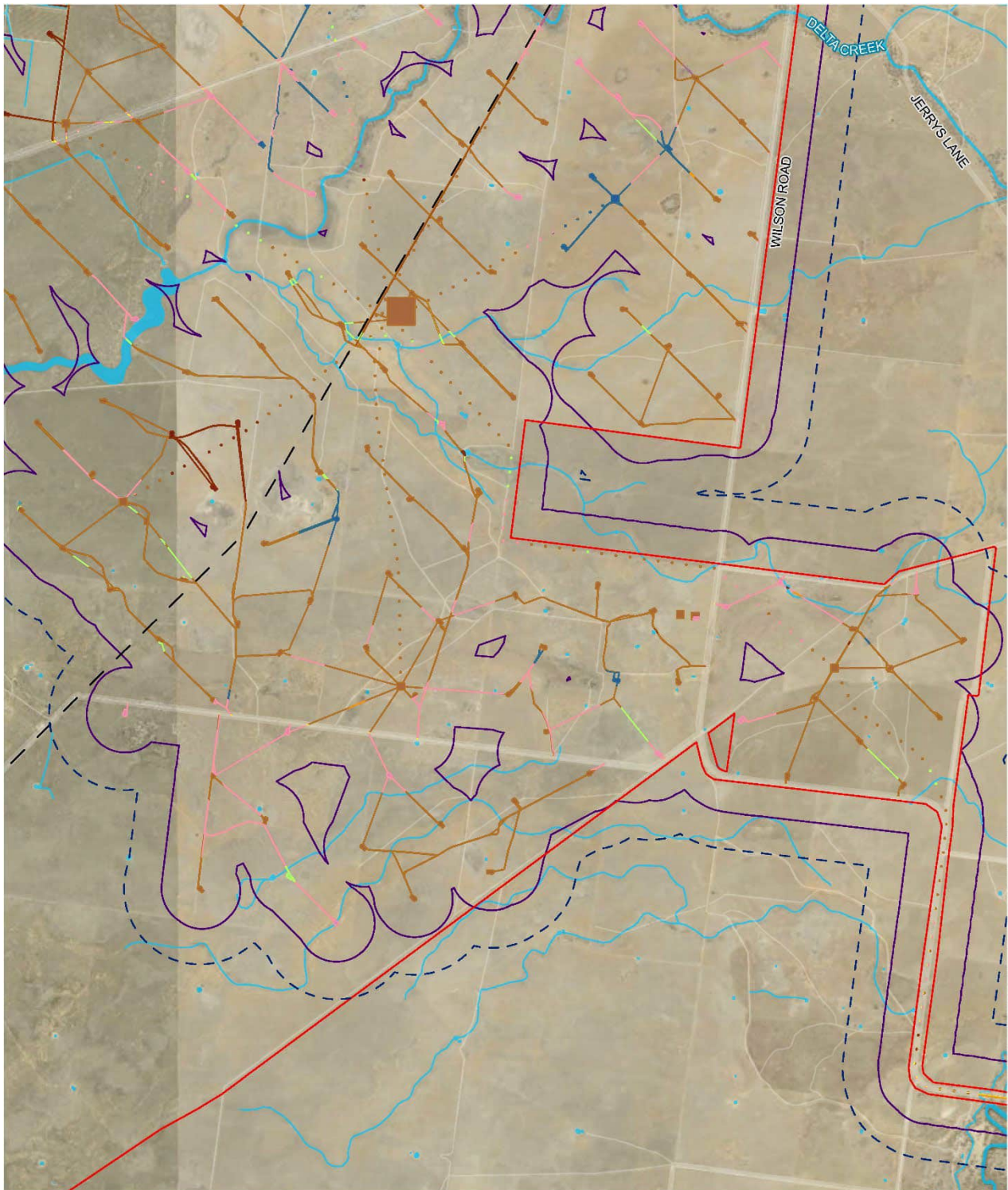


Figure 5-1 Habitat types and habitat features within the landscape buffer
(Page 2 of 4)

Data sources
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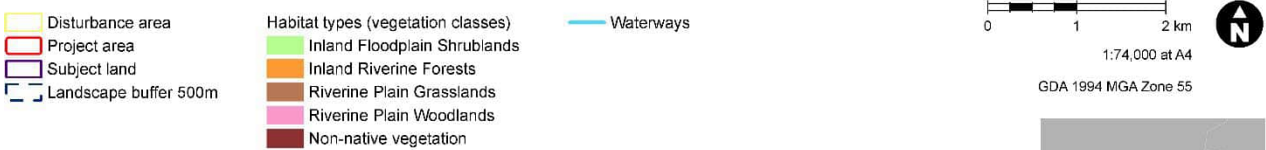
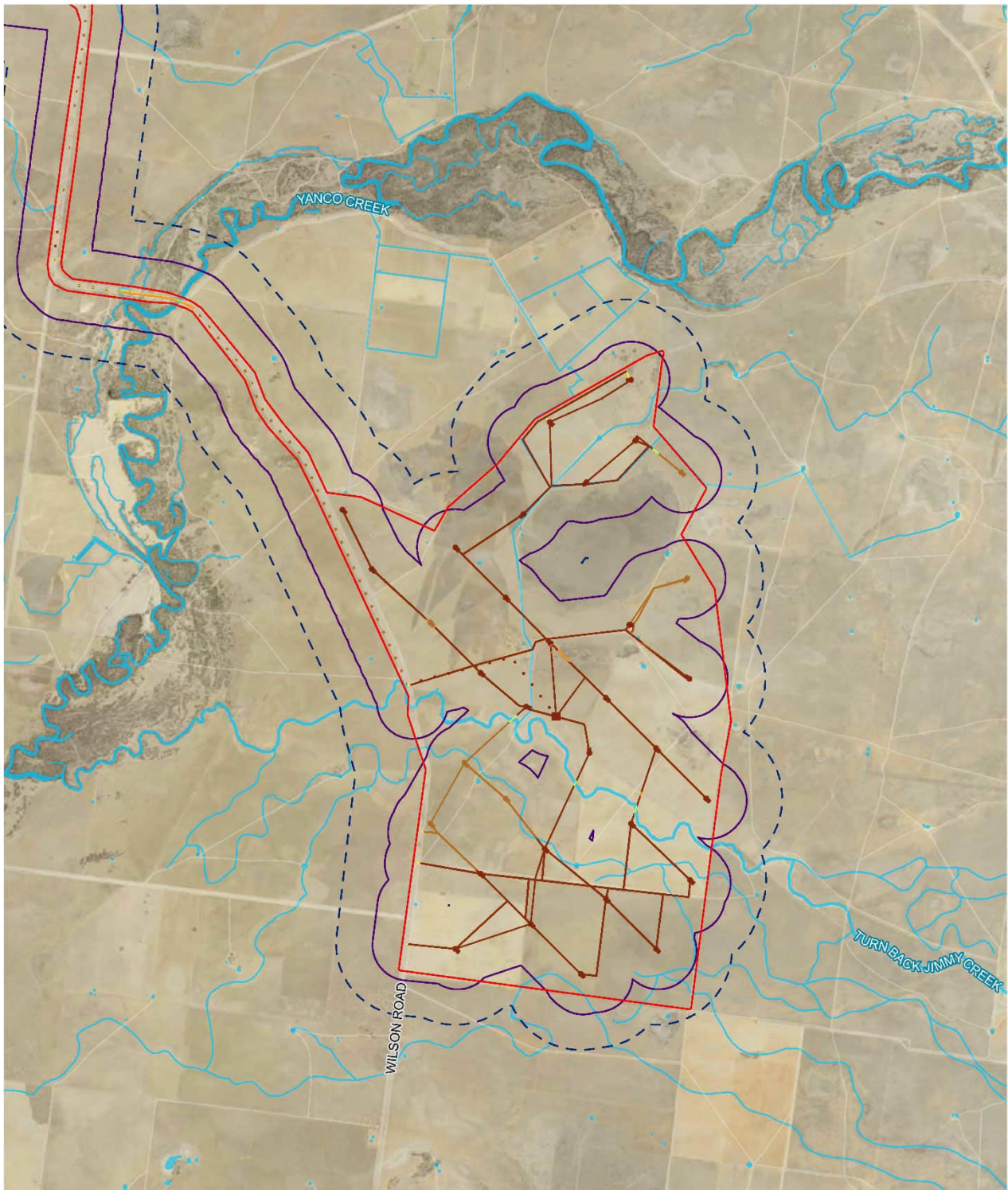


Figure 5-1 Habitat types and habitat features within the landscape buffer
(Page 3 of 4)

Data sources
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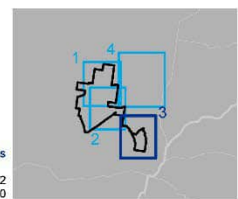




Figure 5-1 Habitat types and habitat features within the landscape buffer
 (Page 4 of 4)

Data sources
 Jacobs 2022
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5.1.4 Ecosystem credit species assessment

Ecosystem credit species are those threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which a targeted survey has a low probability of detection. Ecosystem credit threatened species have been assessed in conjunction with information about the landscape buffer context (Section 3 of the BAM), PCTs and vegetation integrity attributes (Chapter 4 of the BAM), and data from the TBDC (Section 5 of the BAM).

The BAM-C was used to generate a list of the predicted threatened species that met the criteria outlined in Section 5.2.1.2 of the BAM. The results of the BioNet search (DPE, 2021) and the federal Department of the Agriculture, Water and the Environment's PMST (DAWE, 2021) were also used to inform development of the species list.

The initial list of predicted ecosystem credit species identified by the BAM-C is provided in **Table 5-2**. full threatened species habitat suitability assessment is provided in **Appendix F**. Once the initial list of predicted ecosystem credit species was generated, the geographic limitations of each species (where applicable) were examined to see if they were met. Geographic limitations usually relate to altitude or topographic features and different geographic limitations can be described for different IBRA bioregion and subregions across a species' distribution. Where the assessment area is not within the geographic limitation described for a species, the species was removed from the predicted list of threatened species and no further assessment was undertaken.

In accordance with Paragraphs 5.2.2.1 – 5.2.2.4 (Step 2) of the BAM, an onsite assessment was undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to occur within the subject land. Some species do not have any identified habitat constraints, in which case this step was not undertaken. The justification for including or excluding ecosystem credit species from the assessment is provided in **Table 5-2**. The sensitivity to gain class is also identified, which considers the ability of a species to respond to improvements in habitat condition at an offset site.

Under the BAM, targeted survey is not required for ecosystem credit species. However, in some circumstances, the Threatened Biodiversity Data Collection may identify that a species requires assessment for ecosystem credits and species credits (a dual credit species). This occurs where part of the habitat is assessed as a species credit (e.g. breeding habitat, or mapped locations identified as an important area that is used by a species). The remaining part of the habitat is assessed as an ecosystem credit (e.g. foraging habitat, unmapped locations used by a species).

Table 5-2. Summary of predicted ecosystem credit species that were assessed

Species name	Common name	EPBC Act	BC Act	Habitat constraints and geographic limitations	Justification for inclusion / exclusion	Sensitivity to gain class
Birds						
<i>Anseranas semipalmata</i>	Magpie Goose	-	V	None	Included for all associated zones.	Moderate
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	None	Included for all associated zones.	High
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	V	None	Included for all associated zones.	Moderate
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	<u>Habitat constraints:</u> <ul style="list-style-type: none"> ▪ Waterbodies ▪ Brackish or freshwater wetlands 	Included for all associated zones.	Moderate
<i>Certhionyx variegatus</i>	Pied Honeyeater	-	V	None	Included for all associated zones.	Moderate

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat constraints and geographic limitations	Justification for inclusion / exclusion	Sensitivity to gain class
<i>Circus assimilis</i>	Spotted Harrier	-	V	None	Included for all associated zones.	High
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V	None	Included for all associated zones.	Moderate
<i>Epthianura albifrons</i>	White-fronted Chat	-	V	None	Included for all associated zones.	High
<i>Falco hypoleucos</i>	Grey Falcon	V	E	None	Included for all associated zones.	Moderate
<i>Falco subniger</i>	Black Falcon	-	V	None	Included for all associated zones.	High
<i>Grantiella picta</i>	Painted Honeyeater	V	V	<u>Habitat constraints:</u> Mistletoes present at a density of greater than five mistletoes per hectare	Included for all associated zones.	Moderate
<i>Grus rubicunda</i>	Brolga	-	V	None	Included for all associated zones.	Moderate
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	V	<u>Habitat constraints:</u> Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	Included for all associated zones.	High
<i>Hieraaetus morphnoides</i>	Little Eagle	-	V	None	Included for all associated zones.	Moderate
<i>Hirundapus caudacutus</i>	White-throated Needletail	V	-	None	Included for all associated zones.	High
<i>Lathamus discolor</i>	Swift Parrot	CE	E	<u>Habitat constraints:</u> As per mapped areas	Included for all associated zones.	Moderate
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	-	V	None	Included for all associated zones.	Moderate
<i>Kite Lophoictinia isura</i>	Square-tailed Kite	-	V	None	Included for all associated zones.	Moderate
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	-	V	None	Included for all associated zones.	Moderate
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	-	V	None	Included for all associated zones.	Moderate
<i>Ninox connivens</i>	Barking Owl	-	V	None	Included for all associated zones.	High
<i>Oxyura australis</i>	Blue-billed Duck	-	V	None	Included for all associated zones.	Moderate

Species name	Common name	EPBC Act	BC Act	Habitat constraints and geographic limitations	Justification for inclusion / exclusion	Sensitivity to gain class
<i>Pachycephala inornata</i>	Gilbert's Whistler	-	V	None	Included for all associated zones.	Moderate
<i>Pedionomus torquatus</i>	Plains-wanderer	CE	E	<u>None</u>	Included for all associated zones.	High
<i>Petroica boodang</i>	Scarlet Robin	-	V	None	Included for all associated zones.	Moderate
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot (eastern subspecies)	V	E	Within 10 km of the junction of the Murray River	Excluded	Moderate
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	None	Included for all associated zones.	Moderate
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	-	V	None	Included for all associated zones.	Moderate
<i>Pyrholaemus brunneus</i>	Redthroat	-	V	None	Included for all associated zones.	Moderate
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	None	Included for all associated zones.	Moderate
<i>Stagonopleura guttata</i>	Diamond Firetail	-	V	None	Included for all associated zones.	Moderate
<i>Stictonetta naevosa</i>	Freckled Duck	-	V	None	Included for all associated zones.	Moderate
<i>Tyto longimembris</i>	Eastern Grass Owl	-	V	None	Included for all associated zones.	Moderate
<i>Tyto novaehollandiae</i>	Masked Owl	-	V	None	Included for all associated zones.	High
Mammals						
<i>Chalinolobus picatus</i>	Little Pied Bat	-	V	None	Included for all associated zones.	High
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	V	None	Included for all associated zones.	High
<i>Vespadelus baverstocki</i>	Inland Forest Bat	-	V	None	Included for all associated zones.	High

5.1.5 Species-credit species assessment

Threatened species for which the likelihood of occurrence of the species (or elements of suitable habitat for the species) cannot be confidently predicted by vegetation surrogates and landscape features, and which can be reliably detected by survey, are identified in the TBDC as species-credit species.

Habitat suitability is identified as the degree to which the habitat needs of threatened species are present at a particular site. Species-credit species have been assessed in conjunction with information collected about the site context of the subject land (Section 3.2 of the BAM), on PCTs and vegetation integrity attributes in (Section 4 of the BAM), and data obtained from the Threatened Biodiversity Data Collection (Section 5 of the BAM).

The BAM defines species-credit species, for which are identified in the Threatened Biodiversity Data Collection, as those threatened species:

- For which the likelihood of occurrence of the species, or elements of suitable habitat for the species, cannot be confidently predicted by vegetation surrogates and landscape features
- Which can be reliably detected by survey.

Based on the assessment of habitat in the subject land, and review of databases and published information, the species-credit species as outlined in **Table 5-3** are considered 'candidate species' for the assessment, and these species are subject to habitat assessment to determine a list of target species for survey. The full threatened species habitat suitability assessment is provided in **Appendix F**.

Table 5-3. Candidate species-credit species identified by the BAM-C

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class
Flora				
<i>Austrostipa wakoolica</i>	A spear-grass	E	E	Moderate
<i>Brachyscome muelleroides</i>	Claypan Daisy	V	V	High
<i>Brachyscome papillosa</i>	Mossgiel Daisy	V	V	High
<i>Caladenia arenaria</i>	Sand-hill Spider Orchid	E	E	Moderate
<i>Convolvulus tedmoorei</i>	Bindweed	-	E	High
<i>Cullen parvum</i>	Small Scurf-pea	-	E	High
<i>Eucalyptus leucoxydon</i> subsp. <i>pruinosa</i>	Yellow Gum	-	V	High
<i>Lepidium monoplocoides</i>	Winged Peppergrass	E	E	High
<i>Leptorhynchus orientalis</i>	Lanky Buttons	-	E	Moderate
<i>Maireana cheelii</i>	Chariot Wheels	V	V	High
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	E	High
<i>Sclerolaena napiformis</i>	Turnip Copperburr	E	E	High
<i>Solanum karsense</i>	Menindee Nightshade	V	V	Moderate
<i>Swainsona plagiotropis</i>	Red Darling Pea	V	V	High
<i>Swainsona murrayana</i>	Slender Darling Pea	V	V	High
<i>Swainsona sericea</i>	Silky Swainson-pea	-	V	High
Birds				
<i>Anthochaera phrygia</i>	Regent Honeyeater (breeding)	CE	CE	High
<i>Ardeotis australis</i>	Australian Bustard	-	E	High
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	E	High
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE	E	High
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (breeding)	-	V	High
<i>Hieraaetus morphnoides</i>	Little Eagle (breeding)	-	V	Moderate
<i>Lathamus discolor</i>	Swift Parrot (breeding)	CE	E	Moderate
<i>Limosa limosa</i>	Black-tailed Godwit	M	V	High
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo (breeding)	-	V	High
<i>Lophoictinia isura</i>	Square-tailed Kite (breeding)	-	V	Moderate
<i>Ninox connivens</i>	Barking Owl (breeding)	-	V	High
<i>Pedionomus torquatus</i>	Plains-wanderer	CE	E	High

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot (eastern subspecies)	V	E	High
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	High
<i>Tyto novaehollandiae</i>	Masked Owl (breeding)	-	V	High
Mammals				
<i>Myotis macropus</i>	Southern Myotis	-	V	High
<i>Phascolarctos cinereus</i>	Koala	E	E	High
Amphibians				
<i>Litoria raniformis</i>	Southern Bell Frog	V	E	Moderate

5.1.6 Identifying geographic and habitat constraints

Once the initial list of predicted candidate species-credit species shown was generated, this list was examined to determine if species should be removed from the list because the species is considered vagrant, out of geographic range or the habitat or microhabitat features are not present within the subject land.

At this stage, the geographic limitations of each species (where applicable) were examined to see if they were met by the Project area location. Where the Project area is not within the geographic limitation described for a species, the species was removed from the candidate list of threatened species and no further assessment was undertaken.

In accordance with Paragraphs 5.2.1 – 5.2.4 (Step 2) of the BAM, an onsite assessment was undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to occur within the subject land. Some species do not have any identified habitat constraints, in which case this step was not undertaken.

A targeted survey was conducted to identify, map, and classify all hollow-bearing trees within the subject land. Where a hollow-bearing tree was noted this was mapped and the characteristics of the hollow recorded (i.e. height above ground and hollow-size).

The species that were included or excluded based on habitat constraints or geographic limitations are outlined below in **Table 5-4**.

Table 5-4. Complete list of candidate species, showing assessment for those species with listed geographic or habitat constraints

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Habitat constraint	Geographic limitation	Assessment
Flora							
<i>Austrostipa wakoolica</i>	A spear-grass	E	E	Moderate	Alluvial plains and plains	None	Included – Habitat constraint present within the subject land.
<i>Brachyscome muelleroides</i>	Claypan Daisy	V	V	High	Floodplains on grey-brown or red-brown clays and claypans. Wetland-grassland communities on grey-brown or red-brown clays and claypans.	None	Included
<i>Brachyscome papillosa</i>	Mossgiel Daisy	V	V	High	None	None	Included
<i>Caladenia arenaria</i>	Sand-hill Spider Orchid	E	E	Moderate	None	East of Jerilderie	Included – Habitat constraint present within the subject land.
<i>Convolvulus tedmoorei</i>	Bindweed	-	E	High	None	None	Included
<i>Cullen parvum</i>	Small Scurf-pea	-	E	High	None	Hay Plains and to east	Included – Habitat constraint present within the subject land.
<i>Eucalyptus leucoxydon subsp. pruinosa</i>	Yellow Gum	-	V	High	None	None	Included
<i>Lepidium monoplocoides</i>	Winged Peppergrass	E	E	High	None	None	Included
<i>Leptorhynchos orientalis</i>	Lanky Buttons	-	E	Moderate	None	None	Included
<i>Maireana cheelii</i>	Chariot Wheels	V	V	High	Heavy grey clay soils and claypans or shallow depressions	None	Included – Habitat constraint present within the subject land.
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	E	High	None	East of Deniliquin	Included
<i>Sclerolaena napiformis</i>	Turnip Copperburr	E	E	High	None	None	Included
<i>Solanum karsense</i>	Menindee Nightshade	V	V	Moderate	None	West of Maude	Excluded – not within geographic limitation
<i>Swainsona plagiotropis</i>	Red Darling Pea	V	V	High	None	Hay Plain	Included
<i>Swainsona murrayana</i>	Slender Darling Pea	V	V	High	None	None	Included

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Habitat constraint	Geographic limitation	Assessment
<i>Swainsona sericea</i>	Silky Swainson-pea	-	V	High	None	None	Included
Birds							
<i>Anthochaera phrygia</i>	Regent Honeyeater (breeding)	CE	CE	High	As per mapped areas	None	Excluded – subject land does not intercept mapped areas.
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	E	High	Fallen/standing dead timber including logs	None	Included – Habitat constraint present within the subject land.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (breeding)	-	V	High	Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines.	None	Included – Habitat constraint present within the subject land.
<i>Hieraaetus morphnoides</i>	Little Eagle (breeding)	-	V	Moderate	Nest trees - live (occasionally dead) large old trees within vegetation.	None	Included – Habitat constraint present within the subject land.
<i>Lathamus discolor</i>	Swift Parrot (breeding)	CE	E	Moderate	As per mapped areas	None	Excluded – subject land does not intercept mapped areas.
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo (breeding)	-	V	High	Living or dead tree with hollows greater than 10cm diameter	None	Included – Habitat constraint present within the subject land.
<i>Lophoictinia isura</i>	Square-tailed Kite (breeding)	-	V	Moderate	Nest trees	None	Included – Habitat constraint present within the subject land.
<i>Ninox connivens</i>	Barking Owl (breeding)	-	V	High	Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	None	Included – Habitat constraint present within the subject land.
<i>Pedionomus torquatus</i>	Plains-wanderer	CE	E	High	As per mapped areas	None	Included – Mapped areas occur within the subject land.
<i>Polytelis anthopeplus monarchoides</i>	Regent Parrot (eastern subspecies)	V	E	High	Living or dead <i>E. camaldulensis</i> with hollows greater than 5 cm diameter, greater than 5 m above the ground OR trees with DBH of greater than 40cm,	Within 10 km of the junction of the Murray River	Excluded – Project area outside range for this species.

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Habitat constraint	Geographic limitation	Assessment
					within 1 km of watercourses or billabongs. Trees can be isolated but within 20 km of mallee.		
<i>Polytelis swainsonii</i>	Superb Parrot (breeding)	V	V	High	Living or dead E. blakelyi, E. melliodora, E. albens, E. camaldulensis, E. microcarpa, E. polyanthemos, E. mannifera, E. intertexta with hollows greater than 5cm diameter; greater than 4m above ground or trees with a DBH of greater than 30cm.	None	Included – Habitat constraint present within the subject land.
<i>Tyto novaehollandiae</i>	Masked Owl (breeding)	-	V	High	Living or dead trees with hollows greater than 20cm diameter.	None	Included – Habitat constraint present within the subject land.
Mammals							
<i>Myotis macropus</i>	Southern Myotis	-	V	High	Within 200 m of riparian zone. Bridges, caves or artificial structures within 200 m of riparian zone. This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site.	None	Included – Habitat constraint present within the subject land.
<i>Phascolarctos cinereus</i>	Koala	E	E	High	Presence of koala use trees - refer to Survey Comments.	None	Excluded - No direct impact on foraging habitat for Koala.

5.1.7 Candidate species removed from the assessment

In accordance with Paragraphs 5.2.3.1 – 5.2.3.4 (Step 3) of the BAM, a field assessment was undertaken to determine whether the habitats within the subject land were substantially degraded to the point that a candidate species is unlikely to utilise the Project area (or specific vegetation zones). There were a number of threatened species returned from the BAM-C that are species-credit species if breeding habitat would be impacted (i.e. dual credit species). The Project area does not contain breeding habitat for any of these identified species as follows:

- *Solanum karsense* – Project area not west of Maude, NSW
- Regent Honeyeater – outside important area mapping
- Regent Parrot (eastern subspecies) – Project area is greater than 10 km of the junction of the Murray River
- Swift Parrot – outside important area mapping
- Koala – Although River Red Gum and Black Box trees within the disturbance footprint, actual direct impacts will be avoided. Cabling traverses woodland areas and only understorey and ground layer are likely to be disturbed but no direct impact to trees is expected. There's potential for trimming and lopping of branches for the transmission line crossing over the Yanco Creek, but these impacts will be mitigated. As a result, Koala has been excluded from this assessment.

5.1.8 Candidate species added to the assessment

No threatened species-credit species were added to the BAM-C.

5.1.9 Final list of candidate species for further assessment

The list of species retained for further assessment is shown in Table 5-5.

Table 5-5. Final list of candidate species for further assessment

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Potential SAII*	Associated habitat in subject land (TBDC)
Flora						
<i>Austrostipa wakoolica</i>	A spear-grass	E	E	Moderate	No	PCT 17, PCT 26 and PCT 28
<i>Brachyscome muelleroides</i>	Claypan Daisy	V	V	High	Yes	PCT 44, PCT 45 and PCT 46
<i>Brachyscome papillosa</i>	Mossgiel Daisy	V	V	High	No	PCT 13, PCT 16, PCT 24, PCT 44, PCT 45, PCT 46, PCT 160 and PCT 164
<i>Convolvulus tedmoorei</i>	Bindweed	-	E	High	No	PCT 17, PCT 24, PCT 26, PCT 44, PCT 45, PCT 46, PCT 160 and PCT 164
<i>Caladenia arenaria</i>	Sand-hill Spider Orchid	E	E	Moderate	No	PCT 28
<i>Cullen parvum</i>	Small Scurf-pea	-	E	High	No	PCT 9 and PCT 44
<i>Eucalyptus leucoxylon</i> subsp. <i>pruinosa</i>	Yellow Gum	-	V	High	No	PCT 11, PCT 13, PCT 16 and PCT 19
<i>Lepidium monoplacoides</i>	Winged Peppergrass	E	E	High	No	PCT 13, PCT 16, PCT 24, PCT 26, PCT 45, PCT 46 and PCT 160
<i>Leptorhynchus orientalis</i>	Lanky Buttons	-	E	Moderate	No	PCT 24, PCT 26, PCT 44, PCT 45 and PCT 46

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Potential SAII*	Associated habitat in subject land (TBDC)
<i>Maireana cheelii</i>	Chariot Wheels	V	V	High	No	PCT 26, PCT 44, PCT 46 and PCT 164
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	E	High	No	PCT 9, PCT 12, PCT 13, PCT 26 and PCT 45
<i>Sclerolaena napiformis</i>	Turnip Copperburr	E	E	High	No	PCT 26, PCT 44 and PCT 46
<i>Swainsona plagiotropis</i>	Red Darling Pea	V	V	High	No	PCT 26, PCT 44, PCT 45 and PCT 46
<i>Swainsona murrayana</i>	Slender Darling Pea	V	V	High	No	PCT 16, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46 and PCT 164
<i>Swainsona sericea</i>	Silky Swainson-pea	-	V	High	No	PCT 26, PCT 28, PCT 44, PCT 45 and PCT 46
Birds						
<i>Ardeotis australis</i>	Australian Bustard	-	E	High	No	PCT 11, PCT 12, PCT 16, PCT 24, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46, PCT 160 and PCT 164
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	E	High	No	PCT 9, PCT 11, PCT 13, PCT 16, PCT 26 and PCT 28
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (breeding)	-	V	High	No	PCT 9, PCT 11, PCT 12, PCT 13, PCT 16, PCT 17, PCT 19, PCT 24, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46, PCT 160 and PCT 164.
<i>Hieraaetus morphnoides</i>	Little Eagle (breeding)	-	V	Moderate	No	PCT 9, PCT 11, PCT 12, PCT 13, PCT 16, PCT 17, PCT 19, PCT 24, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46, PCT 160 and PCT 164.
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo (breeding)	-	V	High	No	PCT 9, PCT 11, PCT 13, PCT 16, PCT 19, PCT 26, PCT 28 and PCT 45.
<i>Lophoictinia isura</i>	Square-tailed Kite (breeding)	-	V	Moderate	No	PCT 9, PCT 11, PCT 13, PCT 16, PCT 26, PCT 28 and PCT 45.
<i>Ninox connivens</i>	Barking Owl (breeding)	-	V	High	No	PCT 9, PCT 11, PCT 13 and PCT 16.
<i>Pedionomus torquatus</i>	Plains-wanderer	CE	E	High	Yes	PCT 44 and PCT 46.
<i>Polytelis swainsonii</i>	Superb Parrot (breeding)	V	V	High	No	PCT 9, PCT 11, PCT 13, PCT 26, PCT 28, PCT 45 and PCT 46.
<i>Tyto novaehollandiae</i>	Masked Owl (breeding)	-	V	High	No	PCT 9, PCT 11, PCT 13, PCT 24 and PCT 26.
Mammals						
<i>Myotis macropus</i>	Southern Myotis	-	V	High	No	PCT 9 and PCT 11.

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	Potential SAIL*	Associated habitat in subject land (TBDC)
Amphibians						
<i>Litoria raniformis</i>	Southern Bell Frog	V	E	Moderate	No	PCT 11, PCT 12, PCT 13, PCT 17 and PCT 24.

Note: SAIL* = Serious and Irreversible Impact Entity as identified by the BAM-C.

5.2 Targeted species survey methods

After the candidate species list had been developed (see **Section 7.1**), targeted threatened species surveys were undertaken. The surveys undertaken for candidate threatened species of flora and fauna are outlined in the following sections.

5.2.1 Threatened plant surveys

The BAM-C identified PCT associated threatened flora to inform the candidate species list that requires seasonal targeted searches to be undertaken at the time of flowering to maximise detection. After the PCTs and finer scale habitats within the study area had been identified, and the threatened species habitat assessment had been completed, five targeted flora survey events were undertaken by the Jacobs ecology team, including:

- 21-30 September 2021
- 15-20 November 2021
- 23-27 November 2021
- 17 January 2022
- 5-9 September 2022.

The threatened flora surveys were guided by the methodology and effort described in *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method* (Department of Planning, Industry and Environment, 2020). The application of the described guidelines provides an indication of the effort that is likely required. Although the Project area is very large (i.e. 33,000 ha), the survey design for large areas of suitable habitat was not adopted because the study area is comprised of a linear network of narrow access tracks and cabling with WTGs spaced across the Project area.

The method adopted was walked parallel search transects (approximately 10 m spacing between observers). Information from the BioNet Threatened Biodiversity Data Collection (TBDC) was used to determine the appropriate survey timing for target species. Survey timing was also followed up with advice from BCS and threatened species officers.

Prior to each survey event, the Jerilderie Nature Reserve was visited to confirm flowering status for *Swainsona murrayana*, *Swainsona plagiotropis* and *Swainsona sericea* as each species is known to occur in the reserve. This approach was used to adequately cover the areas of suitable habitat at the right time of year to detect target species.

Targeted surveys were carried out over 15 days between 21-30 September 2021 (team of eight ecologists) and 5-9 September 2022 (team of six ecologists) and included the following species (described with their designated survey period as shown in the TBDC):

- *Brachyscome muelleroides* – September -November
- *Brachyscome papillosa* - September -November
- *Caladenia arenaria* – September
- *Convolvulus tedmoorei* – June- September
- *Leptorhynchos orientalis* – September -November
- *Maireana cheelii* – September -December
- *Sclerolaena napiformis* – September -December
- *Swainsona murrayana* – September

- *Swainsona plagiotropis* – September
- *Swainsona sericea* – September -November.

Targeted surveys were carried out over 11 days (team of eight ecologists) between 15-20 and 23-27 November 2021 and included the following species (described with their designated survey period as shown in the TBDC):

- *Austrostipa wakoolica* – October-December
- *Brachyscome muelleroides* – September-November
- *Brachyscome papillosa* – September-November
- *Lepidium monoplacoides* – November-February
- *Maireana cheelii* – September-December
- *Pilularia novae-hollandiae* – October-December
- *Sclerolaena napiformis* – September-December
- *Swainsona sericea* – September-November.

Targeted surveys were carried out over one day (team of two ecologists) on the 17 January 2022 for *Cullen parvum* (detectable between December-January). All surveys were used to search for *Eucalyptus leucoxyloides* subsp. *pruinosa*. This is considered adequate, given the lack of *Eucalyptus* trees in the study area.

The location of walked tracks during the threatened plant surveys are illustrated in **Figure 5-2**.

About 1,193 kilometres was walked within suitable habitat over the survey timeframe throughout 2021 and 2022. A minimum of 10 metre parallel walked transects was used for the grass and forb growth forms present in list above, in areas of open vegetation. Up to five species from the same strata was surveyed per traverse in the same area of suitable habitat. Importantly, due to the large scale of the Project, similar species were grouped together, including *Swainsona murrayana*, *Swainsona plagiotropis* and *Swainsona sericea*, to allow surveys to be completed for other targeted species. Not all areas of suitable habitat were surveyed during the targeted surveys due to additions and modifications to the Project design since September 2021, as well as restricted access to properties from inclement weather (e.g. flood event in November 2021). Description of survey limitations are provided in **Section 5.2.3**. Candidate flora species have been assumed present in areas of suitable habitat (associated PCTs) in absence of targeted surveys due to survey limitations (**Section 5.3.1**). A summary of the survey effort based on the area of habitat for each target plant species is provided in **Table 5-6**.

A description of suitable habitat for each candidate species within the study area is provided below.

Austrostipa wakoolica

Austrostipa wakoolica is listed endangered under the BC Act and EPBC Act. It is confined to the floodplains of the Murray River tributaries of central-western and south-western NSW, with localities including Manna State Forest, Matong, Lake Tooim, Merran Creek, Tulla, Cunninyeuk and Mairjimmy State Forest. It grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine Forest on low sandy range; and a low, rocky rise. The study area contains habitat that meets the description for this species, which includes PCT 17, PCT 26 and PCT 28.

Brachyscome muelleroides

Brachyscome muelleroides is listed vulnerable under the BC Act and EPBC Act. It occurs in the Wagga Wagga, Narranderra, Tocumwal and Walbundrie areas. It also occurs in north-central Victoria (only along the Murray from Tocumwal to the Ovens River). This species grows in damp areas on the margins of claypans in moist grassland with *Pycnosorus globosus*, *Agrostis avenacea* and *Austrodanthonia duttoniana*. It is also found growing in association with seasonal aquatic plants such as *Marsilea* species (Lucas, 2010). This species has been recorded from the margins of lagoons in mud or water, and in association with *Calotis anthemoides*. Suitable habitat is located within the study area, associated with PCT 44, PCT 45 and PCT 46, which were targeted during surveys for this species.

Brachyscome papillosa

Brachyscome papillosa is listed vulnerable under the BC Act and EPBC Act. It is endemic to NSW and chiefly occurs within the Riverina Bioregion, from Mossgiel in the north, Murrumbidgee Valley (Yanga) National Park

in the southwest to Urana in the southeast. Sites are scattered across this Bioregion including the Jerilderie area, the Hay Plain (Maude and Oxley) and around Darlington Point. In addition, there are a number of records from the Willandra Lakes World Heritage Area (including Mungo National Park) with a north-western outlier at Byrnedale Station, north of Menindee. The only known site on southwestern Slopes is Ganmain Reserve. It is recorded primarily in clay soils on Bladder Saltbush (*Atriplex vesicaria*) and Leafless Bluebush (*Maireana aphylla*) plains, but also in grassland and in Inland Grey Box (*Eucalyptus microcarpa*) - Cypress Pine (*Callitris spp.*) woodland. PCT 44, PCT 45, PCT 46 and PCT 160 provide suitable habitat for this species. Walked survey transects were not conducted in PCT 160.

Caladenia arenaria

Caladenia arenaria is listed endangered under the BC Act and EPBC Act. It is found mostly on the southwest plains and western southwest slopes. The original description is of a plant from Nangus, west of Gundagai (1865) and there is a report of the species from Adelong near Tumut. The Sand-hill Spider Orchid is currently only known to occur in the Riverina between Urana and Narranderra. This species occurs in woodland with sandy soil, especially that dominated by White Cypress Pine (*Callitris glaucophylla*), which is present within the study area. Therefore, suitable habitat, associated with PCT 28, containing White Cypress Pine (*Callitris glaucophylla*), was surveyed.

Convolvulus tedmoorei

Convolvulus tedmoorei is listed endangered under the BC Act and has been recorded from northern inland areas of South Australia, south-western Queensland and western NSW. There are few known records from NSW, including two areas on the Murrumbidgee and Darling River (Baaka) floodplains in central-western NSW and two other records from east of Broken Hill to Wilcannia, and from the Menindee Road, Scarsdale. The study area is associated with grey-brown silty clay alluvium on the Murray River Floodplain, which correlates with the known habitat where the species has been recorded. Habitat listed for *Convolvulus tedmoorei* in the TBDC, also associated with the PCTs within the study area, includes PCT 26, PCT 44 and PCT 160 which were targeted during surveys. Walked survey transects were not conducted in PCT 160. This species most closely resembles *Convolvulus clementii* but it can be distinguished by its more prostrate and fleshy habit, its coarse stems and its larger capsules and seeds. The seed surface structure is also a distinguishing character, as is the lack of a wing on the seed (Johnson, 2001).

Cullen parvum

Cullen parvum is listed endangered under the BC Act. A small population was recently reported from near Jerilderie (although it has not been relocated). In recent years, two populations have been recorded in travelling stock reserves south-west of Wagga Wagga, and a population reputedly exists on a roadside near Galong. Another population has recently been discovered on private land near Young. Large populations have been recorded in grassy gaps in the Red Gum Woodlands of Barmah State Park. In known populations in Victoria and NSW, plants are found in grassland, River Red Gum (*Eucalyptus camaldulensis*) Woodland or Box-Gum Woodland, sometimes on grazed land and usually on table drains or adjacent to drainage lines or watercourses, in areas with rainfall of between 450 and 700 mm. Habitat listed for *Cullen parvum* in the TBDC and associated with the PCTs within the study area, includes PCT 7, PCT 9 and PCT 44.

Eucalyptus leucoxylon subsp. pruinosa

Eucalyptus leucoxylon subsp. *pruinosa* is listed vulnerable under the BC Act. It is restricted to several small areas between Barham and Euston. This species is not known from any protected area within NSW, though some remnants occur within State Forests along the Murray River. *Eucalyptus leucoxylon* subsp. *pruinosa* is a tree species which, in New South Wales, occurs at the bases of sandy rises and on loamy clay flats on the floodplains of the Murray River and its tributaries in the Riverina Bioregion. PCT 13 is relevant to the habitat identified within the study area.

Lepidium monolocoides

Lepidium monolocoides is widespread in the semi-arid western plains regions of NSW. Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. Predominant vegetation is usually an open woodland dominated by Bulloak (*Allocasuarina luehmannii*) and/or eucalypts, particularly Black Box (*Eucalyptus largiflorens*) or Poplar Box (*Eucalyptus populnea*). The field layer of the surrounding woodland is dominated by tussock grasses. Habitat listed for *Lepidium*

monoplocoides in the TBDC, associated with the study area includes PCT 26, PCT 160. Walked survey transects were not conducted for PCT 160, resulting in a survey gap.

Leptorhynchus orientalis

Leptorhynchus orientalis has been recorded from several Hay Plain and southern Riverina localities, including Willanthry east of Hillston, Zara-Wanganella via Hay, McKinley Road SW of Hillston, and "Morundah" navy land west of Buckingham SF. A large population has most recently been recorded from Cowl Cowl Station south-southwest of Hillston. This species grows in woodland or grassland, sometimes on the margins of swamps. Communities include a Bimble Box plain in red-brown soil, dense *Acacia pendula* woodland with herbaceous understorey on red clay to clay-loam, open grassland areas on red soils, and red clay plains at the edge of a Canegrass swamp. Suitable habitats surveyed within the study area was associated with the relevant PCTs listed for *Leptorhynchus orientalis* in the TBDC including, PCT 26, PCT 44, PCT 45 and PCT 46.

Maireana cheelii

Maireana cheelii is restricted to the southern Riverina region of NSW, mainly in the area between Deniliquin and Hay. NSW collections have mainly been from the Moulamein, Deniliquin and Hay districts, including Tchelery and Zara Stations. It is usually found on heavier, grey clay soils with Bladder Saltbush (*Atriplex vesicaria*). This species has also been recorded on the Hay Plain in *Atriplex vesicaria*, *Maireana aphylla* and *Acacia homalophylla* shrublands. Soils include heavy brown to red-brown clay-loams, hard cracking red clay, other heavy texture-contrast soils. The study area contains habitat what meets the description for this species, associated with PCT 26, PCT 44 and PCT 46, which were targeted during surveys. Relevant habitat within the study area listed for *Maireana cheelii* in the TBDC includes PCT 26, PCT 44, PCT 46.

Pilularia novae-hollandiae

Pilularia novae-hollandiae has been recorded from suburban Sydney, Khancoban, the Riverina between Albury and Urana (including Henty, Walbundrie, Balldale and Howlong), Oolambeyan National Park near Carrathool and at Lake Cowal near West Wyalong. PCT 9, PCT 13, PCT 26, and PCT 45 provide suitable habitat for this species within the study area, which were included during targeted surveys, and are also listed in the TBDC.

Sclerolaena napiformis

Sclerolaena napiformis is known from only a few small populations in remnant grassland in the southern Riverina of NSW and north-central Victoria. NSW populations are confined to the area between Jerilderie and Moama on travelling stock routes and road reserves. This species is confined to remnant grassland habitats on clay-loam soils and grows on level plains in tussock grassland of *Austrostipa nodosa* and *Chloris truncata*, in grey cracking clay to red-brown loamy clay. Habitat listed for *Sclerolaena napiformis* in the TBDC, associated with the PCTs within the study area, includes PCT 26, PCT 44 and PCT 46, which were targeted during surveys for this species.

Swainsona murrayana

Swainsona murrayana is found throughout NSW. It has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species inhabits a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with *Maireana* species. Habitat listed for *Swainsona murrayana* in the TBDC, associated with the PCTs within the study area, includes PCT 26, PCT 28, PCT 44, PCT 45 and PCT 46, which were targeted during surveys for this species.

Swainsona plagiotropis

Swainsona plagiotropis occurs in the upper River Murray valley in the south-western plains of NSW and into Victoria. Most NSW records are from the Jerilderie area, with possible collections from the Louth-Bourke area and a disjunct record in the north-western plains from Buttabone Stud Park 35 kilometres NW of Warren. It grows on flat grassland and in heavy red soil, often on roadsides and especially in table drains. Soils are derived from quaternary sediments and are usually red-brown clay-loams. The species is absent from black low-lying soils. Habitat listed for *Swainsona plagiotropis* in the TBDC, associated with the PCTs within the

study area, includes PCT 26, PCT 28, PCT 44, PCT 45 and PCT 46, which were targeted during surveys for this species.

Swainsona sericea

Swainsona sericea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. It is found in Natural Temperate Grassland and Snow Gum (*Eucalyptus pauciflora*) Woodland on the Monaro. It is also found in Box-Gum Woodland in the Southern Tablelands and southwest Slopes and sometimes found in association with cypress-pines *Callitris* spp. Habitat listed for *Swainsona sericea* in the TBDC, associated with the PCTs within the study area, includes PCT 26, PCT 28, PCT 44, PCT 45 and PCT 46, which were targeted during surveys for this species.

Table 5-6. Summary of survey effort for threatened plant species

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing and effort
<i>Austrostipa wakoolica</i>	A spear-grass	E	E	Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils. May be associated with PCT 17, PCT 26 and PCT 28 within the study area.	October – December Parallel field traverse with 10 metre spacing. PCT 17: ~ 20 km PCT 26: ~ 140 km PCT 28: ~ 30 km	<u>November 2021</u> PCT 17: 8.2 km PCT 26: 83.9 km PCT 28: 14.8 km
<i>Brachyscome muelleroides</i>	Claypan Daisy	V	V	Grows in damp areas on the margins of claypans in moist grassland. May be associated with PCT 44, PCT 45 and PCT 46 within the study area.	September – November Parallel field traverse with 10 metre spacing. PCT 44: ~ 120 km PCT 45: ~ 6 km PCT 46: ~ 370 km	<u>September 2021</u> PCT 44: 56.6 km PCT 45: 57 km PCT 46: 196.2 km <u>November 2021:</u> PCT 44: 48.4 km PCT 45: 30.2 km PCT 46: 175.4 km <u>September 2022:</u> PCT 44: 68.2 km PCT 45: 6.3 km PCT 46: 166.6 km
<i>Brachyscome papillosa</i>	Mossgiel Daisy	V	V	Recorded primarily in clay soils on Bladder Saltbush and Leafless Bluebush plains, but also in grassland and in Inland Grey Box Cypress Pine woodland. May be associated with PCT 44, PCT 45, PCT 46 and PCT 160 within the study area.	September – November Parallel field traverse with 10 metre spacing. PCT 44: ~ 120 km PCT 45: ~ 6 km PCT 46: ~ 370 km PCT 160: ~ 2 km	<u>September 2021:</u> PCT 44: 56.6 km PCT 45: 57 km PCT 46: 196.2 km <u>November 2021:</u> PCT 44: 48.4 km PCT 45: 30.2 km PCT 46: 175.4 km <u>September 2022:</u> PCT 44: 68.2 km PCT 45: 6.3 km PCT 46: 166.6 km

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing and effort
<i>Caladenia arenaria</i>	Sand-hill Spider Orchid	E	E	occurs in woodland with sandy soil, especially that dominated by White Cypress Pine (<i>Callitris glaucophylla</i>). May be associated with PCT 28 within the study area.	September Parallel field traverse with 10 metre spacing. PCT 28: ~ 30 km	<u>September 2021:</u> PCT 28: 19.1 km <u>September 2022:</u> PCT 28: 16.5 km
<i>Convolvulus tedmoorei</i>	Bindweed	-	E	Grows in self-mulching grey clay soils on the floodplains of the Darling and Murrumbidgee Rivers. May be associated with PCT 17, PCT 24, PCT 26, PCT 44, PCT 45, PCT 46, and PCT 160 within the study area.	June – September Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km
<i>Cullen parvum</i>	Small Scurf-pea	-	E	Plants are found in grassland, River Red Gum Woodland or Box-Gum Woodland, sometimes on grazed land and usually on table drains or adjacent to drainage lines or watercourses, in areas with rainfall of between 450 and 700 mm. May be associated with PCT 9 and PCT 44 within the study area.	January – December Parallel field traverse with 10 metre spacing. PCT 9: ~ 2 km PCT 44: ~ 120 km	<u>January 2022:</u> PCT 44: 3.7 km
<i>Eucalyptus leucoxylon subsp. pruinosa</i>	Yellow Gum	-	V	Occurs at the bases of sandy rises and on loamy clay flats on the floodplains of the Murray River and its tributaries in the Riverina Bioregion. May be associated with PCT 13 within the study area.	All year Parallel field traverse with 10 metre spacing. PCT 13: ~5 km	<u>September 2021:</u> PCT 13: 3.4 km <u>November 2021:</u> PCT 13: 2 km <u>September 2022:</u> PCT 13: 3.2 km
<i>Lepidium monoplacoides</i>	Winged Peppergrass	E	E	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of around 300-500 mm. May be associated with PCT 13, PCT 16, PCT 24, PCT 26, PCT 45, PCT 46 and PCT 160 within the study area.	January – December Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km	<u>November 2021:</u> PCT 26: 83.9 km

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing and effort
<i>Leptorhynchos orientalis</i>	Lanky Buttons	-	E	Grows in woodland or grassland, sometimes on the margins of swamps. May be associated with PCT 26, PCT 44, PCT 45 and PCT 46 within the study area.	September – November Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km PCT 45: ~ 6 km PCT 46: ~ 370 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km PCT 45: 57 km PCT 46: 196.2 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km PCT 45: 6.3 km PCT 46: 166.6 km
<i>Maireana cheelii</i>	Chariot Wheels	V	V	Usually found on heavier, grey clay soils with <i>Atriplex vesicaria</i> (Bladder Saltbush). Soils include heavy brown to red-brown clay-loams, hard cracking red clay, other heavy texture-contrast soils. Tends to grow in shallow depressions, often on eroded or scalded surfaces, and does not extend to the higher soils in the habitat. May be associated with PCT 26, PCT 44 and PCT 46 within the study area.	September – December Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km PCT 46: ~ 370 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km PCT 46: 196.2 km <u>November 2021:</u> PCT 26: 83.9 km PCT 44: 48.4 km PCT 46: 175.4 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km PCT 46: 166.6 km
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	-	E	Austral Pillwort grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous. May be associated with PCT 9, PCT 12, PCT 13, PCT 26, PCT 44, PCT 45 and PCT 46 within the study area.	October – December Parallel field traverse with 10 metre spacing. PCT 9: ~ 2 km PCT 13: ~ 5 km PCT 26: ~ 140 km PCT 45: ~ 6 km PCT 44: ~ 120 km PCT 46: ~ 370 km	<u>November 2021:</u> PCT 9: 0.2 km PCT 13: 2 km PCT 26: 83.9 km PCT 45: 30.2 km PCT 44: 48.4 km PCT 46: 175.4 km

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing and effort
<i>Sclerolaena napiformis</i>	Turnip Copperburr	E	E	Confined to remnant grassland habitats on clay-loam soils. Grows on level plains in tussock grassland of <i>Austrostipa nodosa</i> and <i>Chloris truncate</i> , in grey cracking clay to red-brown loamy clay. May be associated with PCT 26, PCT 44 and PCT 46 within the study area.	September – December Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km
<i>Swainsona murrayana</i>	Slender Darling Pea	V	V	The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with <i>Maireana</i> species. May be associated with PCT 26 and PCT 28, PCT 44, PCT 45, PCT 46 within the study area.	September Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km
<i>Swainsona plagiotropis</i>	Red Darling Pea	V	V	Grows on flat grassland and in heavy red soil, often on roadsides and especially in table drains. Soils are derived from quaternary sediments and are usually red-brown clay-loams. The species is absent from black low-lying soils. May be associated with PCT 26, PCT 44, PCT 45 and PCT 46 within the study area.	September Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km
<i>Swainsona sericea</i>	Silky Swainson-pea	-	V	Found in Natural Temperate Grassland and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodland on the Monaro. May be associated with PCT 26, PCT 28, PCT 44, PCT 45 and PCT 46 within the study area.	September – November Parallel field traverse with 10 metre spacing. PCT 26: ~ 140 km PCT 44: ~ 120 km	<u>September 2021:</u> PCT 26: 117.1 km PCT 44: 56.6 km <u>September 2022:</u> PCT 26: 100.6 km PCT 44: 68.2 km

* Associated PCTs for each species are taken from their profile on the BioNet Threatened Biodiversity Data Collection database.

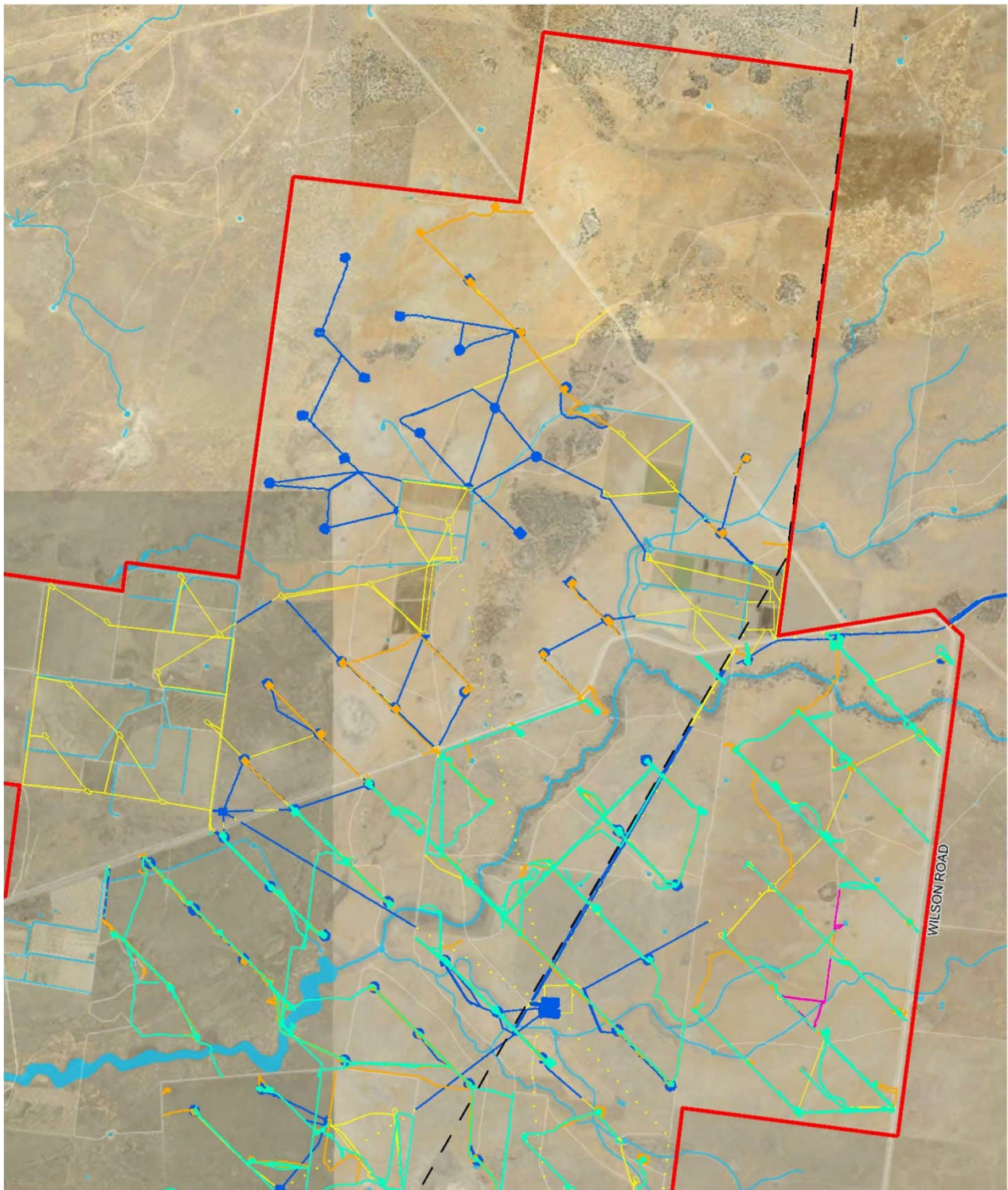
** The number of required survey kms is taken from the *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method* (Department of Planning Industry and Environment, 2020).

5.2.1.1 Weather conditions during targeted flora surveys

Targeted flora surveys were conducted over a period of 21 days during September 2021, November 2021 and January 2022. A summary of the daily temperatures and rainfall preceding each day area provided in **Table 5-7**, obtained from Deniliquin Airport AWS (074258), located approximately 50 kilometres southwest from the Project area.

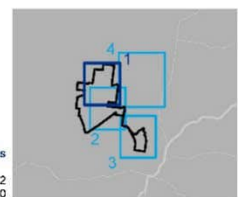
Table 5-7. Weather and rainfall conditions during flora surveys (Deniliquin Airport AWS 074258)

Date	Min temp (°C)	Max temp (°C)	Wind (3pm) (direction - km/h)	Rainfall (24 hours) (mm)	Total rainfall in 7 days prior (mm)	Monthly rainfall prior to survey (mm)
21/9/21	1.2	16.2	SSW – 30	0.6	2	35.4
22/9/21	3.2	19.8	WSW – 15	0.2	2.2	35.2
23/9/21	3.3	22.3	WNW – 20	0	2	35.2
24/9/21	6.1	23.6	W – 39	0	2	31.6
25/9/21	1.1	16.7	SSW – 28	0	2	25.6
26/9/21	-1	18.8	E – 17	0	0.8	25.4
27/9/21	3.5	21	NNE – 11	0	0.8	25.4
28/9/21	6.8	25.4	E – 11	0	0.2	23.6
29/9/21	13.7	18.3	ENE – 20	0	0	23.6
30/9/21	12.8	22.1	SSW – 30	12.2	12.2	35.6
15/11/21	8	18.4	W – 30	0	20.6	65.6
16/11/21	2.6	20.6	SSW – 15	0.6	21.2	56.6
17/11/21	4.3	24.5	NNW – 11	0.2	21.4	36
18/11/21	8.3	29.7	NNE – 20	0	21.4	36
19/11/21	14.3	19.3	NNW – 7	0	21.4	36
20/11/21	12.3	21.2	SSW – 11	0	13.8	36
23/11/21	15.1	26.4	NE – 17	0	1.2	37
24/11/21	17.3	26.8	E – 17	0	1	38.6
25/11/21	18.1	22	SE – 13	6.6	7.6	43.4
26/11/21	13.8	24.3	ENE – 20	0	7.6	43.4
27/11/21	9.3	25.4	ESE – 19	3	10.6	46.4
17/1/22	22.4	25.1	WNW – 6	0	8	49.8
05/09/22	0.9	15	SE – 9	0	0.2	13.6
06/09/22	5.3	18.8	E – 15	0	0	13.4
07/09/22	8	18.1	ENE – 20	0	0	13.4
08/09/22	12.7	14.9	NNE – 28	3.2	0	16.6
09/09/22	7.7	18.4	N – 17	13.4	3.2	30



- | | | |
|------------------|----------------------------|----------------------------------|
| Disturbance area | Threatened plant transects | Waterways |
| Project area | September 2021 | Existing 132kV transmission line |
| | November 2021 | Road |
| | January 2022 | |
| | September 2022 | |

0 1 2 km
 1:74,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
 © Department of Customer Service 2020

Figure 5-2. Targeted threatened flora surveys (Page 1 of 4)

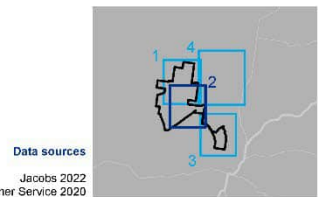
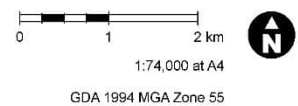
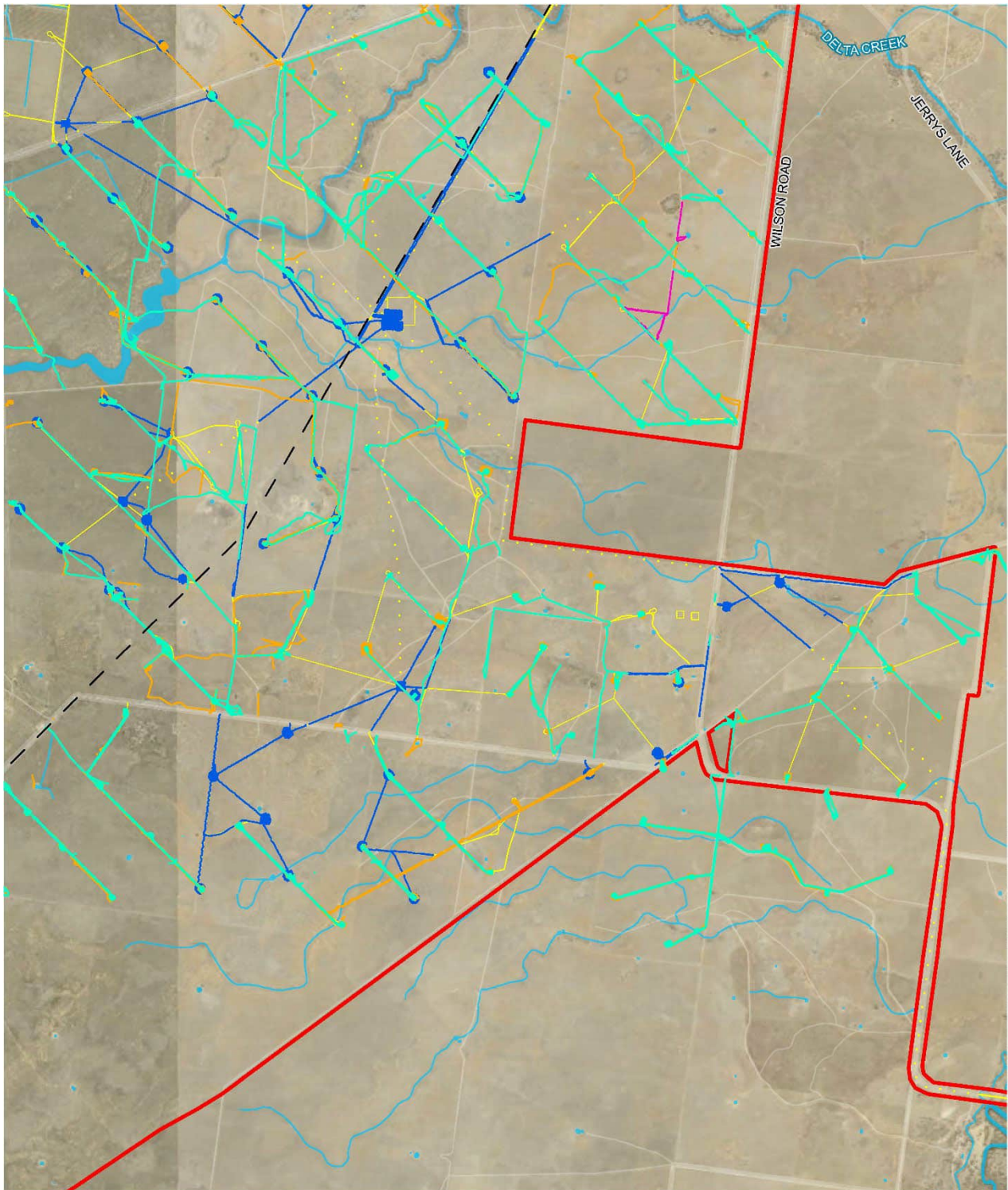
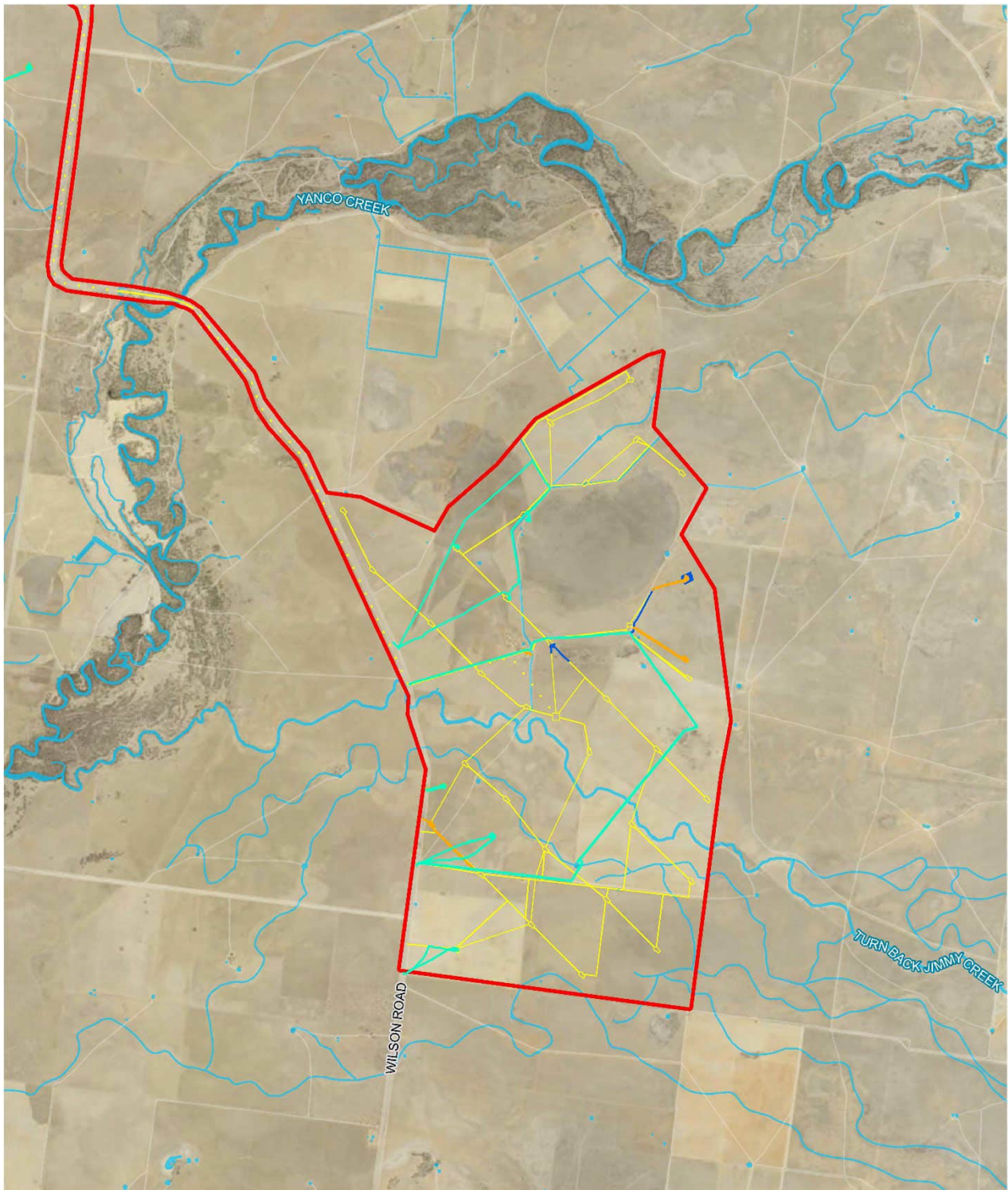


Figure 5-2. Targeted threatened flora surveys (Page 2 of 4)

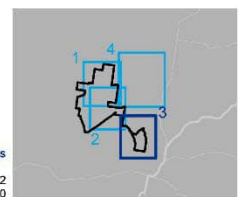


- Disturbance area
- Project area
- Threatened plant transects
- September 2021
- November 2021
- September 2022
- Waterways
- Road

0 1 2 km

1:74,000 at A4

GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
 © Department of Customer Service 2020

Figure 5-2. Targeted threatened flora surveys (Page 3 of 4)

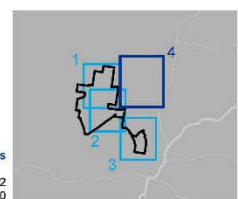
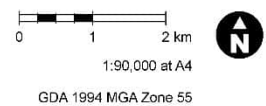


Figure 5-2. Targeted threatened flora surveys (Page 4 of 4)

5.2.2 Threatened fauna surveys

Targeted surveys were undertaken for threatened fauna where potential habitat was identified within the subject land. The primary focus was on targeting threatened species, identified as candidate species-credit species. Surveys included diurnal and nocturnal effort using a stratified sampling approach that aimed to sample the range of habitats present. Opportunistic observations of threatened species were also recorded during survey activities and generally while present in the subject land. Surveys were focused on areas within the Project area and, where possible, also occurred in adjacent habitats that extended beyond the Project area which may be indirectly impacted by the Project.

Fauna surveys were conducted during November 2021 and February 2022 using a combination of sampling techniques based on the required survey period and techniques detailed for each species in the BioNet Threatened Biodiversity Data Collection (TBDC) and methodology and effort as outlined in the document *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Department of Environment and Conservation, 2004) and later guidelines including:

- *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (Department of Environment and Climate Change, 2009)
- *'Species-credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage, 2018)
- Survey guidelines for Australia's threatened bats under the Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment Water Heritage and the Arts, 2010c)
- Survey guidelines for Australia's threatened birds - Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment Water Heritage and the Arts, 2010c).

Details of the specific survey techniques and effort applied are outlined in this section of the BDAR and methods are described in relation to the habitat types sampled for the target species in **Table 5-8**. The location of fauna survey techniques and effort are shown on **Figure 5-3** and **Figure 5-4**.

Important habitat is mapped in the 500 m landscape buffer for one threatened bird species (Endangered, BC Act and Critically Endangered, EPBC Act), namely the Plains-wanderer (*Pedionomus torquatus*) (refer **Figure 5-8**). The important area mapping for Plains-wanderer is associated with PCT 44 and PCT 46 within the Project area. The landscape is naturally open with scattered woodland patches and swamp amongst natural grassland on cracking clay soils, providing favourable habitat for the Plains Wanderer. As the area of important habitat intersects the Project area, a survey is not required for the Plains-wanderer and the species is assumed present. The species polygon is determined based on the vegetation zones within the Project area which impacts the important habitat.

The targeted surveys for birds and microbats aim to gather data on species present, their distribution and abundance within the proposed Project area and surrounding habitats, inclusive of flight activity to assess the risk of collision with turbine blades. Seasonal bird and bat surveys were undertaken (a total of four survey events) across the Project area. This information has been used to inform the assessment of prescribed impacts on threatened and protected animals from turbine strikes from a wind farm. These survey results collected have been used, in conjunction with turbine specific information, to predict the number of bird and bat collisions that might be caused by the Project (refer to **Section 6**).

A background review was undertaken of all threatened and protected bird and bat species records within 20 kilometres of the Project area. Information from relevant literature and incidental species sightings during other surveys was used to inform surveys.

The targeted fauna surveys include techniques and equipment specifically designed for the species in focus. Standard fauna surveys involved harp traps and ultrasonic call recording (Anabat) for microbats and sound meters and call playback and spotlighting for nocturnal birds.

For determining habitat and density of sampling sites, an assessment area was established with a 200-metre buffer on the current footprint, including turbines, tracks, trenching and other associated infrastructure.

Table 5-8. Summary of survey techniques and survey effort for candidate threatened fauna species

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing, technique and effort
Diurnal Birds						
<i>Ardeotis australis</i>	Australian Bustard	-	E	Potential habitat within the subject land is associated with PCT 11, PCT 12, PCT 16, PCT 24, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46, PCT 160 and PCT 164.	All year. Diurnal area searches or transect-point surveys in areas of favoured habitat in and around the study area. Detection mostly by sighting and calls.	Opportunistic observation throughout survey period. Bird roaming and utilisation surveys for prescribed impacts over November 2021, February 2022, May 2022 and July 2022. The entire study area and woodland patches in the subject land were covered during the survey, walking and driving.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (breeding)	-	V	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 12, PCT 13, PCT 17, PCT 24, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46, PCT 160	July – December Observation from vantage points to detect soaring species over suitable habitat. Detection by sightings. Area searches on foot in suitable habitat in and around the study area. Detection by sightings, calls and signs of occupancy. Transect surveys by vehicle within extensive study areas looking for flying or perched birds and nests.	Opportunistic observation throughout survey period. Bird roaming and utilisation surveys for prescribed impacts over November 2021, February 2022, May 2022 and July 2022. The entire study area and woodland patches in the subject land were covered during the survey, walking and driving.
<i>Hieraaetus morphnoides</i>	Little Eagle (breeding)	-	V	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 12, PCT 13,, PCT 17, PCT 26, PCT 28, PCT 44, PCT 45, PCT 46, PCT 160	August – October Observation from vantage points to detect soaring species over suitable habitat. Detection by sightings. Area searches on foot in suitable habitat in and around the study area. Detection by sightings, calls and signs of occupancy. Transect surveys by vehicle within extensive study areas looking for flying or perched birds and nests.	
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Potential habitat within the subject land is associated with the intact patches of PCT 9, PCT 11, PCT 13, PCT 16, PCT 26 and PCT 28	September – February Diurnal area searches or transect-point surveys in areas of favoured habitat in and around the study area. Detection mostly by sighting and calls. Diurnal transect surveys along watercourses or roads.	

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing, technique and effort
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo (breedin)	-	V	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 13, PCT 16, PCT 19, PCT 26, PCT 28 and PCT 45.	September – December Ground area searches and road transects. Also targeted watches of food and nest trees in suitable habitat. Detection by sighting, vocalisation and foraging signs.	Opportunistic observation throughout survey period. Bird roaming and utilisation surveys for prescribed impacts over November 2021, February 2022, May 2022 and July 2022.
<i>Lophoictinia isura</i>	Square-tailed Kite (breeding)	-	V	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 13, PCT 16, PCT 26, PCT 28 and PCT 45.	September – January Observation from vantage points to detect soaring species over suitable habitat. Detection by sightings. Area searches on foot in suitable habitat in and around the study area. Detection by sightings, calls and signs of occupancy. Transect surveys by vehicle within extensive study areas looking for flying or perched birds and nests.	The entire study area and woodland patches in the subject land were covered during the survey, walking and driving. Observations to locate large stick nests and hollowing bearing trees undertaken throughout survey period.
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Potential habitat within the subject land is associated with the intact patches of PCT 9, PCT 11, PCT 13, PCT 26, PCT 28, PCT 45 and PCT 46.	September – November Area searches or transect surveys of suitable habitat, preferably in the early morning (sunrise to 10 am) and evening (4 pm to sunset). Morning surveys may be of greater value as the species' movements is more coordinated at this time. Detection by sighting or call, usually of flying birds. Vehicle-based transects appropriate in areas where most habitat is restricted to roadside remnants. Survey effort will need to be increased outside the breeding season, as dispersal makes the species more difficult to detect.	

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing, technique and effort
Nocturnal Birds						
<i>Burhinus grallarius</i>	Bush Stone-curlew	-	E	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 13, PCT 16, PCT 26 and PCT 28.	All year. Call playback, wait 5 minutes to hear call, play again and listen for another 5 minutes, followed by spotlighting. Species is mainly found in western slopes and plains and the Riverina, smaller numbers on Central and North Coast with increasing numbers in Tweed Valley. It may be easier to detect during breeding season (spring-summer), possibly calls all year, but it is unclear how well it responds to playback. The species was allocated to a species-credit as experts determined that it cannot be predicted to occur at a site based on vegetation surrogates but can be detected reliably from survey.	Nocturnal bird surveys were undertaken over four nights (July 2022 and August 2022). This comprised call playback and spotlighting, as well as sound meters. Opportunistic observation throughout survey period. Bird roaming and utilisation surveys for prescribed impacts over November 2021, February 2022, May 2022 and July 2022. The entire study area and woodland patches in the subject land were covered during the survey, walking and driving. Observations to locate large stick nests and hollowing bearing trees undertaken throughout survey period.
<i>Ninox connivens</i>	Barking Owl	-	V	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 13 and PCT 16.	Call playback, wait 5 minutes to hear call, play again and listen for another 5 minutes, followed by spotlighting. Playback surveys effective in suitable habitat, especially in lead up to breeding season. Area and transect searches unlikely to be useful due to nocturnal habits and cryptic nature.	Nocturnal bird surveys were undertaken over four nights (July 2022 and August 2022). This comprised call playback and spotlighting, as well as sound meters. Targeted stag watching and call playback were undertaken in August- September 2022.
<i>Tyto novaehollandiae</i>	Masked Owl	-	V	Potential habitat within the subject land is associated with PCT 9, PCT 11, PCT 13, PCT 24 and PCT 26.	Call playback, wait 5 minutes to hear call, play again and listen for another 5 minutes, followed by spotlighting. Playback surveys effective in suitable habitat, especially in lead up to breeding season. Area and transect searches unlikely to be useful due to nocturnal habits and cryptic nature.	Observations to locate large stick nests and hollowing bearing trees undertaken throughout survey period.

Biodiversity Development Assessment Report

Species name	Common name	EPBC Act	BC Act	Habitat preferences and associated PCTs	Required survey period and survey guidelines	Survey completed – timing, technique and effort
Mammals						
<i>Myotis macropus</i>	Southern Myotis	-	V	Potential habitat within the subject land is associated with PCT 9 and PCT 11.	Oct-March. All surveys are to be undertaken during spring/summer from October – March. Harp trap or mist net is to be placed in areas of potential habitat. Harp traps are to be set beside or over pools of water along creeks or rivers. The minimum number of survey nights using harp traps is 4 nights per trap. Acoustic detection is to occur between October and March during spring/summer, for a duration of 4 nights.	Up to five acoustic recorders were deployed in November 2021, February 2022, May 2022 and July 2022 over three to four nights, comprising 43 trap nights. Anabat units were placed in suitable breeding and foraging habitat within 200 metres from watercourses, culverts, caves and artificial structures. Anabat devices were attached to windmills near farm dams to increase the height of detectors. Any culverts and artificial structures in the landscape were inspected for roosting bats.
Amphibians						
<i>Litoria raniformis</i>	Southern Bell Frog	V	E	Potential habitat within the subject land is associated with PCT 11, PCT 12, PCT 13, PCT 17 and PCT 24.	October – January Initial habitat assessment - surveys using a combination of call detection, call playback and spotlighting. A minimum of four nights under ideal conditions. Visual surveys or acoustic recorders should be completed along the edges of suitable breeding habitat or, if practical, through shallow wetlands. Small wetlands (<50 m at greatest length) should be covered in about one hour. Large sites should be sampled systematically.	Habitat assessments were completed to identify suitable habitat in the Project area. Five nights targeted frog survey, in January 2022, was undertaken at locations with potential habitat for Southern Bell Frog, this included habitats with permanent water at wetlands, farm dams, creeks and irrigated areas with emergent wetland vegetation if available.

5.2.2.1 Bird utilisation survey

Surveys for targeted bird species were undertaken during November 2021, February 2022, May 2022 and July 2022. Details of the survey methods implemented are outlined in the following sections.

A bird utilisation survey was undertaken to focus on key species of concern and record data for all species including:

- All threatened species
- Species which are rarely recorded
- Species which exist naturally at relatively low densities
- Waders
- Nocturnal birds
- All bats
- Larger birds such as eagles, hawks, kites, herons, pelicans
- Migratory birds.

A total of 46 fixed survey points were selected in the different vegetation formations (surrogate for habitat types) and habitat types across the Project area for the November 2021 and February 2022. Various modifications to the Project footprint occurred in April-May 2022 which reduced the number of bird sites to 40 fixed points that were surveyed in May and July 2022 surveys. On some occasions bird sites were re-located due to access restrictions. Most bird sites were placed on the fringes of woodlands, particularly sandhills, where there is a continuum of habitats (woodland to grassland and/or sandhills and swamp shrublands), therefore, some sites sampled multiple habitat types. There are also sites adjacent or within cropped areas to capture the spatial extent of the Project area. Bird sites are illustrated in **Figure 5-3**.

The search area radius of fixed points is standardised, at least 100 metres for small birds and up to 800 metres for large birds. The duration of the fixed point counts were 20 minutes each. The height at which each bird flies when passing through the survey area was estimated and classified in three height band categories (0-20 metres, 20-50 metres, >50 metres), based on the Rotor Sweep Area (RSA), below, within and above the RSA. The start time was recorded, where surveys were undertaken during early morning, late morning, early evening and late evening. Additionally, multiple survey replicates of the same site were completed over four seasons and surveyed a different time periods (e.g. alternating morning and afternoon surveys).

The method and results of the bird utilisation survey is presented in more detail in **Section 6.1**.

5.2.2.2 Bird roaming survey

Roaming surveys were completed to complement the bird utilisation surveys. These surveys are done between the bird utilisation survey periods while moving from one site to the next. The roaming surveys are useful for recording possible occurrence of rare or threatened species. A record of each species and habitat usage was noted during the roaming surveys. All sightings and observations of raptor species, large stick nests and hollow nesting were also recorded.

All bird surveys are adequate for detecting the species identified in the BAM-C candidate species list and MNES (including target list of dual credit species):

- Australian Bustard (*Ardeotis australis*)
- Bush Stone-curlew (*Burhinus grallarius*)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*)
- Little Eagle (*Hieraaetus morphnoides*)
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)
- Square-tailed Kite (*Lophoictinia isura*)
- Superb Parrot (*Polytelis swainsonii*).

5.2.2.3 Nest tree survey

Bird surveys also included a nest tree survey to assist in the detection of breeding activity by raptors, large cockatoos and parrots. Nest tree surveys occurred during November 2021, February 2022, May 2022 and July 2022.

This comprised searches for suitable hollow bearing trees and stick nests for potential dual credits species within designated search buffers beyond the study area to account for possible disturbances and to determine possible species polygons. All locations with suitable breeding habitat were searched in the subject land where appropriate access was available.

Dedicated habitat assessments were undertaken to determine evidence of breeding habitat. This mapping is limited to a 500 m buffer (the subject land) on the study area to capture potential nest trees, depending on the target species and species polygon buffer shown in the TBDC.

The target list of species credit species (based on PCT associations) with potential breeding in the subject land is show in **Table 5-9**.

Table 5-9. Target species, breeding buffers, breeding period nest specifications

Species	BC Act	EPBC Act	Breeding habitat buffers (radius)	Breeding period	Nest specifications
Barking Owl <i>Ninox connivens</i>	V	-	100 m	May-December	living or dead trees containing ≥ 20cm (diameter of entrance) tree hollows at a height ≥ 4m
Masked Owl <i>Tyto novaehollandiae</i>	V	-	100 m	May-August	living or dead trees containing ≥ 20cm (diameter of entrance) tree hollows at a height ≥ 3m
Little Eagle <i>Hieraaetus morphnoides</i>	V	-	300 m	August-October	living or dead trees containing stick nest 60-75 cm across, 30 cm deep, at a height ≥ 5m
Square-tailed Kite <i>Lophoictinia isura</i>	V	-	300 m	September-January	living or dead trees containing stick nest 50-85 cm across, 25-60 cm deep, at a height ≥ 8m
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>) (500 metre radius buffer).	V	-	500 m	July-December	living or dead trees containing stick nest 50-110 cm across, 25-60 cm deep, at a height ≥ 10m.
Major Mitchell's Cockatoo <i>Lophochroa leadbeateri</i>	V	-	200 m	September-December	living or dead tree with >10cm (diameter of entrance) tree hollows
Superb Parrot <i>Polytelis swainsonii</i>	V	V	200 m	September-November	living or dead trees containing > 5cm (diameter of entrance) tree hollows at a height ≥ 4m, or trees with DBH greater than 30cm

All locations with suitable breeding habitat were searched in the study area. Observers recorded tree species, diameter at breast height, hollow types, sizes and heights and captured photos of each potential nest tree in order to determine the number of potential nest trees that meet the habitat constraints criteria for each species credit species. Evidence of previous inhabitancy (owl pellets, scat whitewash, animal carcasses, etc.) was searched for beneath each tree. An ID code and nest tree size class was assigned to each nest tree in the subject land to assist in identifying suitable trees for nocturnal surveys and diurnal monitoring during other surveys. Nest trees size classes, number of nest trees and candidate species are shown in **Table 5-10** and **Table 5-11**. The location of nest trees with size class in the subject land are shown **Figure 5-4**.

Table 5-10. Nest tree size classes assigned to all potential stick nest trees in the subject land

Size class	Candidate species	Number of trees in habitat buffers	
		0-300 m	300-500 m
Small (1-20cm)	-	64	7
Medium (20-50cm)	-	26	7
Large (50-100cm)	Little Eagle Square-tailed Kite White-bellied Sea eagle	14	0
Very Large (>100cm)	White-bellied Sea eagle	16	2
Total		120	16

Table 5-11. Nest tree size classes assigned to all potential hollow bearing nest trees in the subject land

Size class	Candidate species	Number of trees in habitat buffers	
		0-100 m	100-200 m
Small (1-10cm)	Superb Parrot	10	2
Medium (10-20cm)	Major Mitchell's Cockatoo Superb Parrot	92	20
Large(>20cm)	Barking Owl Masked Owl Major Mitchell's Cockatoo	107	21
Total		209	43

5.2.2.4 Nocturnal bird survey

The Threatened Biodiversity Data Collection (TBDC) and the Large Forest Owl Recovery Plan (DEC 2006) were initially reviewed to determine the most accepted habitat constraints criteria for assessing potential nest trees and conducting stagwatch surveys to identify actual nest trees used by Masked Owl and Barking Owl.

Potential nest trees were stagwatched for 90 minutes, 30 minutes before sunset and 60 minutes following sunset. Surveys were undertaken within the subject land where access was available. A spotlight was used to monitor activity of known tree hollows and possible roosting birds nearby. A total of 10 potential nest trees were watched, including numerous nearby hollowing bearing trees within proximity of an observer. Due to the very large extent of potential breeding habitat in the subject land, it wasn't feasible to stagwatch all potential hollow bearing trees. However, many hollow bearing trees are clustered closely together in small woodland patches in the subject land and surveys were undertaken at locations with these clusters of hollowing bearing trees to maximize detection of breeding owls. Additionally, sound meters were used to supplement nocturnal surveys with recording of bird calls at night in woodland patches, particularly along Delta Creek.

Advice from BCS (pers. comm. Michael Todd) noted the potential scarcity or low likelihood of Masked Owl and Barking Owl breeding habitat in the subject land and provided recommendations to also include call play in nocturnal surveys to maximize detection.

Nocturnal bird surveys were undertaken over five nights, over 11-14 July 2022 and 18 August 2022. This comprised call playback, stag watch and spotlighting to targeted potential breeding locations of Masked Owl and Barking Owl in Black Box woodland habitat along Delta Creek, isolated Black Box and River Red Gum woodland patches and River Red Gum woodland along Yanco Creek. Stagwatch and spotlighting locations are provided in **Figure 5-4**.

5.2.2.5 Diurnal observations – nest trees

Daytime monitoring of potential nest trees was undertaken during all surveys to maximise observations to detect the presence and activity of Little Eagle, Major Mitchell's Cockatoo, Square-tailed Kite, Superb Parrot and White-bellied Sea Eagle during their breeding period. Considerable bird survey effort was completed in

utilisation and roaming surveys discussed in **Section 5.2.2.1** and **Section 5.2.2.2**. These surveys were adequate for detecting target bird species over four seasons and to narrow down breeding locations.

The November 2021 bird surveys were completed during the Superb Parrot breeding period to determine whether the species is likely to nest and forage in the subject land. The surveys were completed in accordance with the Commonwealth survey guidelines (DEWHA, 2010).

Although the dedicated bird surveys were undertaken outside the Little Eagle breeding period, suitable stick nest trees were checked during other surveys in August and September 2022.

In order to locate an active nest tree, birds will need be in attendance to confirm breeding during their breeding period. This may include the presence of a male and female; or female with nesting material; or an individual in a hollow or on a large stick nest. Given the very large extent of the subject land, any bird observed within the prescribed buffer area of a potential nest tree will be considered as a breeding location.

5.2.2.6 Microbat survey

Bat activity surveys were conducted between 13-17 November 2021 (23 trap nights), 4-18 February 2022 (10 trap nights), 9-11 May 2022 (6 trap nights) and 11-15 July 2022 (13 trap nights) with a combined total of 52 trap nights using ultrasonic call recording devices such as Anabat Express detectors (Titley Scientific). Devices were positioned within 200 metres of suitable habitat (ie. available waterbodies, artificial structures, hollow bearing trees) and on elevated structures (ie. windmills) where available.

The threatened bat species Southern Myotis (*Myotis macropus*) was also targeted as a species credit species in suitable habitat within the Project area. Bat surveys were conducted in accordance with methods described in the Survey Guidelines for Australia's Threatened Bats (Commonwealth of Australia, 2010) and the Species credit threatened bats and their habitats (OEH, 2018). Anabat units were placed in suitable breeding and foraging habitat within 200 metres from watercourses, culverts, caves and artificial structures. Survey guidelines require a minimum of 16 trap nights across a minimum of four nights for areas of suitable habitat (i.e. less than or equal to 50 hectares). Any culverts and artificial structures in the landscape were inspected for potential breeding habitat for bats or signs of bats (guano etc).

Harp traps were not used in the survey due to the limited habitat areas with suitable waterbodies and obvious flyways in the landscape. As a result, acoustic recordings were relied on to detect bat species and determine bat activity in the landscape. Southern Myotis cannot be reliably identified from their call. Their call shape is the same as *Nyctophilus*. Based on this limitation, the Southern Myotis was assumed present in potential habitat within 200 metres of waterbodies that are 3 metres or greater in width.

Echolocation calls from the November 2021 survey were initially analysed by Dr Heidi Kolkert from Impact Ecology for absence and presence. All echolocation calls from all survey events were later sent to Rob Gration from Eco Aerial Environmental Services for detailed analysis. This included allocation of every file to a species and counting the number of call records for each species to determine relative abundance for estimating prescribed impacts on bat activity from wind turbines. Further details on the bat activity survey method is described in **Section 6.1.5**.

5.2.2.7 Southern Bell Frog

The Project area has potential habitat for the Southern Bell Frog (*Litoria raniformis*) associated with the tributaries of the Murray and Murrumbidgee Rivers. This species can be found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, River Red Gum swamps or billabongs along floodplains and river valleys. They also have potential to occur in irrigated crops, particularly where there is no available natural habitat. There are numerous records of Southern Bell Frog to the north east of the Project area in Coleambally Irrigation Area. Southern Bell Frogs is associated with PCT 7, PCT 9, PCT 13, and PCT 17 in the study area.

A landscape survey approach was used to initially identify potential locations of suitable habitat for Southern Bell Frog using native vegetation class mapping in the landscape buffer (**Figure 5-1**) and ponds/ farm dams from aerial imagery. This highlighted locations of Inland Riverine Forests, Inland Floodplain Shrublands and Inland Floodplain Swamps. This was supplemented with rapid vegetation survey in October 2021 confirm locations of suitable wetland habitat within the landscape buffer. There was a significant flood event during targeted flora surveys in November 2021, and the timing of water level rise was used to opportunistically

detect frogs during the day. The flood event triggered a major breeding event for Crucifix Frog (*Notaden bennettii*) which was recorded across the whole study area in all PCTs.

Dedicated habitat assessments were completed in 17-21 January 2022 at potential habitat locations comprising permanent water such as farm dams, drainage lines and ponds. Preferred breeding sites are shallow natural or constructed pools to 20 cm depth containing emergent vegetation (Threatened Species Scientific Committee, 2019). The habitat assessments did not identify any suitable habitat for Southern Bell Frog with most waterbodies lacking permanent shallow water and emergent vegetation. However, targeted surveys were completed at locations deemed marginal for the species. This included isolated habitats with permanent water at forested wetlands (one pond with black box and River Red Gum on Yanco Creek), farm dams, creeks and irrigated areas with some emergent wetland vegetation where available.

Three nights of Southern Bell Frog searches, call playback and spotlighting were undertaken during January 2022 at the low quality habitats identified. Given the lack of suitable habitat in the Project area, one night of survey per site was considered adequate. Targeted surveys included one night at a pond site located at junction of Cadell Road and Mcklenons Bore Road which had a historical record of Southern Bell Frog. Locations of habitat assessments and targeted frog searches are provided **Figure 5-3**.

Frog surveys were conducted in accordance with methods described in the Survey Guidelines for Australia's Threatened Frogs (Commonwealth of Australia, 2010) and the *NSW Survey Guide for Threatened Frogs, A guide for the survey of threatened frogs and their habitats for the Biodiversity Assessment Method* (DPIE 2020).

Rainfall in the three months preceding the targeted frog survey (October – December 2021) comprised 172.2 mm (Deniliquin Airport AWS 074258). Rainfall was above average for all months preceding the survey, particularly in October which recorded 45.7 mm above average.

5.2.2.8 Weather conditions during targeted fauna surveys

Targeted fauna surveys were conducted over a period of 25 days during, November 2021, February 2022, May 2022 and July 2022. A summary of the daily temperatures and rainfall preceding each day area provided in **Table 5-12** obtained from Deniliquin Airport AWS (074258). A rainfall total of 28.6 mm occurred over the five-day period of the amphibian survey during January 2021, and conditions were considered optimum for the targeted frog species, with ephemeral drainage areas filled and water observed accumulating in depressions around the Project area.

Table 5-12. Weather and rainfall conditions during fauna surveys (Deniliquin Airport AWS 074258)

Date	Min temp (°C)	Max temp (°C)	Wind (3pm) (direction - km/h)	Rainfall (24 hours) (mm)	Total rainfall in 7 days prior (mm)	Monthly rainfall prior to survey (mm)
15/11/21	8	18.4	W - 30	0	20.6	65.6
16/11/21	2.6	20.6	SSW - 15	0.6	21.2	56.6
17/11/21	4.3	24.5	NNW - 11	0.2	21.4	36
18/11/21	8.3	29.7	NNE - 20	0	21.4	36
19/11/21	14.3	19.3	NNW - 7	0	21.4	36
20/11/21	12.3	21.2	SSW - 11	0	13.8	36
17/1/22	22.4	25.1	WNW - 6	0	8	49.8
18/1/22	15.3	31.8	WNW - 6	0	8	49.8
19/1/22	16.2	33.2	SSW - 13	0.6	8.6	50.4
20/1/22	14.9	31.9	ENE - 20	0	2	50
21/1/22	16.7	32.2	E - 26	0	2	12.8
14/02/2022	19.4	37.9	N-19	0	0	0
15/02/2022	18.4	38.8	SE-9	0	0	0
16/02/2022	19.3	38.2	NNW-19	0	0	0
17/02/2022	19.0	30.1	WSW-19	0	0	0

Date	Min temp (°C)	Max temp (°C)	Wind (3pm) (direction - km/h)	Rainfall (24 hours) (mm)	Total rainfall in 7 days prior (mm)	Monthly rainfall prior to survey (mm)
18/02/2022	13.3	27.4	SSW-28	0.2	0	0
9/05/2022	3.4	18.2	SSW-4	0	0.2	0.2
10/05/2022	6.2	21	E-15	0.2	0.2	0.2
11/05/2022	12.1	19.8	E-13	0	0.4	0.4
12/05/2022	13.5	17	E-11	7.8	0.4	0.4
13/05/2022	14.1	20.4	N-13	4.2	8.2	8.2
11/07/2022	-0.1	14.8	WNW-9	0.2	0.6	1
12/07/2022	3.7	12.2	WNW-9	0	0.6	1.2
13/07/2022	0.1	13.6	SSW-26	0	0.6	1.2
14/07/2022	-2.7	13	SSW-22	0.2	0.4	1.2

5.2.3 Survey limitations

The bird and bat survey's used a landscape approach to capture information about the full occurrence bird and bat species diversity, distribution, movement and behaviour.

The field survey provides a limited view into the whole Project area which comprises around 33,000 hectares and was generally focused on vegetation and habitat within the indicative footprint. On the contrary the bird and bat survey has taken a landscape approach to capture information about the full occurrence bird and bat species diversity, distribution, movement and behaviour. The diversity of flora and fauna species recorded from this Project area should not be seen to be comprehensive, but rather an early indication of the species present at the time of the survey. A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (e.g. orchids or migratory birds) and require specific weather conditions for optimum detection (e.g. frogs). The conclusions of this report are therefore based upon available data and field survey and are therefore indicative of the environmental condition of the Project area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species for the purposes of a preliminary assessment of biodiversity constraints.

A total of 10 potential nest trees were watched during the nocturnal surveys. Due to the very large extent of potential breeding habitat in the subject land, it wasn't feasible to stagwatch all potential hollow bearing trees. However, many hollow bearing trees are clustered closely together in small woodland patches in the subject land and surveys were undertaken at locations with these clusters of hollowing bearing trees to maximize detection of breeding owls. Additionally, sound meters were used to supplement nocturnal surveys with recording of bird calls at night in woodland patches, particularly along Delta Creek.

Advice from BCS (pers. comm. Michael Todd) noted the potential scarcity or low likelihood of Masked Owl and Barking Owl breeding habitat in the subject land and provided recommendations to also include call play in nocturnal surveys to maximize detection.

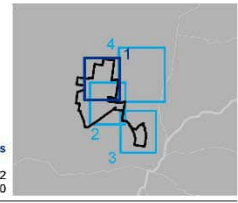
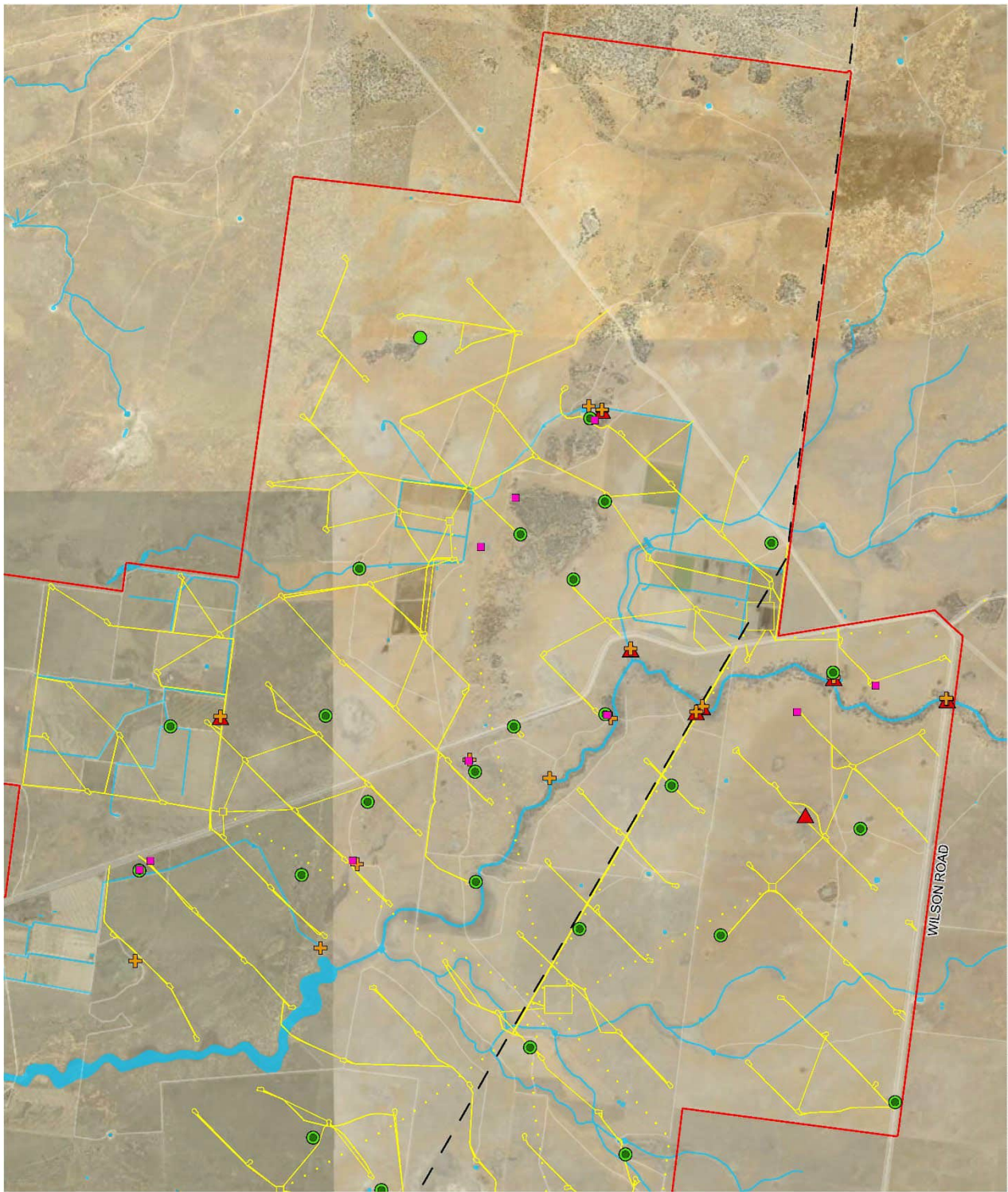
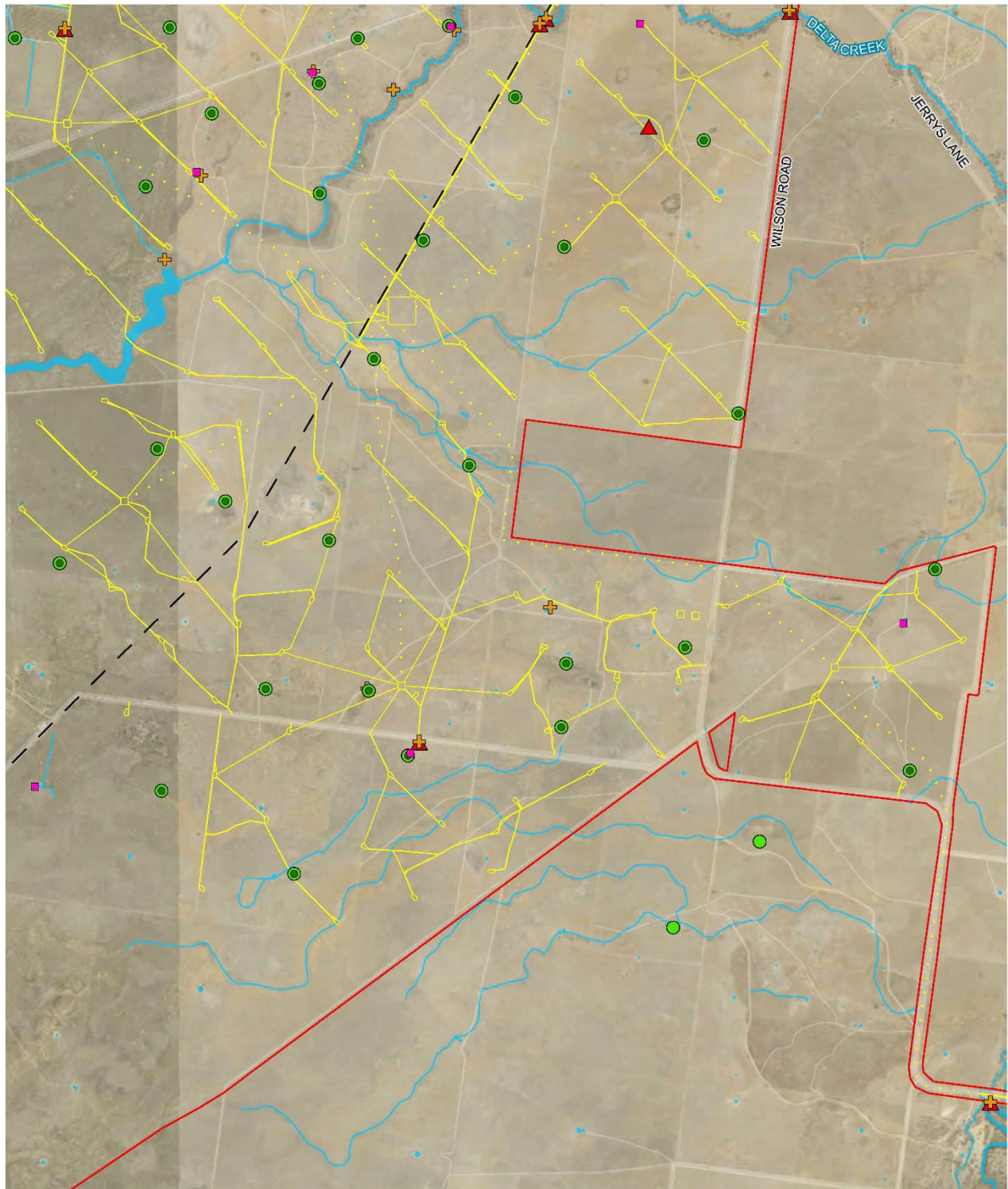


Figure 5-3. Location of targeted fauna surveys (Page 1 of 4)



- | | | | |
|------------------|--|----------------------------------|----------------------|
| Disturbance area | Bird site (February 2021) | Road | |
| Project area | Bird site (November 2021) | Waterways | |
| | Targeted frog search | Existing 132kV transmission line | 1:74,000 at A4 |
| | Habitat assessment location | | GDA 1994 MGA Zone 55 |
| | Bat call detector and Songmeter location | | |

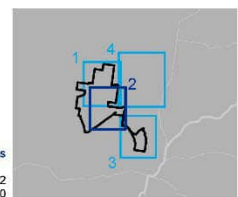
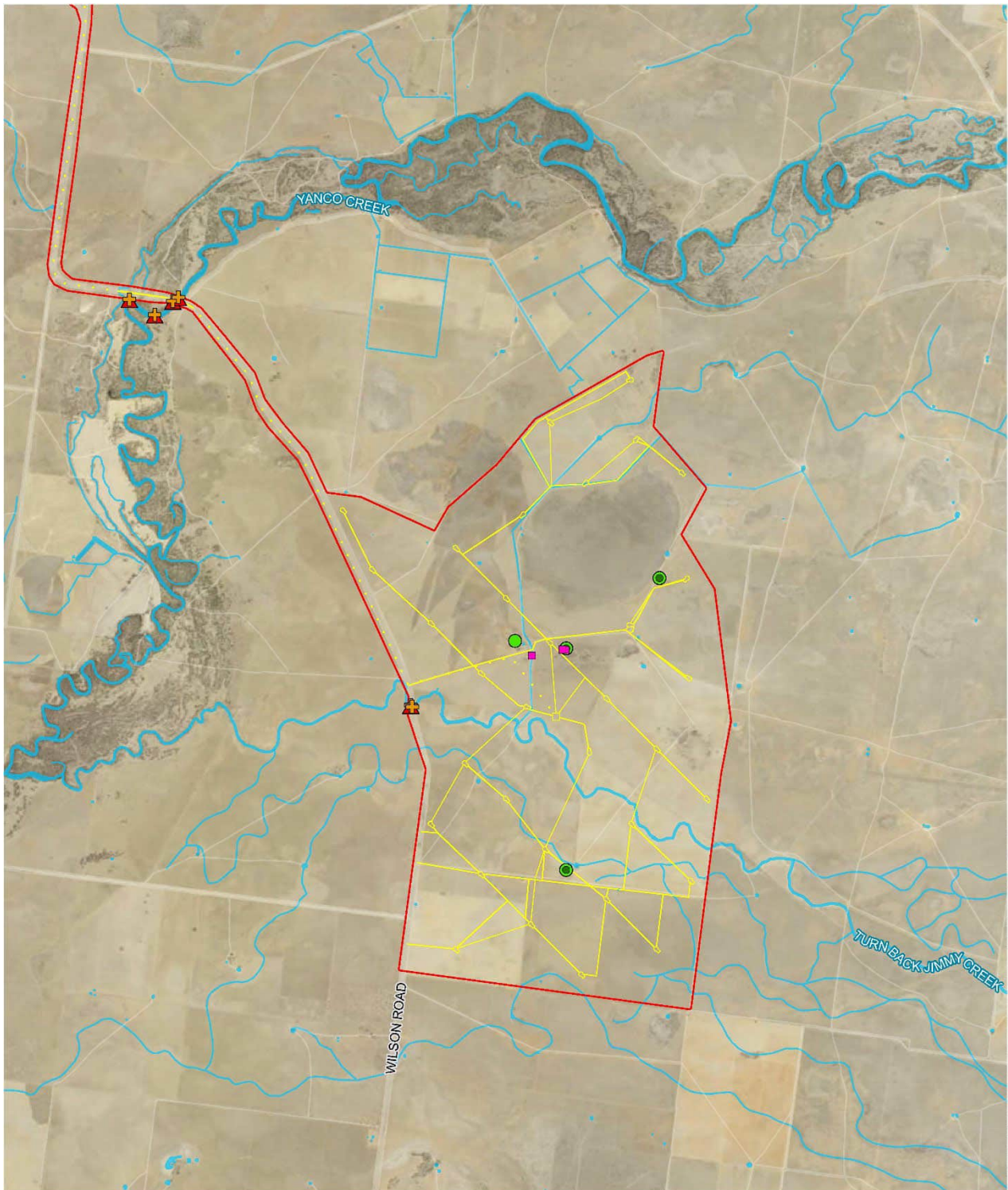


Figure 5-3. Location of targeted fauna surveys (Page 2 of 4)



- Disturbance area
- Project area
- Bird site (February 2021)
- Bird site (November 2021)
- ▲ Targeted frog search
- + Habitat assessment location
- Bat call detector and Songmeter location
- Road
- Waterways

0 1 2 km

1:74,000 at A4

GDA 1994 MGA Zone 55

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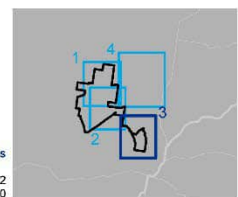


Figure 5-3. Location of targeted fauna surveys (Page 3 of 4)

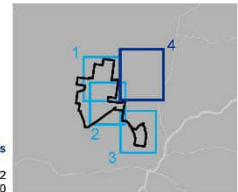
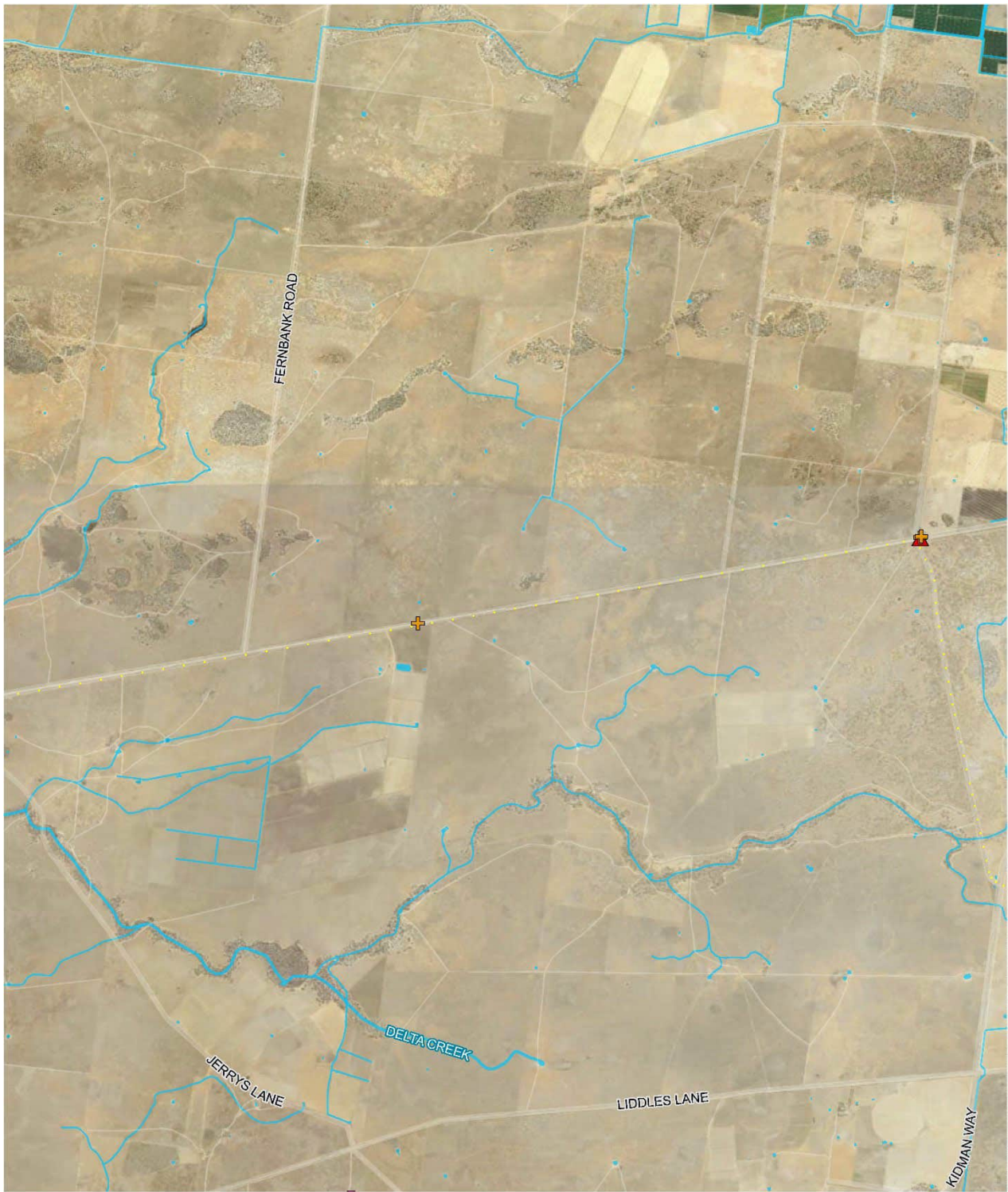
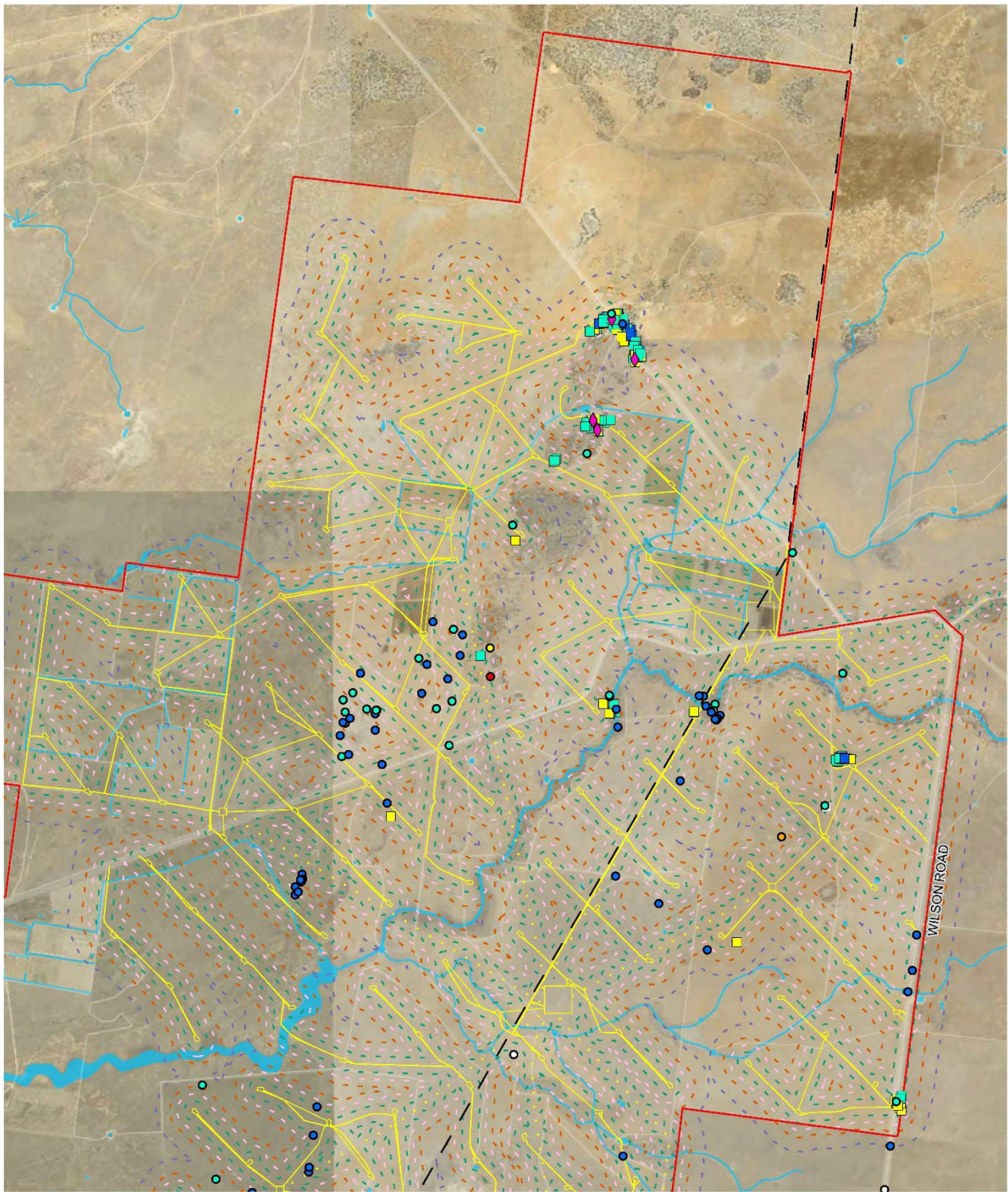


Figure 5-3. Location of targeted fauna surveys (Page 4 of 4)



- | | | |
|------------------|---------------------------|----------------------------------|
| Disturbance area | Stagwatches and spotlight | Waterways |
| Project area | Stick nest | Road |
| Habitat buffer | Very large | Existing 132kV transmission line |
| 100m | Large | |
| 200m | Medium | |
| 300m | Small | |
| 500m | Unknown | |
| | Hollow bearing tree | |
| | Large | |
| | Medium | |
| | Small | |
| | Unknown | |

0 1 2 km
 1:74,000 at A4
 GDA 1994 MGA Zone 55

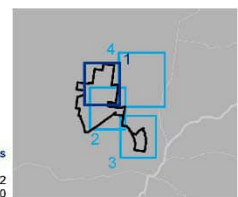
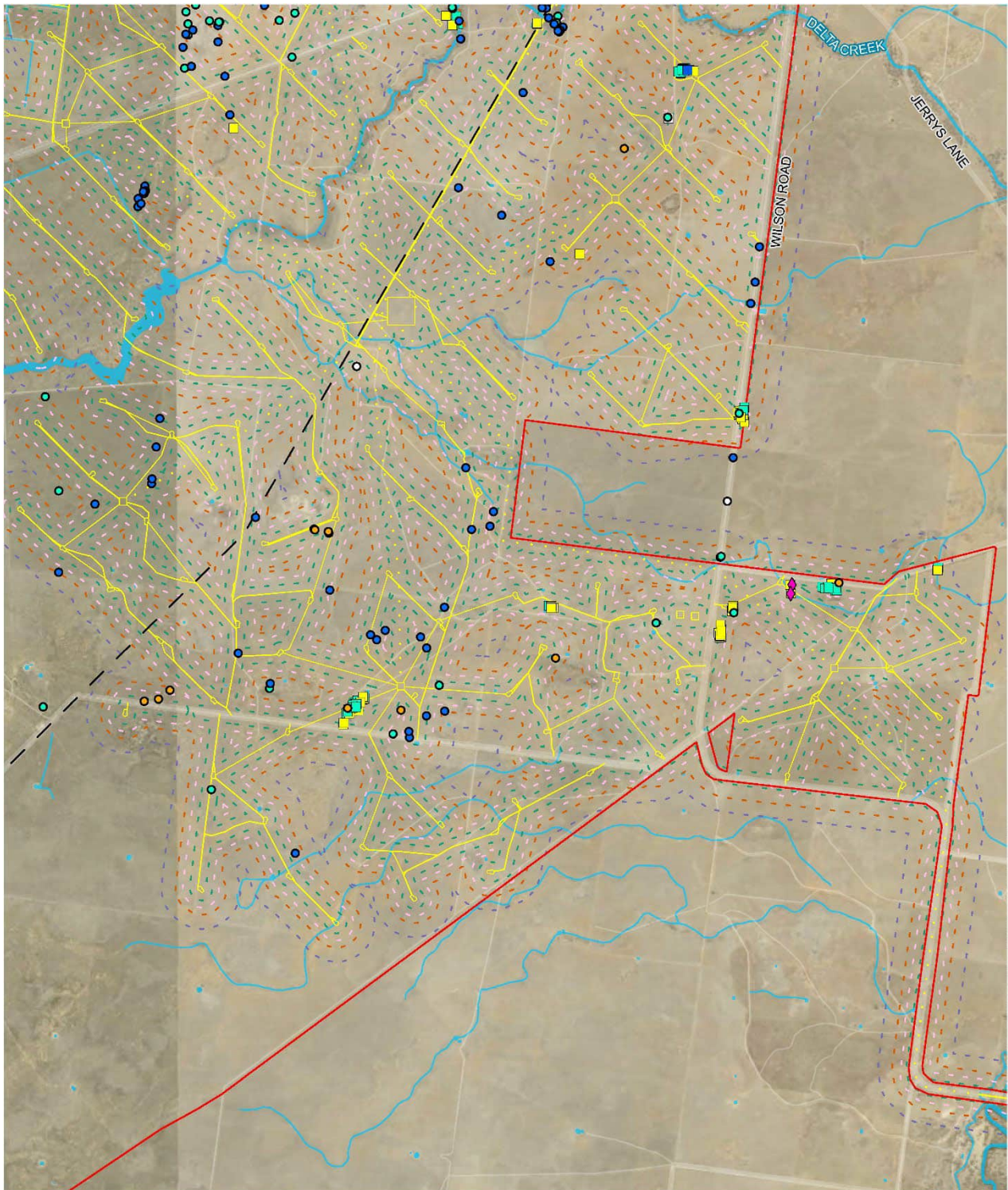
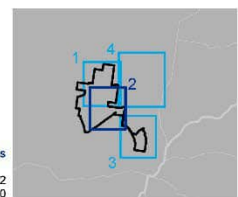


Figure 5-4. Targeted nest tree survey and stagwatches (Page 1 of 4)



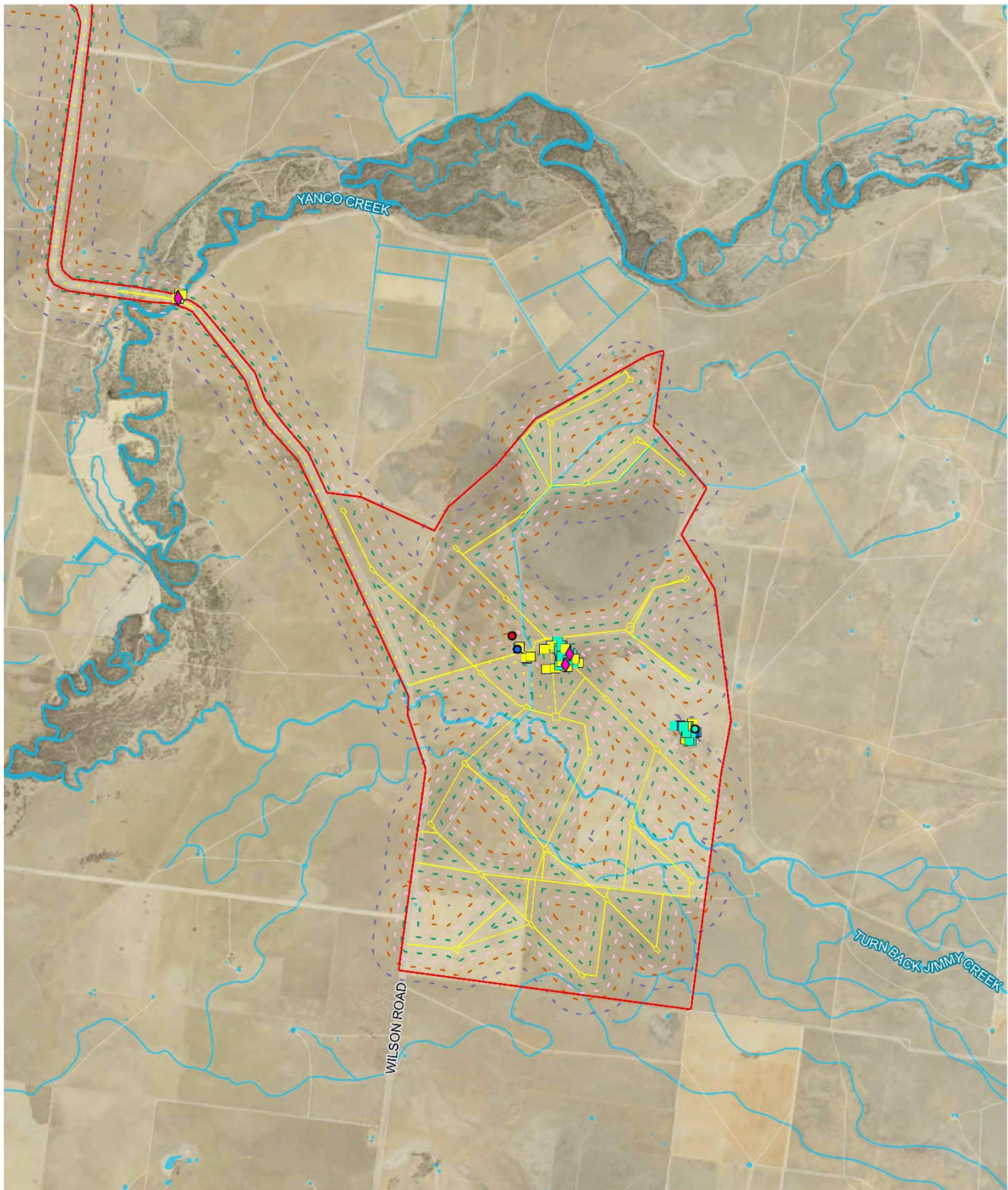
- | | | |
|------------------|-------------------------|----------------------------------|
| Disturbance area | Stagwatch and spotlight | Waterways |
| Project area | Stick nest | Road |
| Habitat buffer | Very large | Existing 132kV transmission line |
| 100m | Medium | |
| 200m | Small | |
| 300m | Unknown | |
| 500m | Hollow bearing tree | |
| | Large | |
| | Medium | |
| | Small | |
| | Unknown | |

0 1 2 km
 1:74,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
 © Department of Customer Service 2020

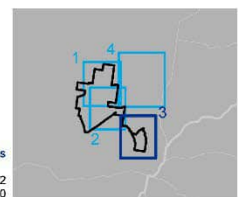
Figure 5-4. Targeted nest tree survey and stagwatch surveys (Page 2 of 4)



- | | | |
|------------------|-------------------------|-----------|
| Disturbance area | Stagwatch and spotlight | Waterways |
| Project area | Stick nest | Road |
| Habitat buffer | Extra Large | |
| 100m | Medium | |
| 200m | Small | |
| 300m | Hollow bearing tree | |
| 500m | Large | |
| | Medium | |
| | Small | |



1:74,000 at A4
GDA 1994 MGA Zone 55

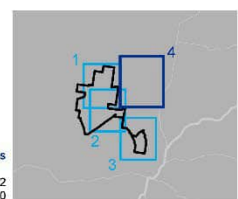
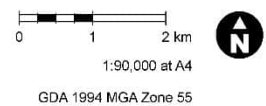


Data sources
Jacobs 2022
© Department of Customer Service 2020

Figure 5-4. Targeted nest tree survey and stagwatch surveys (Page 3 of 4)



- Disturbance area
- Waterways
- Road
- Habitat buffer**
- 100m
- 200m
- 300m
- 500m



Data sources
 Jacobs 2022
 © Department of Customer Service 2020

Figure 5-4. Targeted nest tree survey and stagwath surveys (Page 4 of 4)

5.3 Threatened species survey results

5.3.1 Threatened flora

To determine the presence of a candidate species-credit species, Subsection 5.2.4 of the BAM allows an assessor to consider several options. To determine presence, the assessor must:

- a. assume the species is present, or
- b. conduct a threatened species survey, as per Section 5.3 of the BAM, or
- c. obtain an expert report, or
- d. for candidate species including dual credit species, where the TBDC indicates that an important habitat map identifies the species credit component, the assessor must confirm whether the subject land is within an area identified on the important habitat map

Surveys were conducted in September 2021, November 2021, January 2022 and September 2022 which satisfies the requirements detailed in Section 5.3 of the BAM for all threatened flora species identified.

Fifteen threatened plant species were targeted during surveys of the study area. Two threatened plant species were found within the study area during targeted surveys including:

- *Swainsona murrayana* (Slender Darling Pea) – listed vulnerable under BC Act and EPBC Act
- *Swainsona sericea* (Silky Swainson-pea) listed vulnerable under BC Act.

5.3.1.1 *Swainsona murrayana* (Slender Darling Pea)

The survey period occurred in September 2021 and 2022 and were inside the main flowering period for this species. Surveys undertaken in September 2021 identified both *Swainsona murrayana* and *Swainsona sericea*. September 2022 surveys only recorded *Swainsona murrayana* (**Photo 5-1** and **Photo 5-2**). A total of 280 individual plants were recorded over both survey periods. Other common *Swainsona* were also recorded; *Swainsona procumbens* and *Swainsona swainsonioides*. All specimens for all species were collected and identification confirmed by the Australian National Herbarium in Canberra in ACT.

It is acknowledged that *Swainsona murrayana* dieback after flowering in September, however it is possible that plant remains would have still been identifiable during the November 2021 survey considering the high rainfall in the months preceding the survey.

Swainsona murrayana populations were recorded inside and outside the study area, and are generally widespread across the Project area except south of Yanco Creek. The Project design was extensively modified after recording populations in the September 2021 survey, and most populations were avoided. However, populations recorded in the September 2022 are at different locations in disturbance footprint. A 30 m buffer was placed around each point (individual or small cluster) to represent suitable habitat (habitat buffer) for the species in the study area (**Figure 5-5**). Habitat buffers are used to identify important habitat areas for *Swainsona murrayana* that needs to be avoided. The disturbance footprint intercepts with 1.69 hectares (species polygon) of known habitat for *Swainsona murrayana*.

An additional species polygon was added to the known population of *Swainsona murrayana* in locations with suitable habitat not surveyed and habitat must be assumed present. This includes 30.43 hectares, and comprises a total of 32.12 hectares of suitable habitat for this species in the disturbance footprint represented as a species polygon shown in **Figure 5-5** and **Figure 5-6**.



Photo 5-1. *Swainsona murrayana* specimen recorded north of Moonbria Lane (September 2021)



Photo 5-2. *Swainsona murrayana* specimen recorded north of Mabins Well Drive (September 2022)

5.3.1.2 *Swainsona sericea* (Silky Swainson-pea)

The survey period occurred in September 2021, 2022 and November 2022 and were inside the main flowering period for this species. Only surveys undertaken in September 2021 identified *Swainsona sericea*. A total of 11 individual plants were recorded the 2021 survey period (**Photo 5-3** and **Photo 5-4**). This species was recorded at Jerilderie Nature Reserve in November 2022, but flowers were senescent and no plants were recorded in the September 2022 survey. Specimens of *Swainsona sericea* specimens were collected and identification confirmed by the Australian National Herbarium in Canberra in ACT.

Swainsona sericea populations were recorded inside and outside the study area, restricted between Mabins Well Road and Moonbria Lane to the west of Wilson Road. A 30 m buffer was placed around each point (individual or small cluster) to represent suitable habitat (habitat buffer) for the species in the study area **Figure 5-5**). All known population of *Swainsona sericea* have been avoided by the Project and no species polygon occurs in the disturbance footprint. However, an additional species polygon to represent suitable habitat not surveyed where species are assumed present. This includes 27.24 hectares of suitable habitat for this species in the disturbance footprint represented as a species polygon shown in **Figure 5-5**.



Photo 5-3. *Swainsona sericea* specimen recorded north of Moonbria Lane (September 2021)



Photo 5-4. *Swainsona sericea* specimen recorded west of Wilson Road (September 2021)

5.3.1.3 Threatened flora assumed present

Due to limitations in accessing all of the disturbance footprint for targeted survey of threatened flora, remaining areas of suitable habitat that we not traversed are assumed to be habitat for 14 candidate species with exception of *Eucalyptus leucoxyton* subsp. *pruinosa*. In associated PCTs, targeted survey gaps comprised:

- 36.05 hectares in September 2021 and 2022 surveys
- 89.47 hectares in November 2021 survey
- 35.29 hectares in January 2022 survey.

Suitable habitat in these survey gap locations assumed presence for the following threatened flora:

- *Austrostipa wakoolica* – PCTs 17, 26, 28
- *Brachyscome muelleroides* – PCTs 44, 45, 46
- *Brachyscome papillosa* - PCTs 44, 45, 46, 160
- *Caladenia arenaria* – PCT 28
- *Convolvulus tedmorei* –PCTs 26, 44
- *Cullen parvum* - PCTs 7, 9, 44
- *Lepidium monoplocoides* - PCTs 26, 160
- *Leptorhynchos orientalis* – PCTs 26, 44, 45, 46
- *Maireana cheelii* –PCTs 26, 44, 46

- *Pilularia novae-hollandiae* – PCTs 9, 13, 26, 45
- *Sclerolaena napiformis* – PCTs 26, PCT 44
- *Swainsona murrayana* – PCTs 26, 28, 44, 45, 46
- *Swainsona plagiotropis* – PCTs 26, 44, 45, 46
- *Swainsona sericea* – PCTs 26, 28, 44, 45, 46.

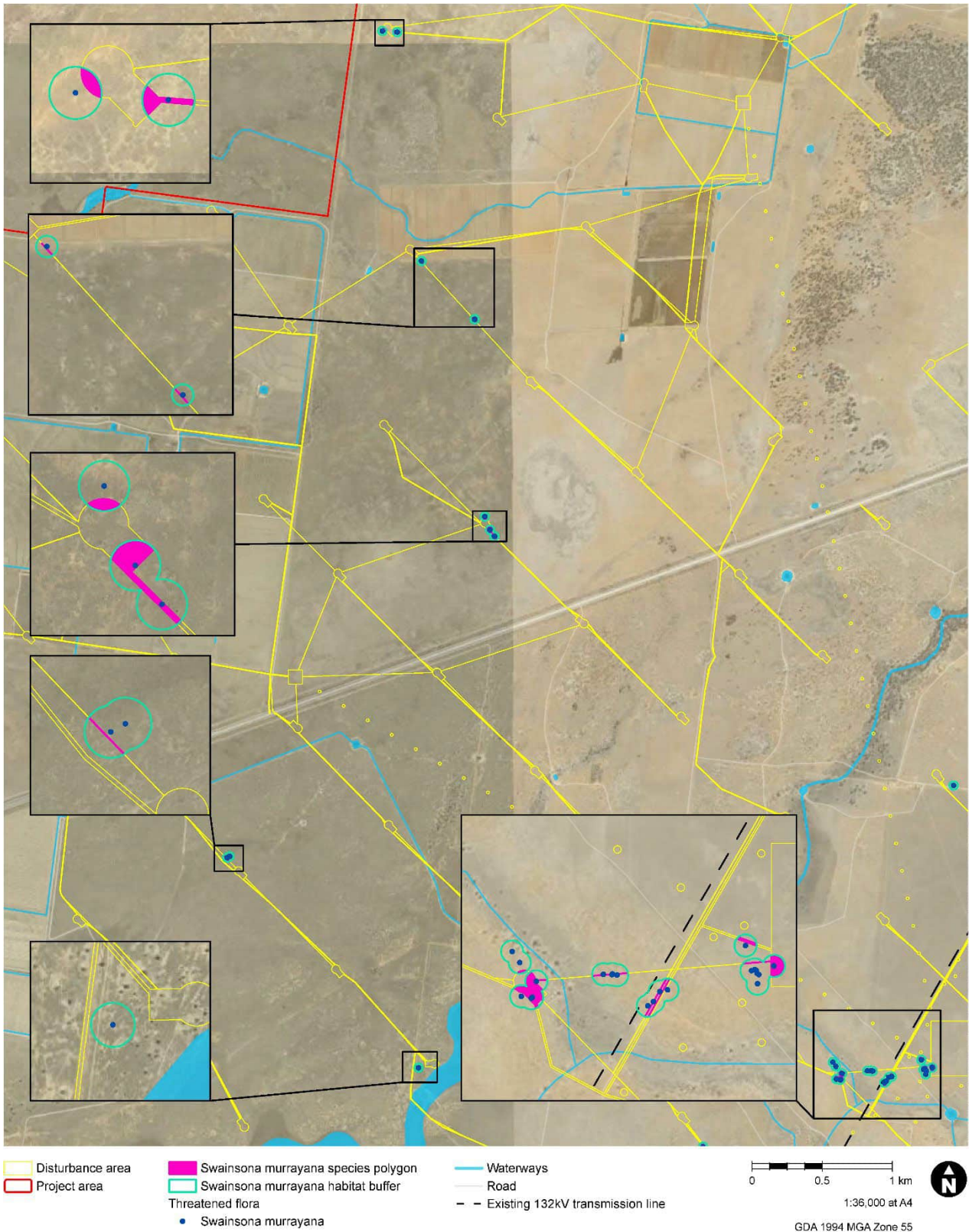


Figure 5-5. *Swainsona murrayana* and *Swainsona sericea* habitat buffers and species polygons (Page 1 of 4)

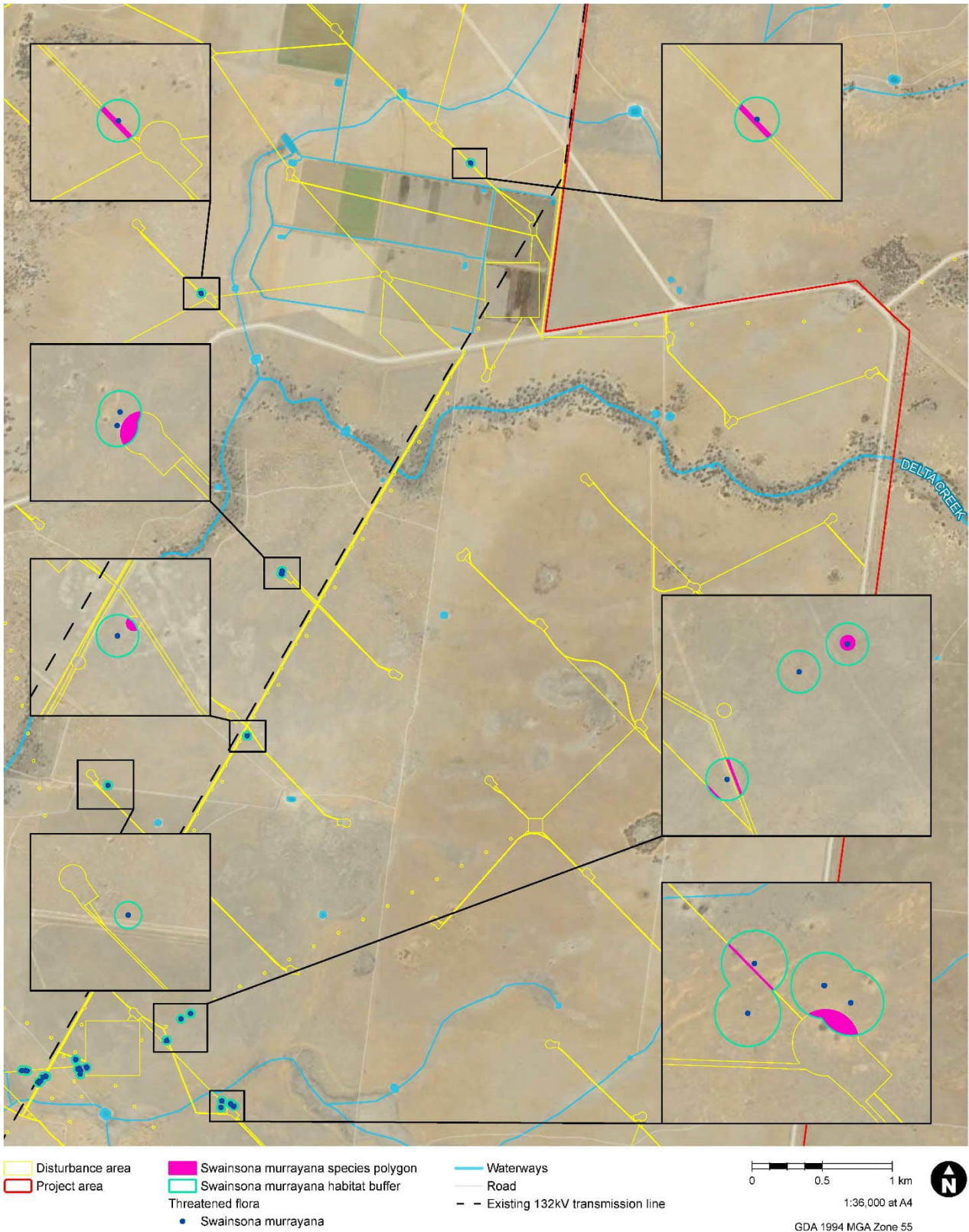


Figure 5-5. *Swainsona murrayana* and *Swainsona sericea* habitat buffers and species polygons (Page 2 of 4)

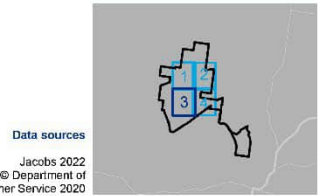
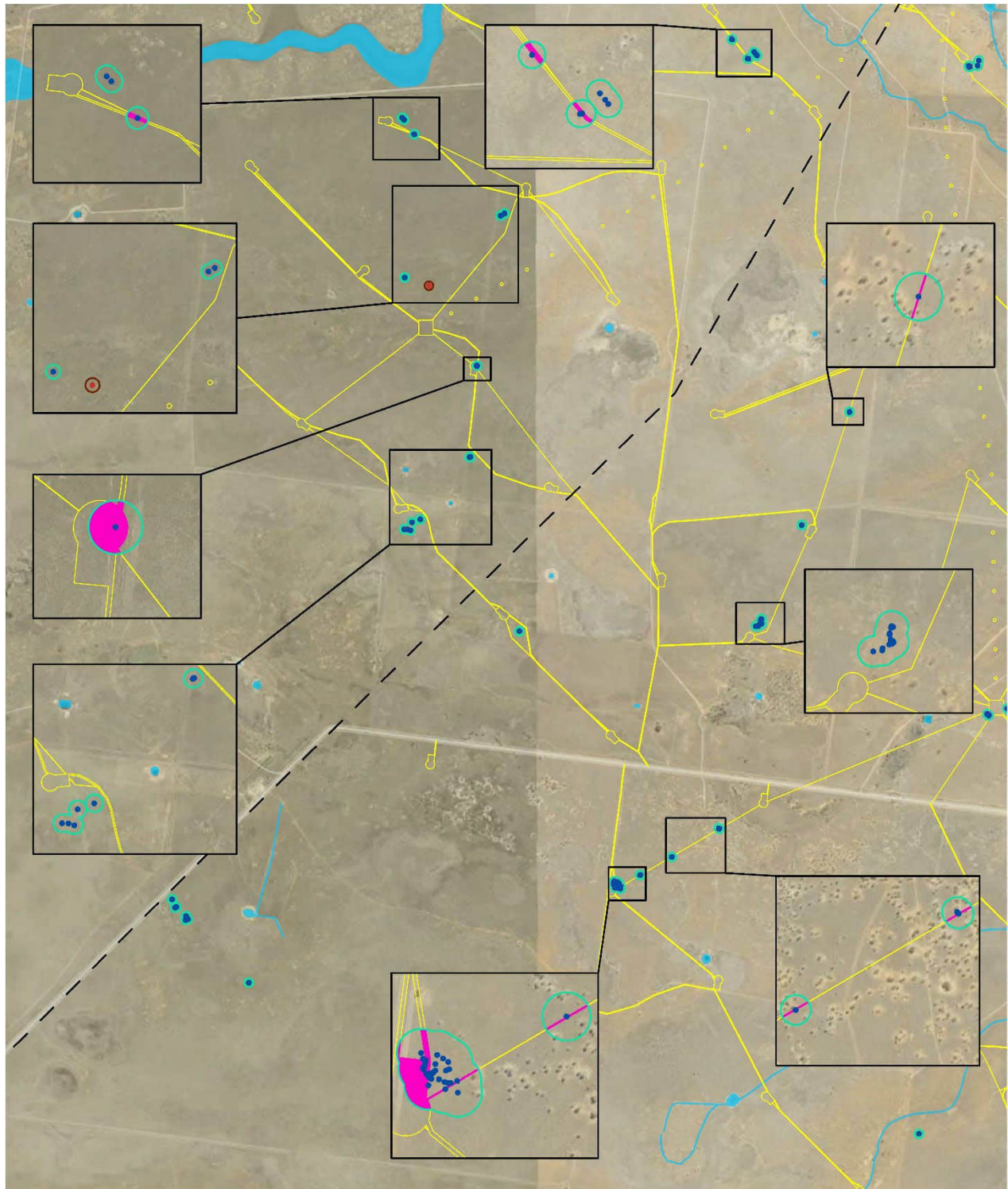


Figure 5-5. *Swainsona murrayana* and *Swainsona sericea* habitat buffers and species polygons (Page 3 of 4)

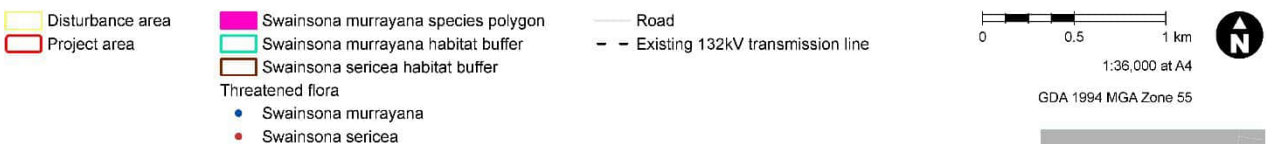
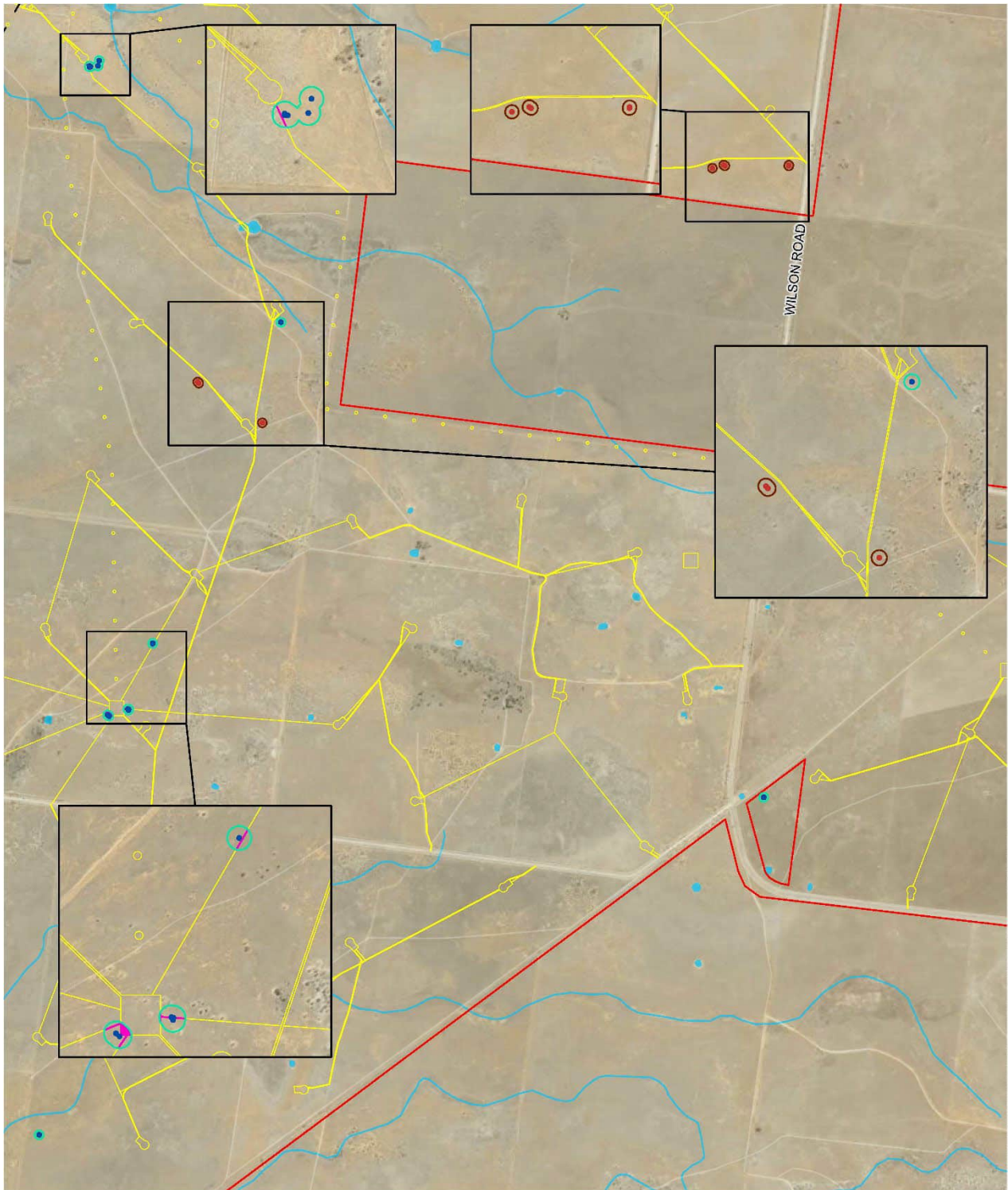


Figure 5-5. *Swainsona murrayana* and *Swainsona sericea* habitat buffers and species polygons (Page 4 of 4)

Data sources
 Jacobs 2022
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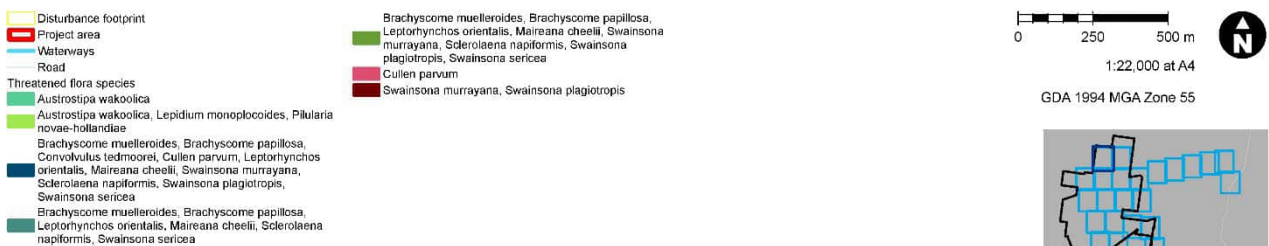
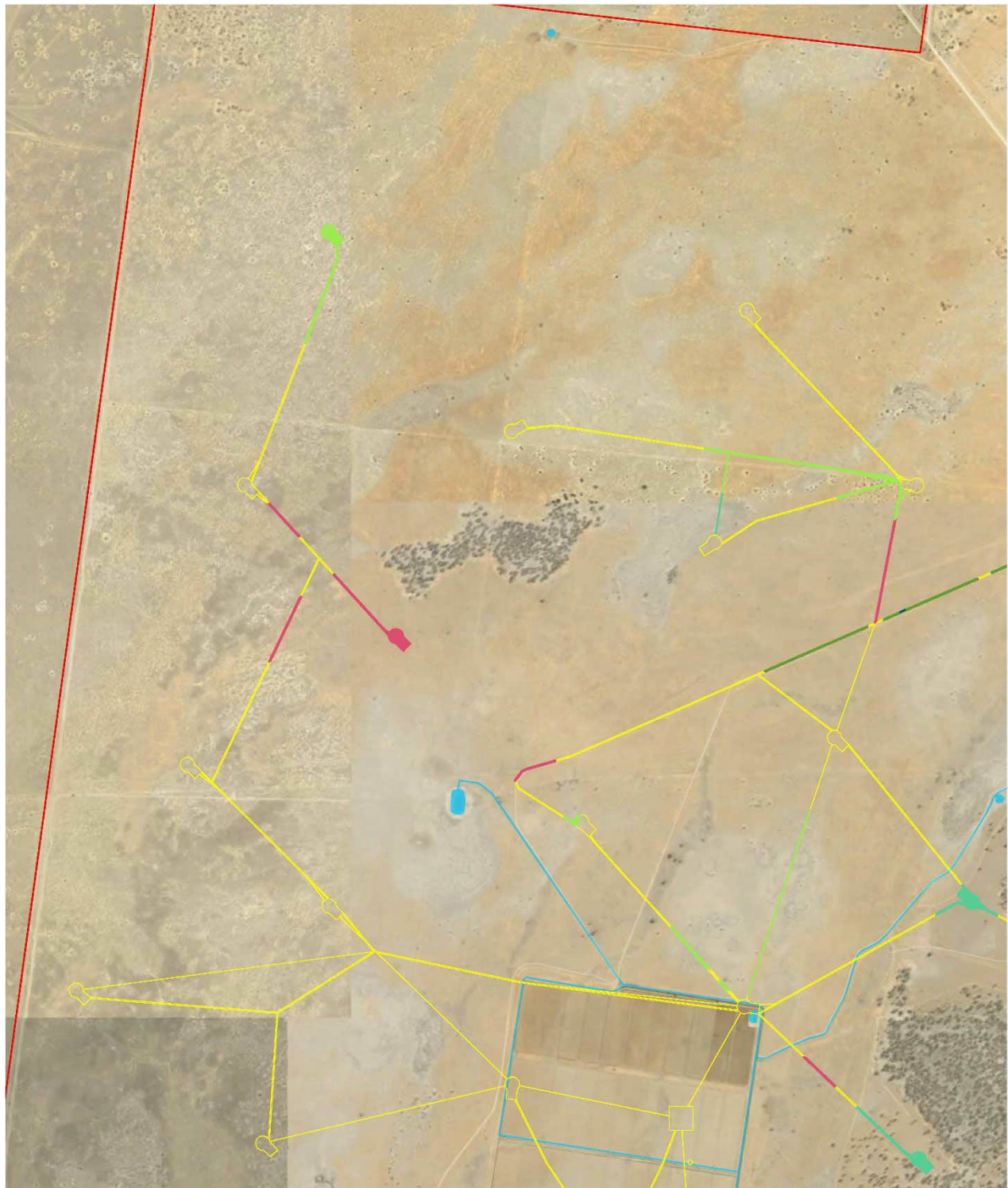


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 1 of 27)

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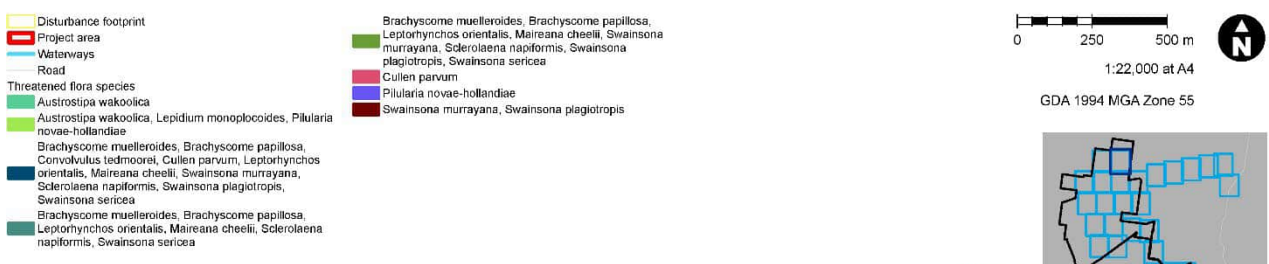
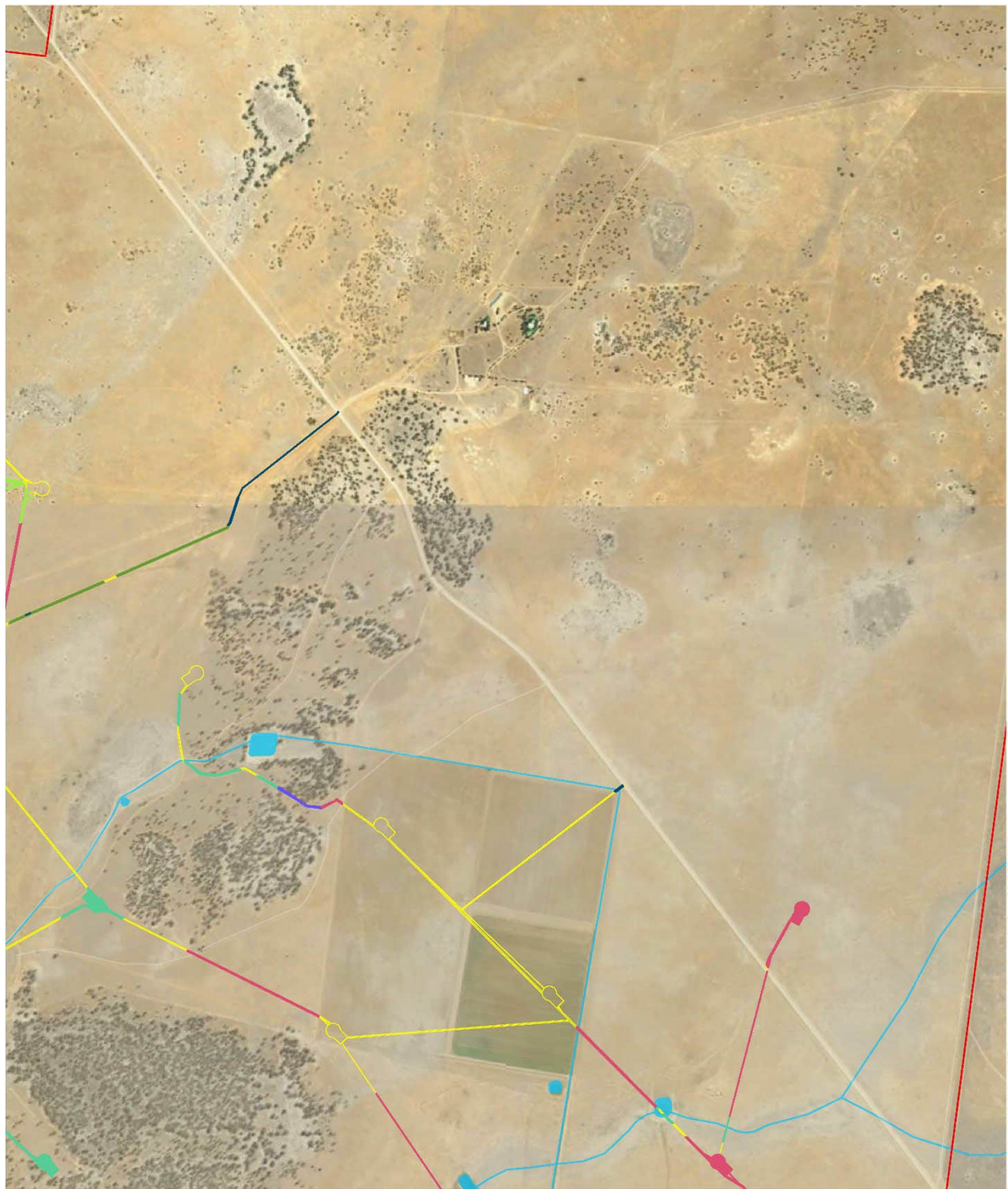
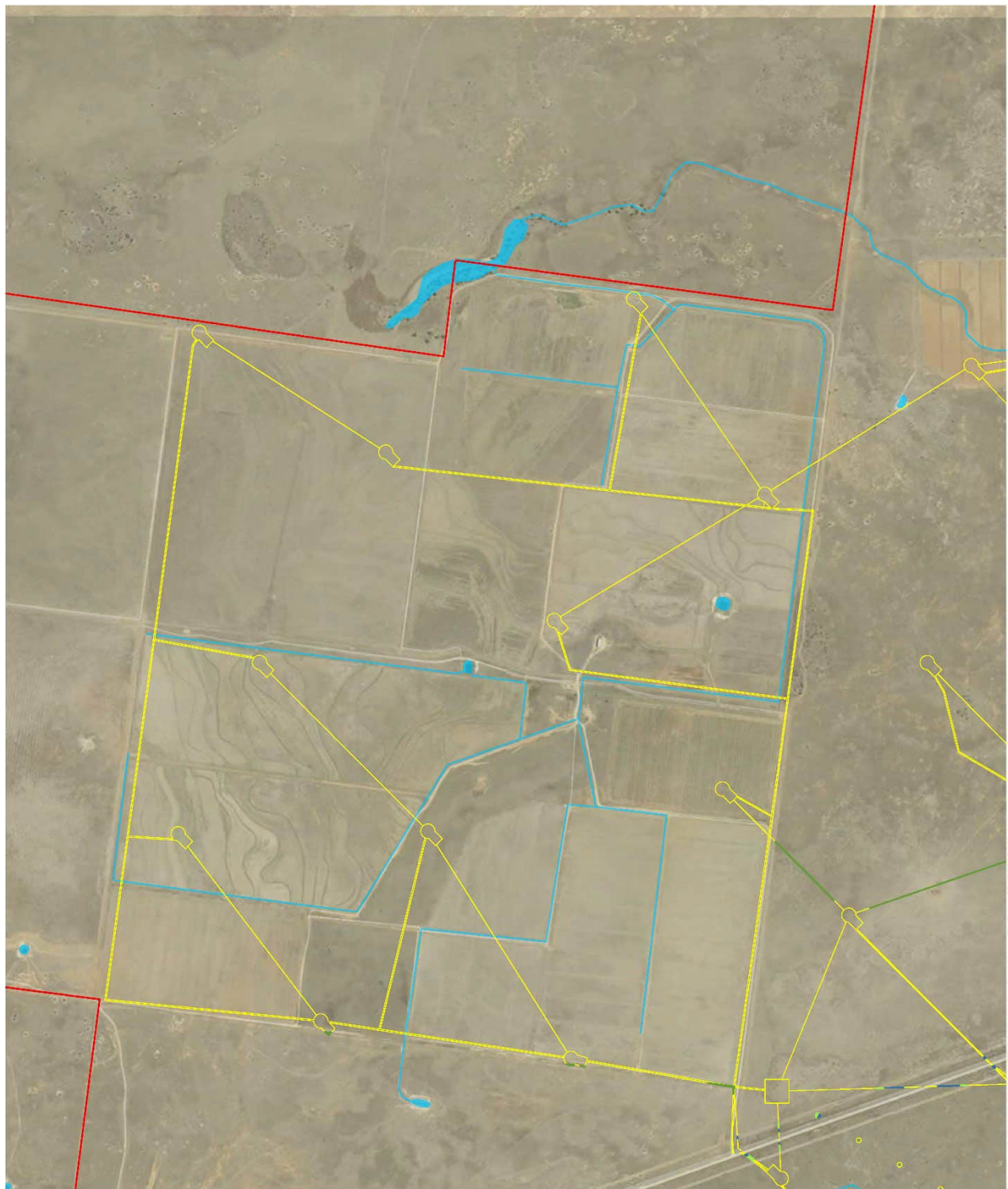
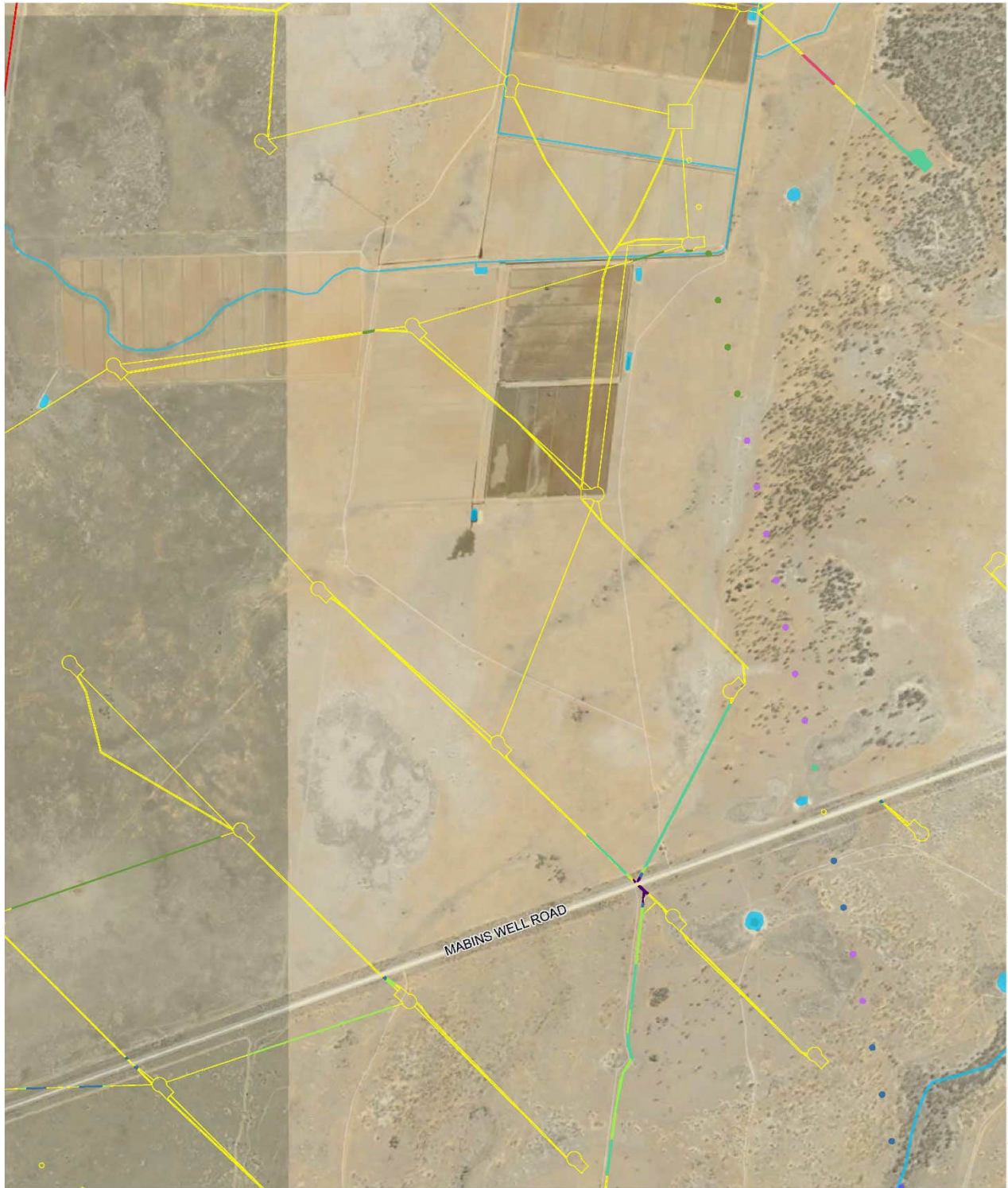


Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 2 of 27)



<p>Disturbance footprint</p> <p>Project area</p> <p>Wetlanways</p> <p>Road</p> <p>Threatened flora species</p> <ul style="list-style-type: none"> ■ <i>Austrostipa wakoolica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplacoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> ■ <i>Austrostipa wakoolica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplacoides</i>, <i>Ptilularia novae-hollandiae</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> ■ <i>Austrostipa wakoolica</i>, <i>Lepidium monoplacoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> ■ <i>Austrostipa wakoolica</i>, <i>Lepidium monoplacoides</i>, <i>Ptilularia novae-hollandiae</i> 	<ul style="list-style-type: none"> ■ <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> ■ <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Swainsona murrayana</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> ■ <i>Convolvulus tedmoorei</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> ■ <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> 	<p>0 250 500 m</p> <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> <p>Data sources</p> <p>Jacobs 2022</p> <p>© Department of Customer Service 2020</p>
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Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 3 of 27)



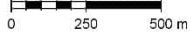

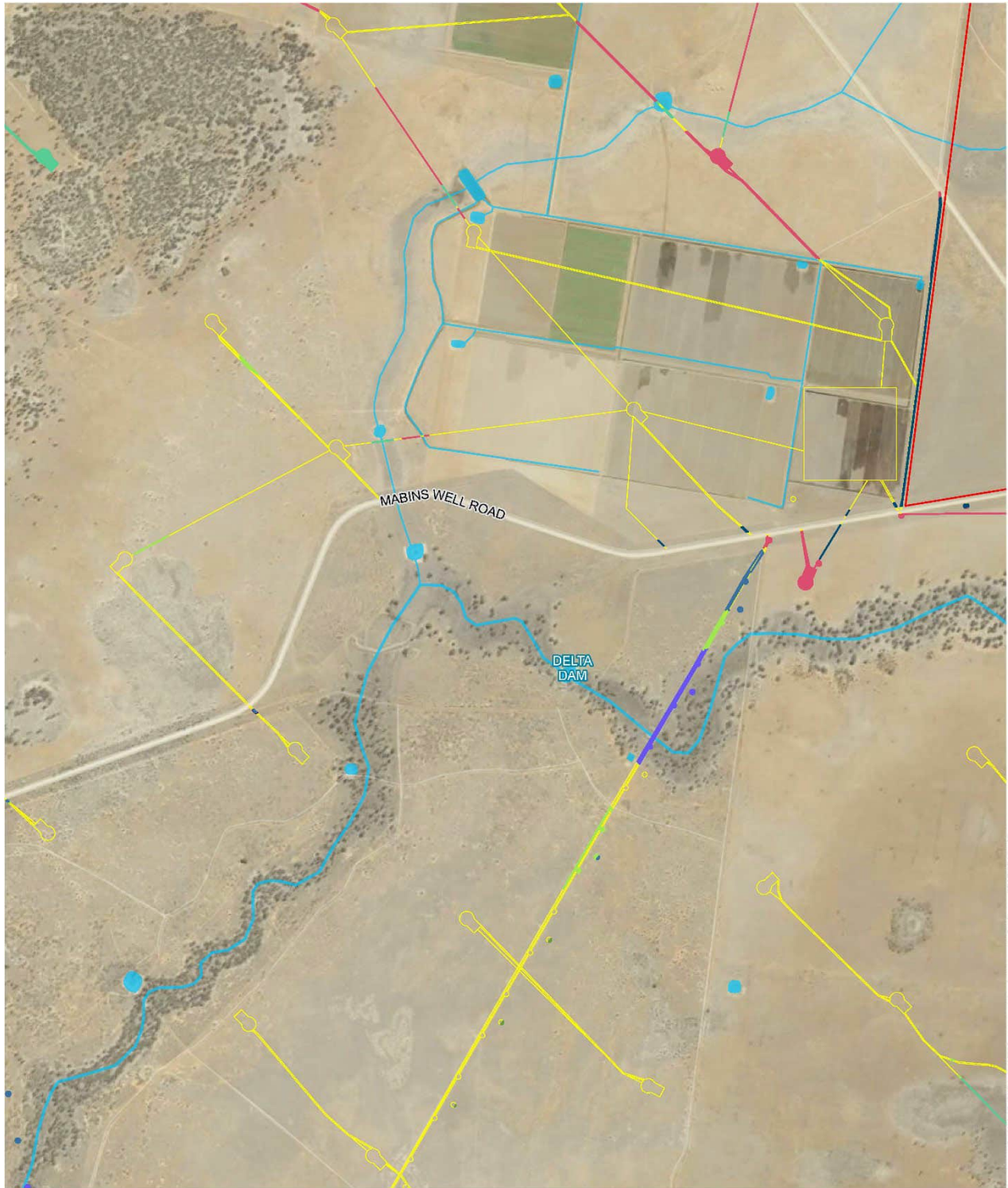
<ul style="list-style-type: none"> □ Disturbance footprint □ Project area — Waterways — Road <p>Threatened flora species</p> <ul style="list-style-type: none"> □ <i>Austrostipa wakoocica</i> □ <i>Austrostipa wakoocica</i>, <i>Caladenia arenaria</i>, <i>Swainsona murrayana</i>, <i>Swainsona sericea</i> □ <i>Austrostipa wakoocica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> □ <i>Austrostipa wakoocica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplocoides</i>, <i>Ptilularia novae-hollandiae</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> 	<ul style="list-style-type: none"> □ <i>Austrostipa wakoocica</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> □ <i>Austrostipa wakoocica</i>, <i>Lepidium monoplocoides</i>, <i>Ptilularia novae-hollandiae</i> □ <i>Brachyscome mueleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Swainsona murrayana</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> □ <i>Convolvulus tedmoorei</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> □ <i>Cullen parvum</i> □ <i>Ptilularia novae-hollandiae</i> 	<div style="text-align: right;">  <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p>  </div>
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Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 4 of 27)



<ul style="list-style-type: none"> Disturbance footprint Project area Waterways Road <p>Threatened flora species</p> <ul style="list-style-type: none"> <i>Austrostipa wakoolica</i> <i>Austrostipa wakoolica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> <i>Austrostipa wakoolica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplocoides</i>, <i>Ptilularia novae-hollandiae</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> <i>Austrostipa wakoolica</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i> 	<ul style="list-style-type: none"> <i>Austrostipa wakoolica</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> <i>Austrostipa wakoolica</i>, <i>Lepidium monoplocoides</i>, <i>Ptilularia novae-hollandiae</i> <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Brachyscome papillosa</i>, <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Convolvulus tedmoorei</i>, <i>Cullen parvum</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Swainsona murrayana</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Cullen parvum</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> 	<ul style="list-style-type: none"> <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchos orientalis</i>, <i>Maireana cheelii</i>, <i>Swainsona murrayana</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> <i>Brachyscome papillosa</i>, <i>Convolvulus tedmoorei</i>, <i>Maireana cheelii</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> <i>Convolvulus tedmoorei</i>, <i>Cullen parvum</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> <i>Convolvulus tedmoorei</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> <i>Cullen parvum</i> <i>Ptilularia novae-hollandiae</i> <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> 	<div style="text-align: right;"> <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> </div> <div style="text-align: right; margin-top: 10px;"> <p>Data sources</p> <p>Jacobs 2022 © Department of Customer Service 2020</p> </div>
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Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 5 of 27)

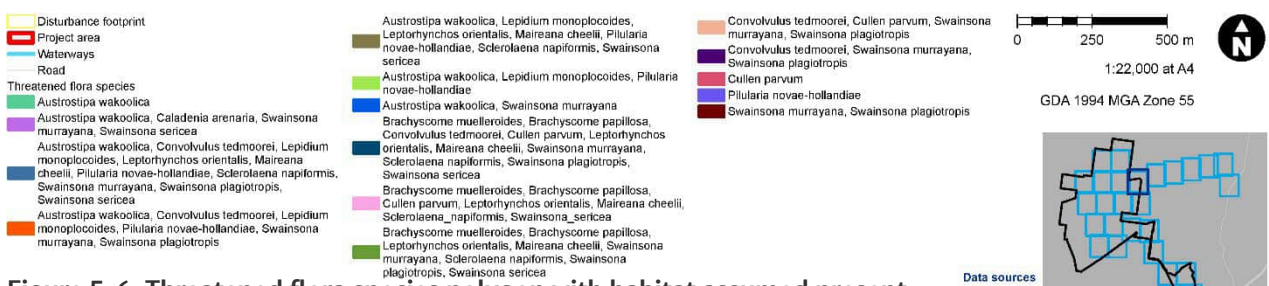
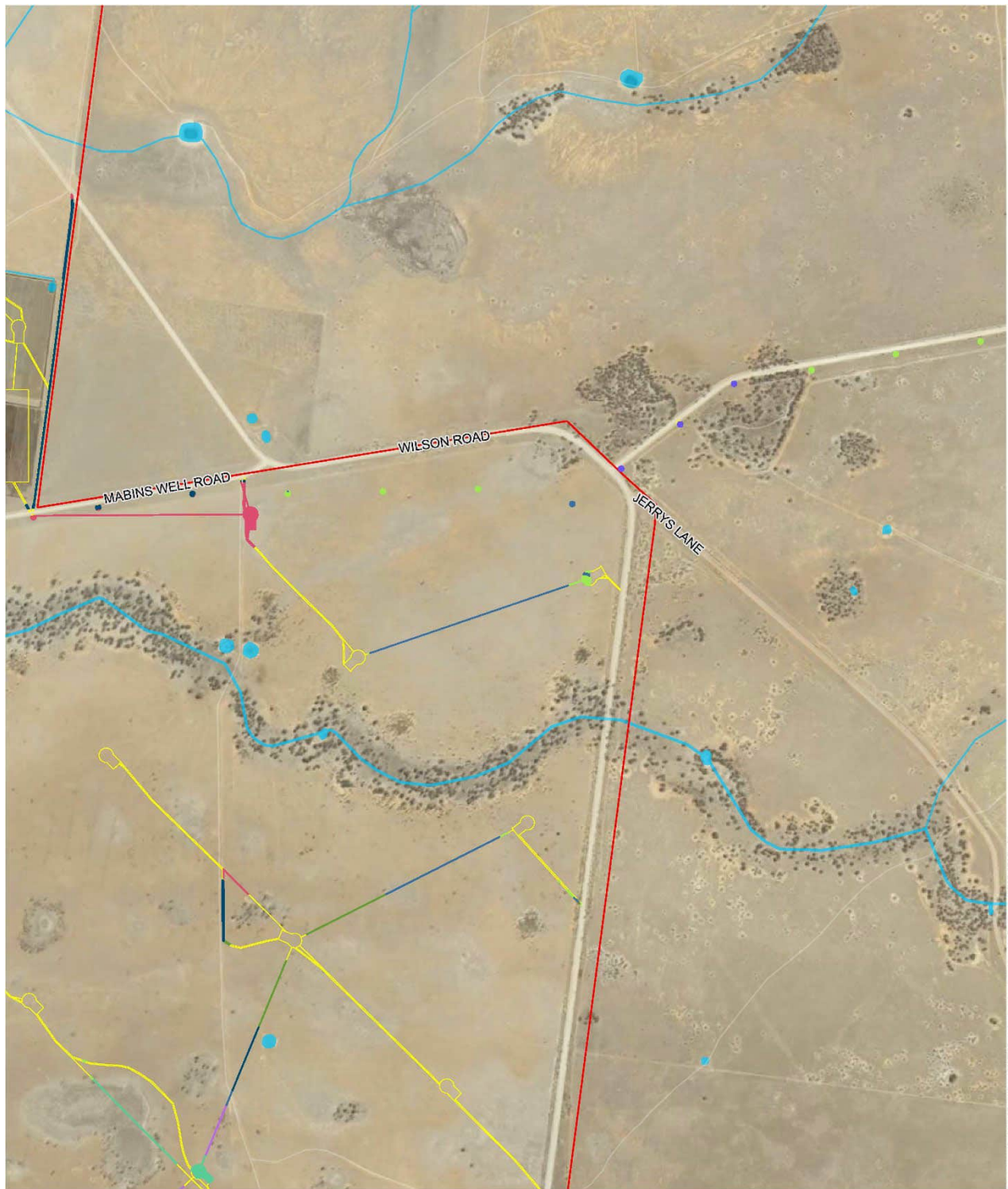
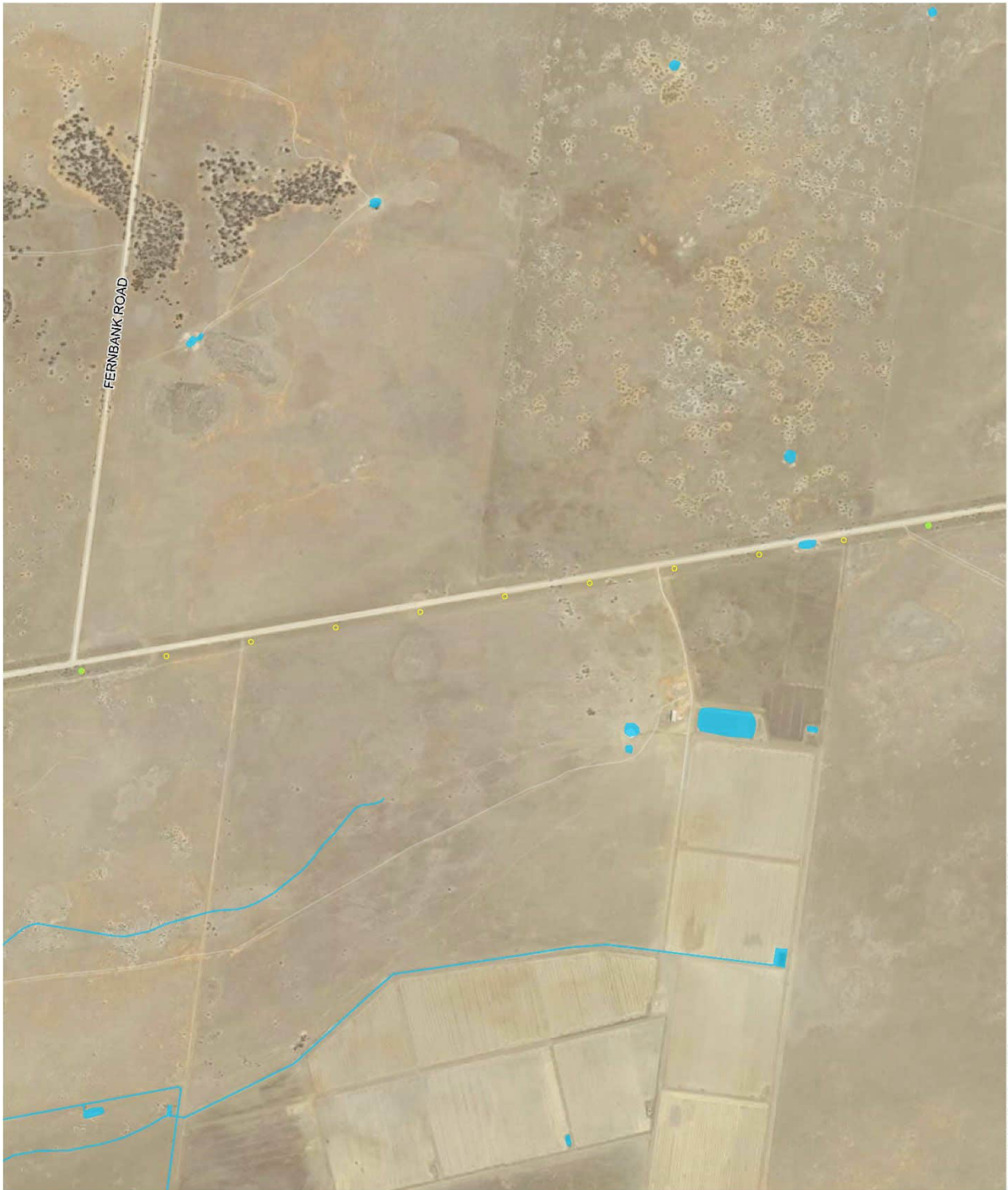


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 6 of 27)



Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 7 of 27)



- Disturbance footprint
- Wetland
- Road
- Threatened flora species
- Austrostipa wakoolica*, *Lepidium monolocoides*, *Pikularia novae-hollandiae*

0 250 500 m

1:22,000 at A4

GDA 1994 MGA Zone 55

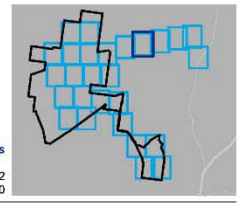
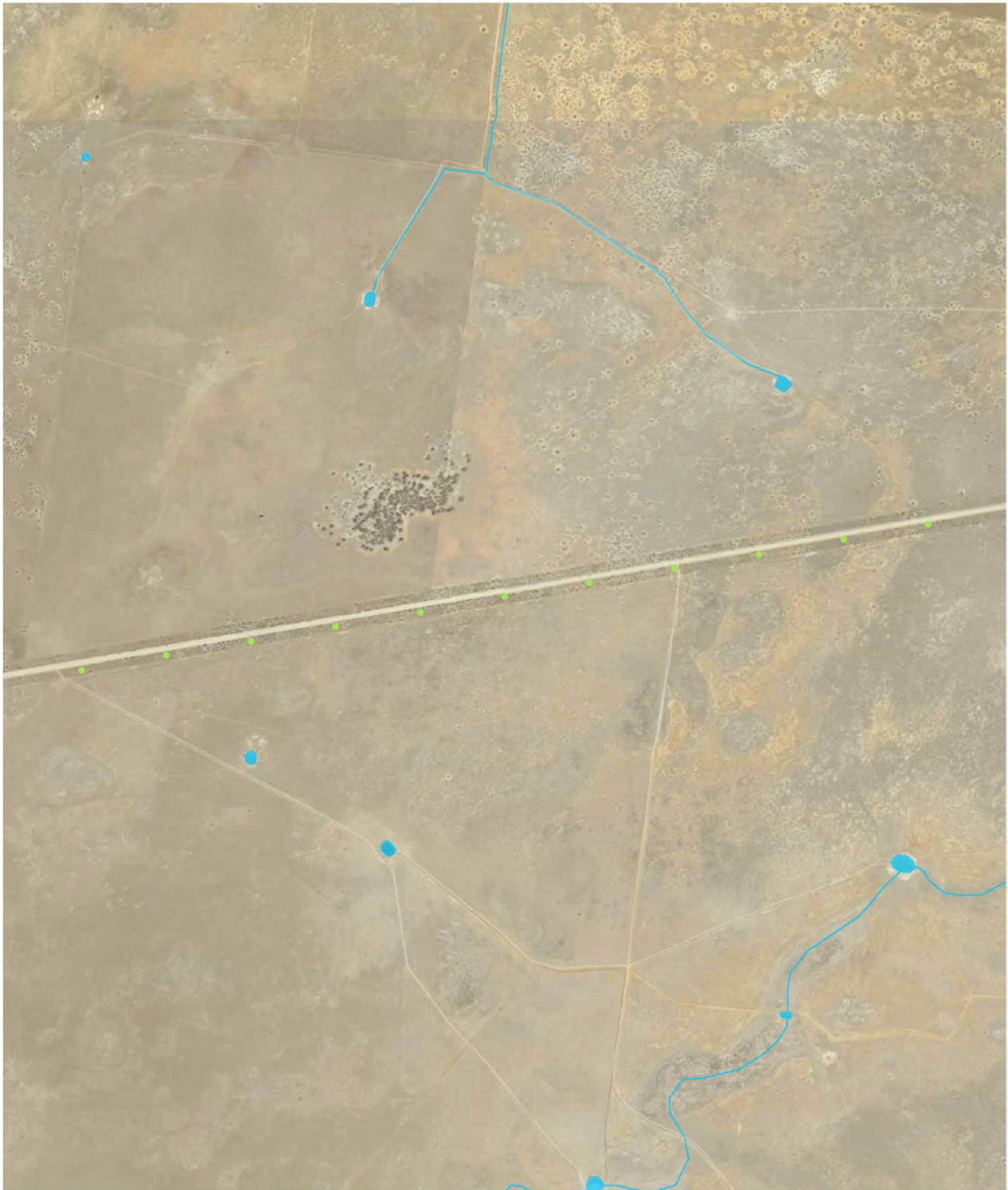
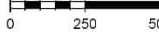



Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 8 of 27)

Data sources
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- Disturbance footprint
- Westerways
- Road
- Threatened flora species**
- Austrostipa wakoolica*, *Lepidium monoplacoides*, *Ptilularia novae-hollandiae*

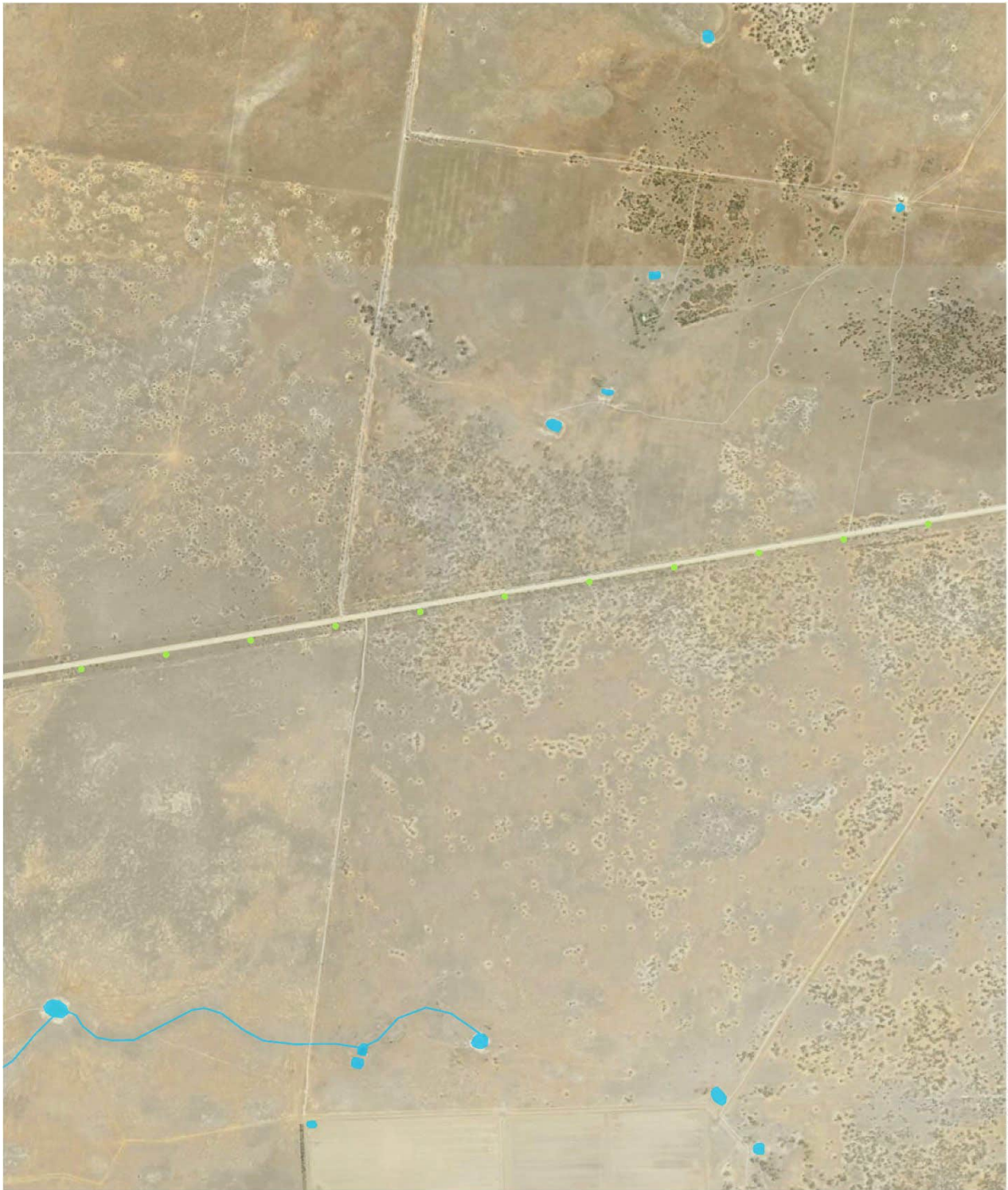



1:22,000 at A4
GDA 1994 MGA Zone 55



Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 9 of 27)

Data sources
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- ▭ Disturbance footprint
- Westerly waterways
- Road
- Threatened flora species
 - ▭ *Austrostipa wakoolica*, *Lepidium monoplacoides*, *Pikularia novae-hollandiae*

0 250 500 m

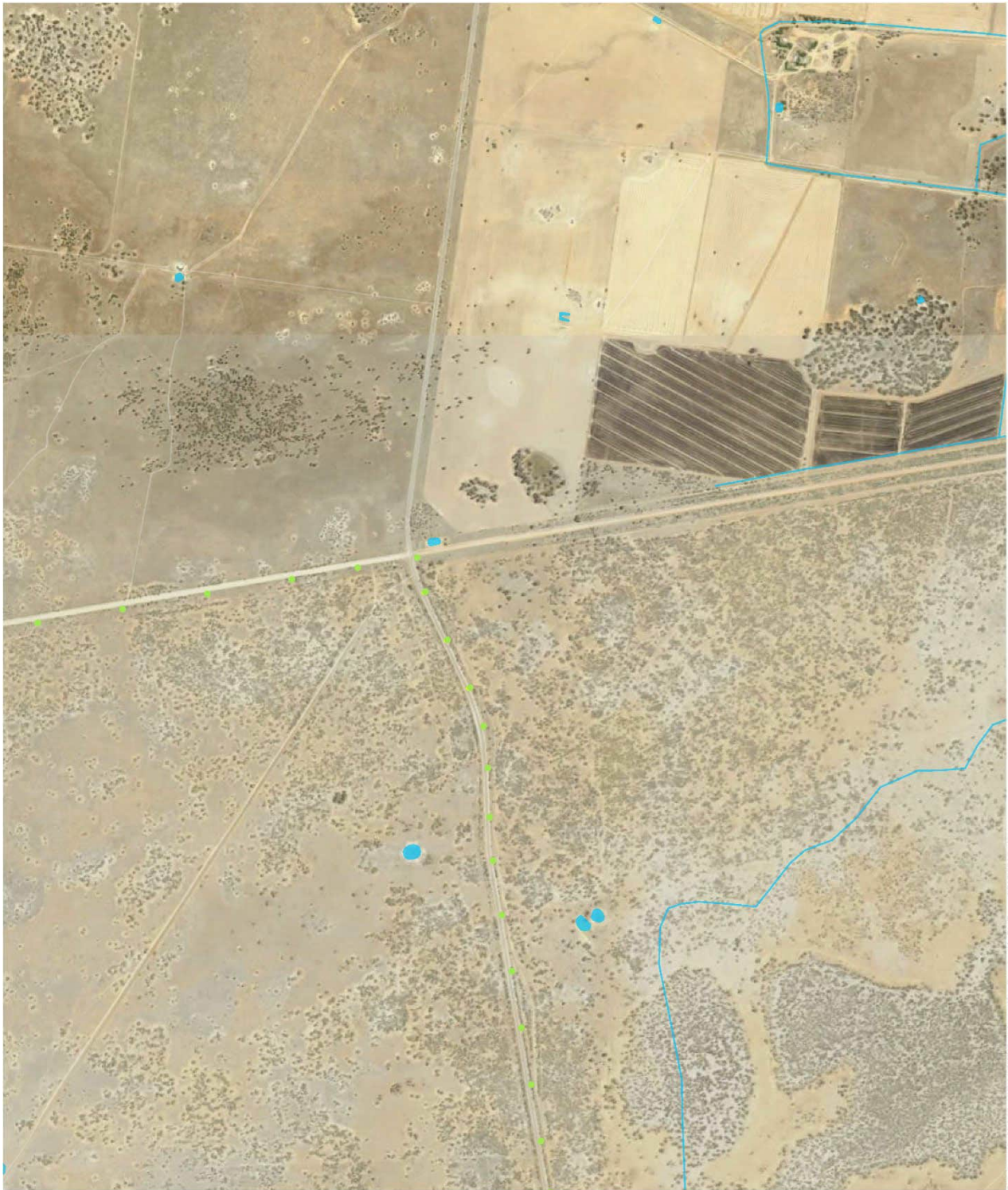
1:22,000 at A4

GDA 1994 MGA Zone 55



Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 10 of 27)

Data sources
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■ Disturbance footprint
■ Wetterways
■ Road
 Threatened flora species
● *Austrostipa wakoolica*, *Lepidium monoplacoides*, *Pilularia novae-hollandiae*

0 250 500 m
 1:22,000 at A4
 © Department of Customer Service 2020

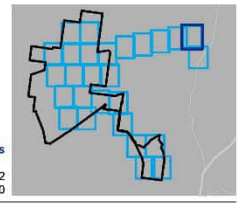
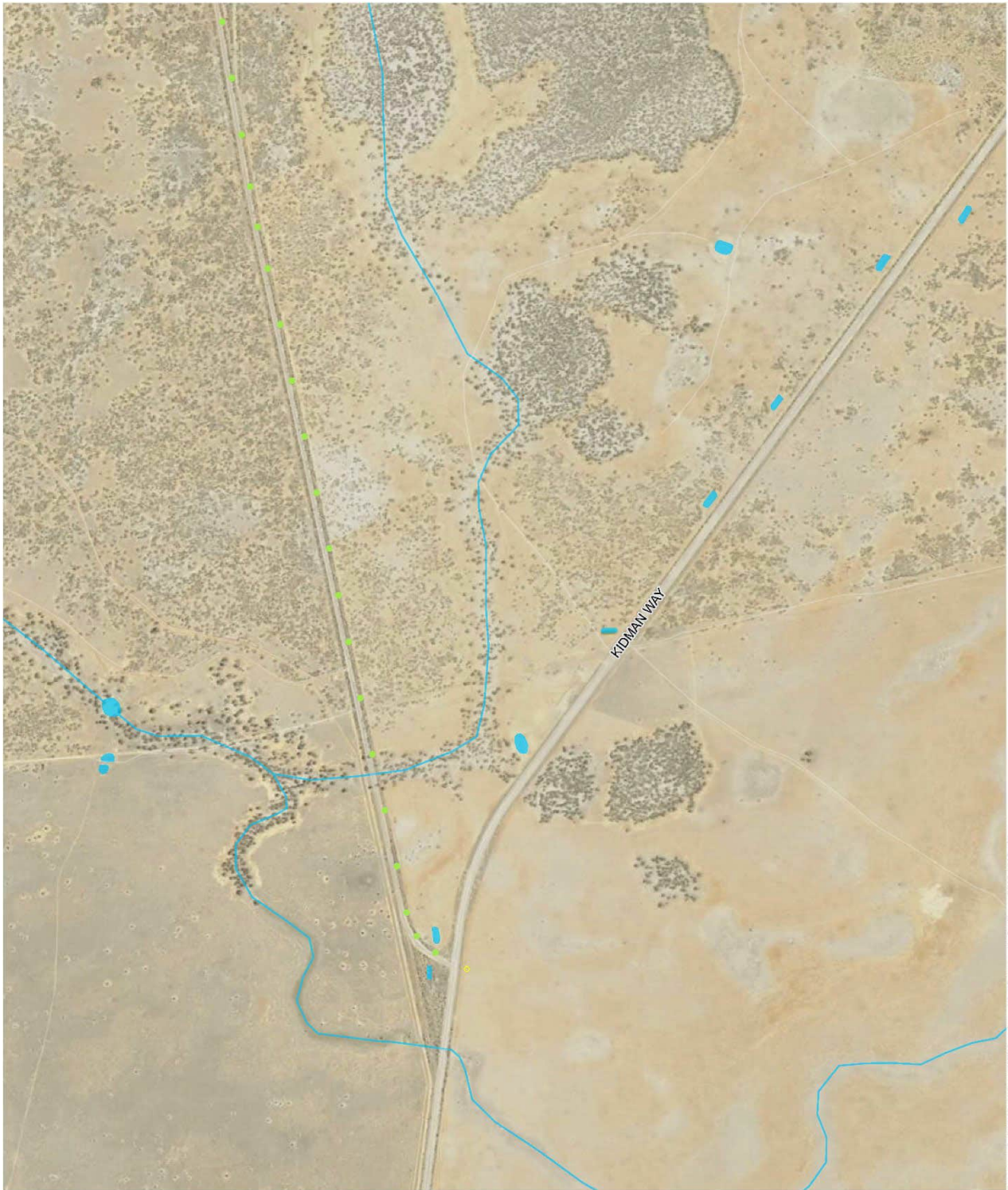
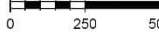


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 11 of 27)


Data sources
 Jacobs 2022
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- Disturbance footprint
- Watersways
- Road
- Threatened flora species
- Austrostipa wakoolica*, *Lepidium monoplacoides*, *Ptilularia novae-hollandiae*



 1:22,000 at A4



 GDA 1994 MGA Zone 55

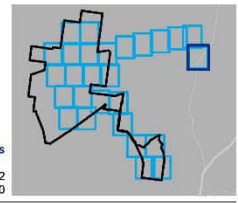


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 12 of 27)

Data sources
 Jacobs 2022
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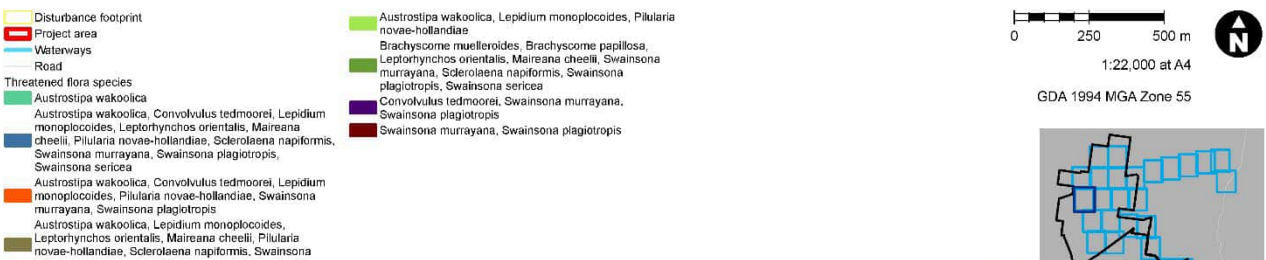
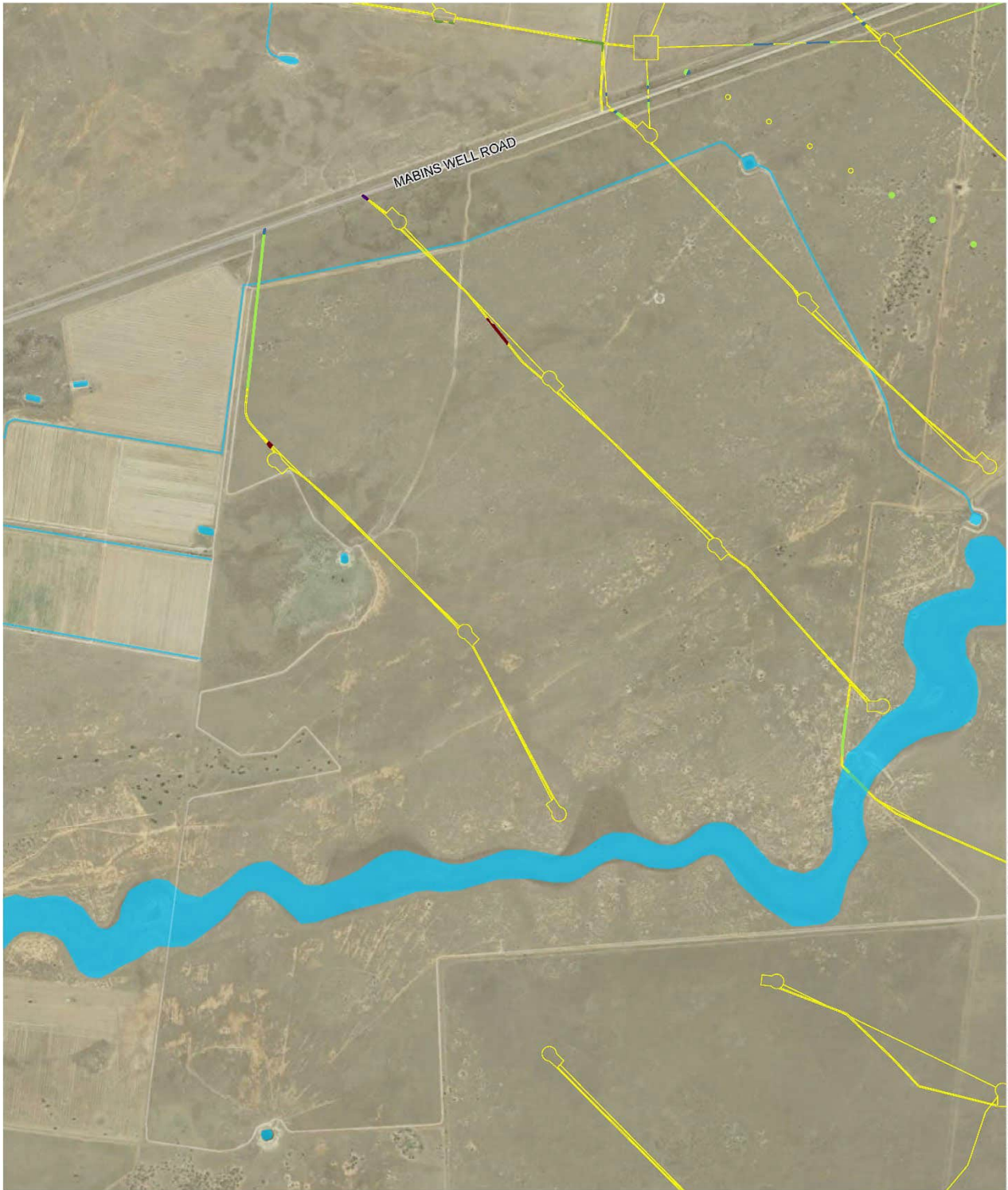


Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 13 of 27)

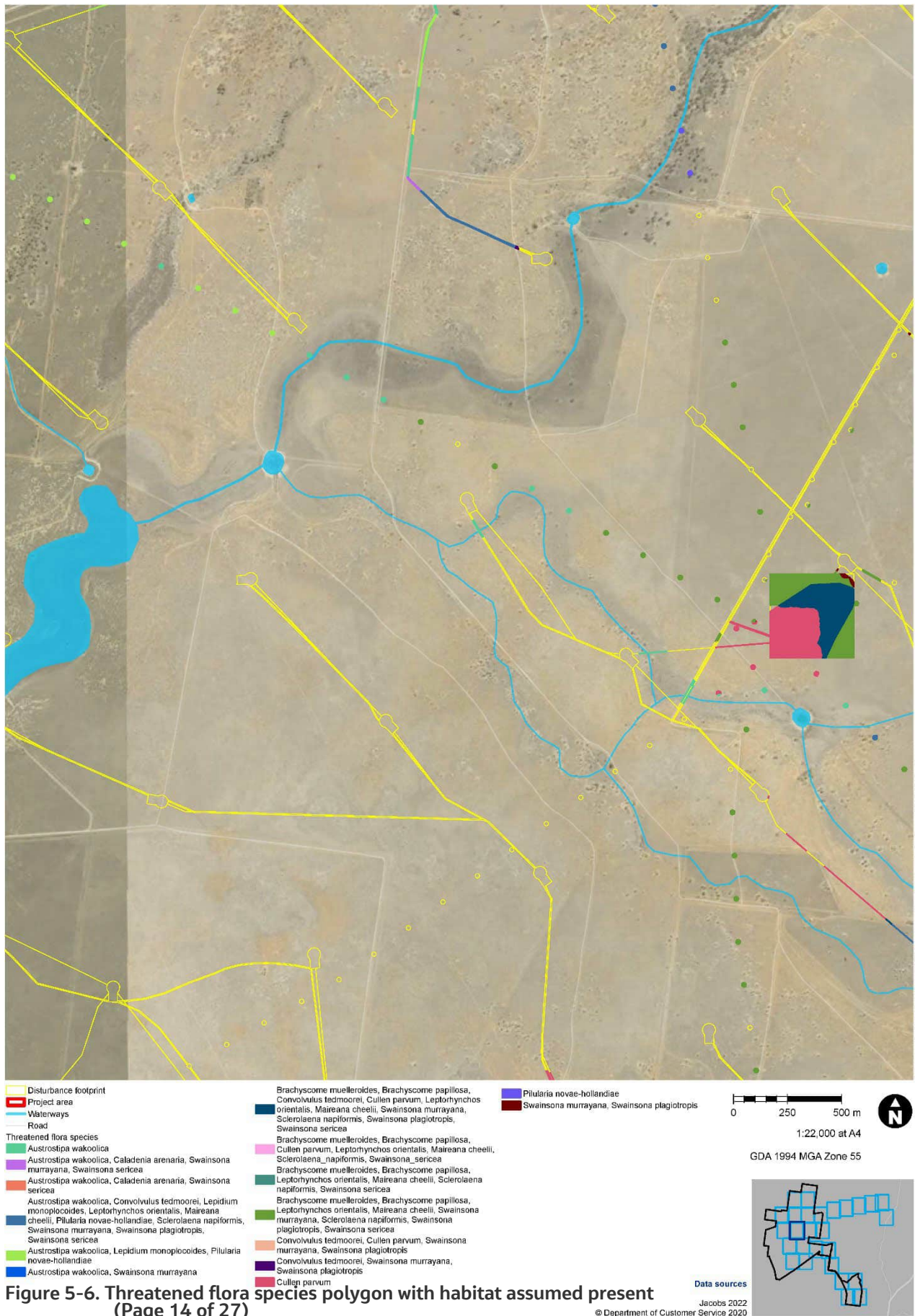


Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 14 of 27)

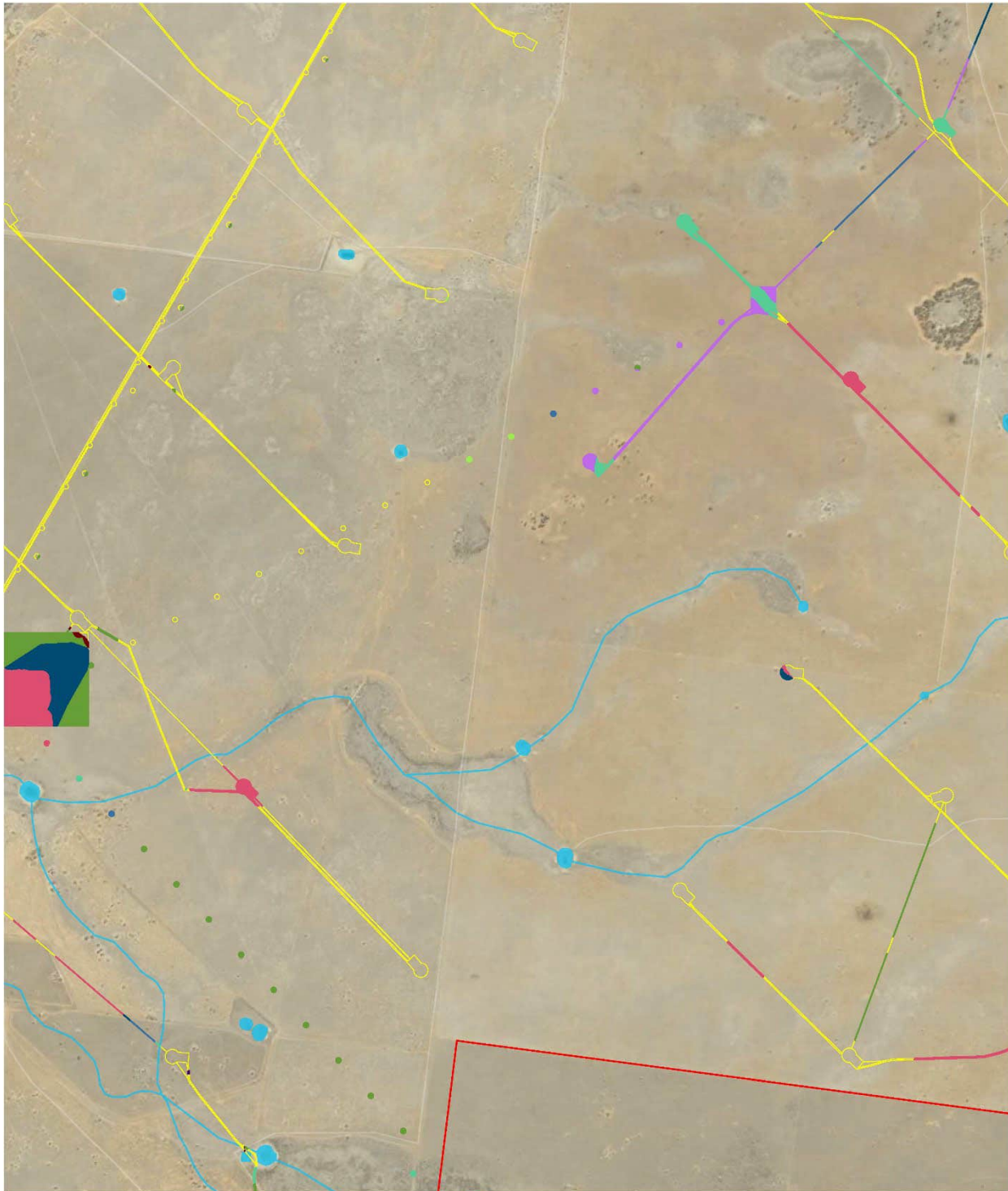


Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 15 of 27)

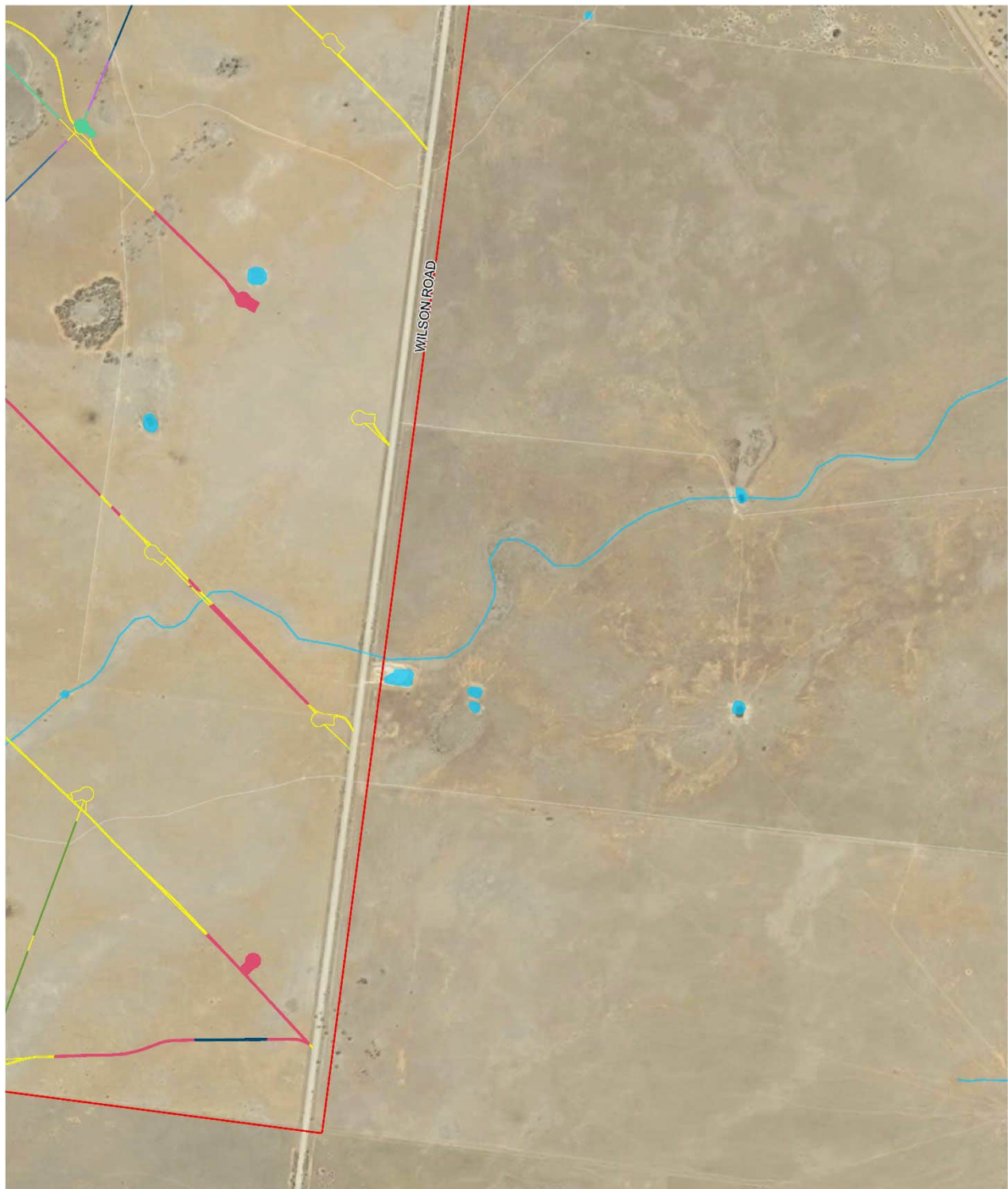
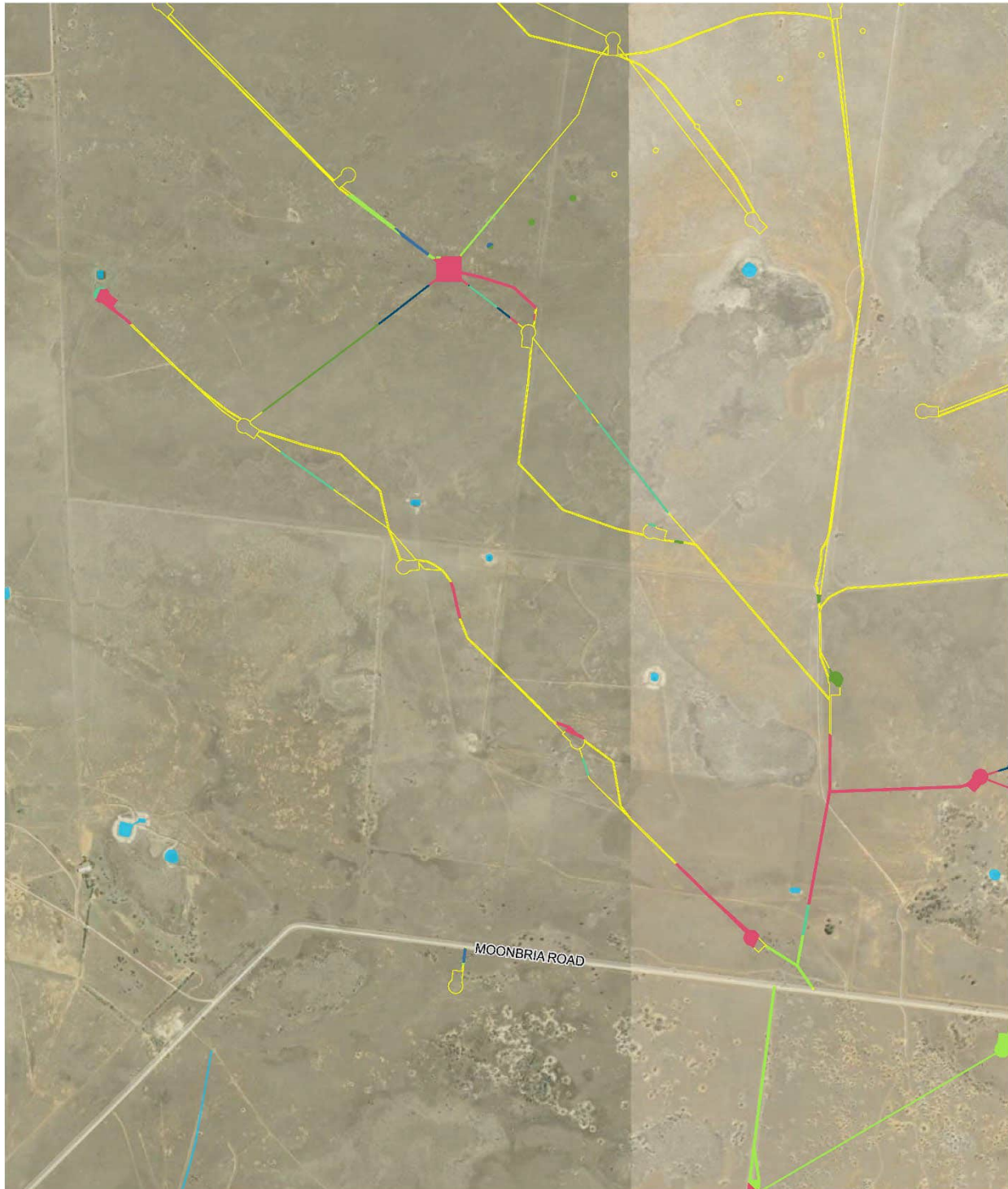


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 16 of 27)



<ul style="list-style-type: none"> ▬ Disturbance footprint ▬ Project area ▬ Waterways ▬ Road Threatened flora species ▬ <i>Austrostipa wakoolica</i> ▬ <i>Austrostipa wakoolica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchus orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> ▬ <i>Austrostipa wakoolica</i>, <i>Convolvulus tedmoorei</i>, <i>Lepidium monoplocoides</i>, <i>Ptilularia novae-hollandiae</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> ▬ <i>Austrostipa wakoolica</i>, <i>Lepidium monoplocoides</i>, <i>Leptorhynchus orientalis</i>, <i>Maireana cheelii</i>, <i>Ptilularia novae-hollandiae</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> 	<ul style="list-style-type: none"> ▬ <i>Austrostipa wakoolica</i>, <i>Lepidium monoplocoides</i>, <i>Ptilularia novae-hollandiae</i> ▬ <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Convolvulus tedmoorei</i>, <i>Cullen parvum</i>, <i>Leptorhynchus orientalis</i>, <i>Maireana cheelii</i>, <i>Swainsona murrayana</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> ▬ <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Cullen parvum</i>, <i>Leptorhynchus orientalis</i>, <i>Maireana cheelii</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> ▬ <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchus orientalis</i>, <i>Maireana cheelii</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona sericea</i> ▬ <i>Brachyscome muelleroides</i>, <i>Brachyscome papillosa</i>, <i>Leptorhynchus orientalis</i>, <i>Maireana cheelii</i>, <i>Swainsona murrayana</i>, <i>Sclerolaena napiformis</i>, <i>Swainsona plagiotropis</i>, <i>Swainsona sericea</i> ▬ <i>Convolvulus tedmoorei</i>, <i>Cullen parvum</i>, <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> ▬ <i>Cullen parvum</i> 	<ul style="list-style-type: none"> ▬ <i>Swainsona murrayana</i>, <i>Swainsona plagiotropis</i> 	<p>0 250 500 m</p> <p>1:22,000 at A4</p> <p>GDA 1994 MGA Zone 55</p> <p>Data sources</p> <p>Jacobs 2022</p> <p>© Department of Customer Service 2020</p>
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Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 17 of 27)

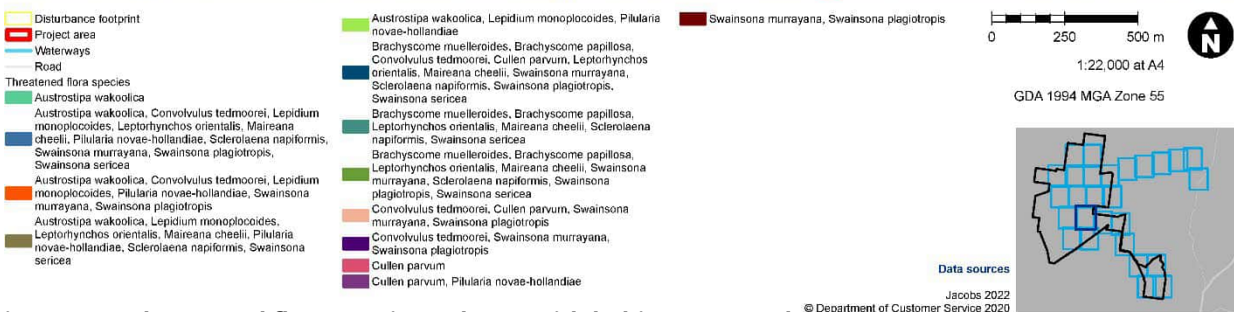
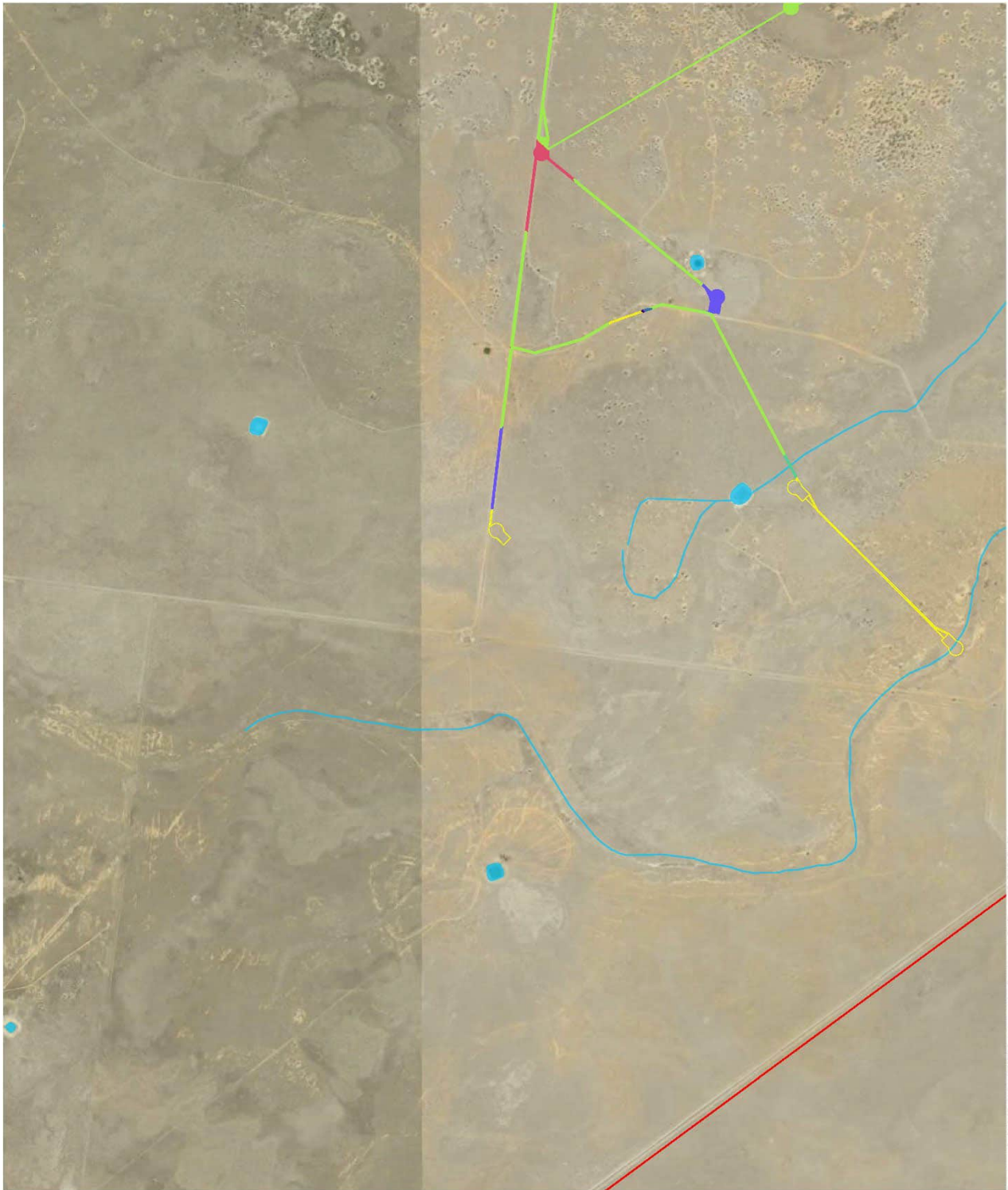


Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 18 of 27)



- ▭ Disturbance footprint
- ▭ Project area
- ▭ Wetlaneways
- ▭ Road
- Threatened flora species**
- ▭ *Austrostipa wakoolica*
- ▭ *Austrostipa wakoolica*, *Convolvulus tedmoorei*, *Lepidium monoplocoides*, *Leptorhynchus orientalis*, *Maireana cheelii*, *Ptilularia novae-hollandiae*, *Sclerolaena napiformis*, *Swainsona murrayana*, *Swainsona plagiotropis*, *Swainsona sericea*
- ▭ *Austrostipa wakoolica*, *Lepidium monoplocoides*, *Ptilularia novae-hollandiae*
- ▭ *Convolvulus tedmoorei*, *Swainsona murrayana*
- ▭ *Swainsona plagiotropis*
- ▭ *Cullen parvum*
- ▭ *Ptilularia novae-hollandiae*

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Figure 5-6. Threatened flora species polygon with habitat assumed present
 (Page 19 of 27)

Data sources
 Jacobs 2022
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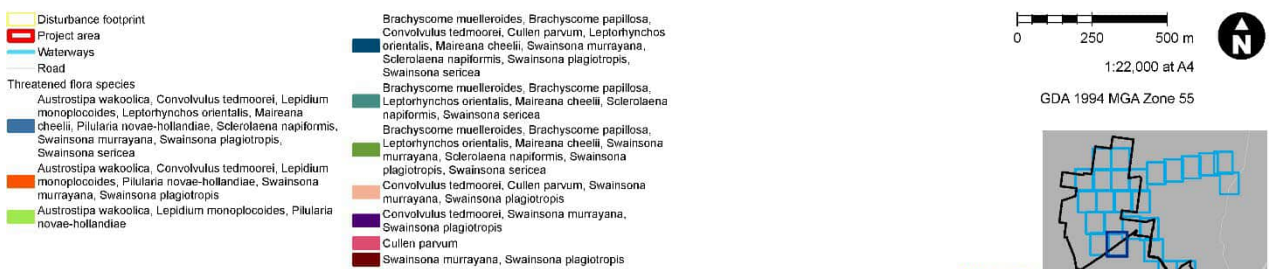
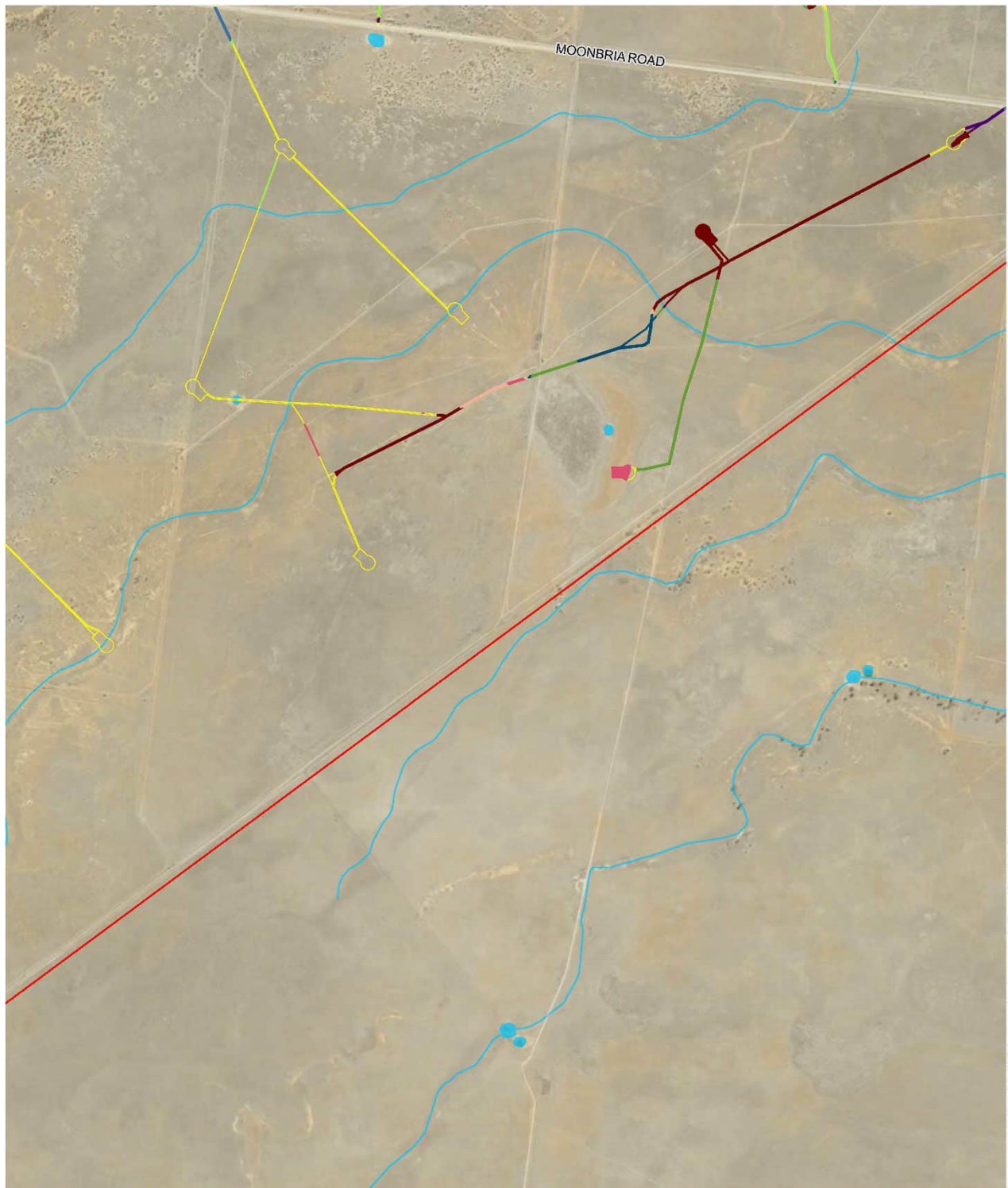


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 20 of 27)

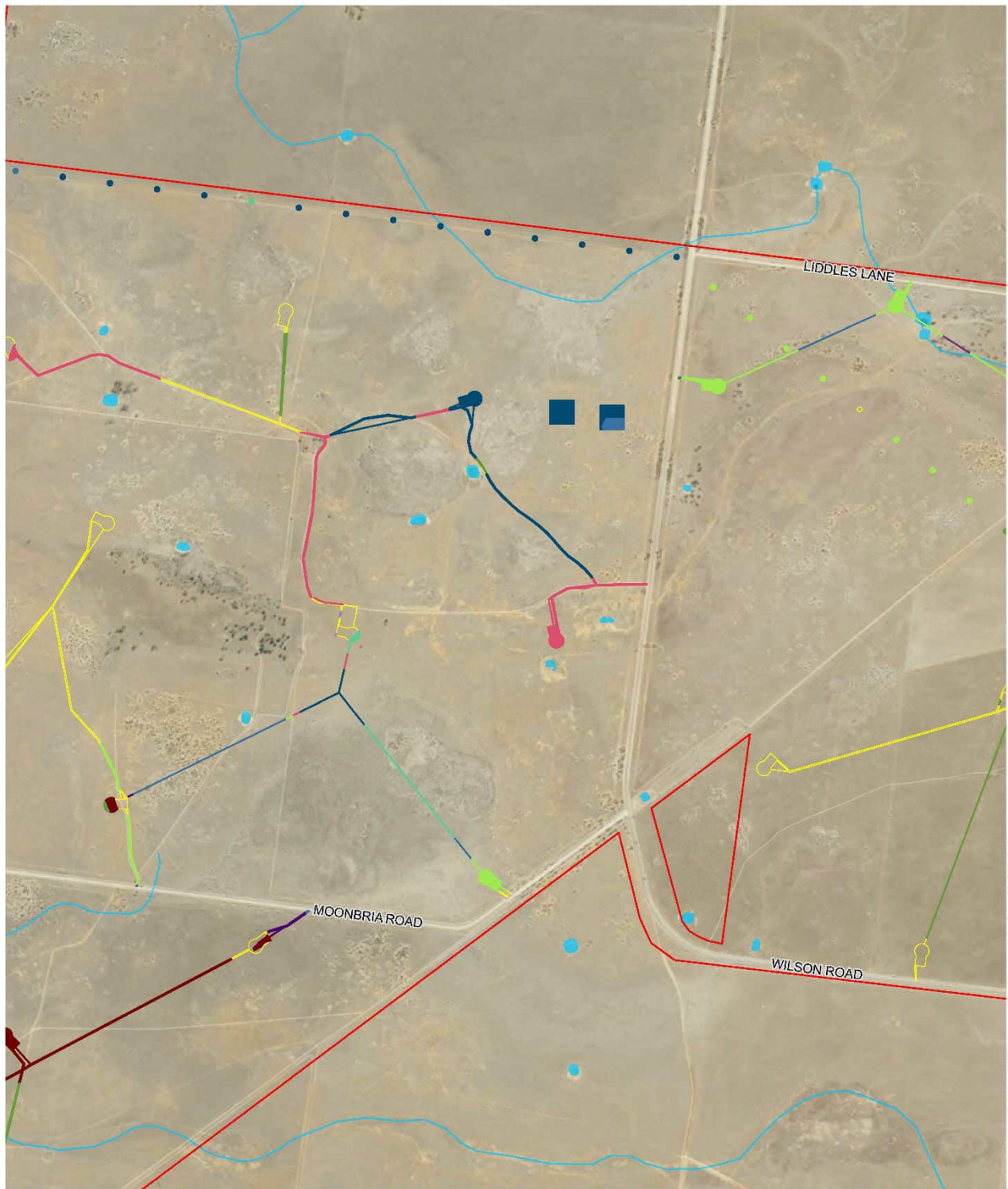


Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 21 of 27)

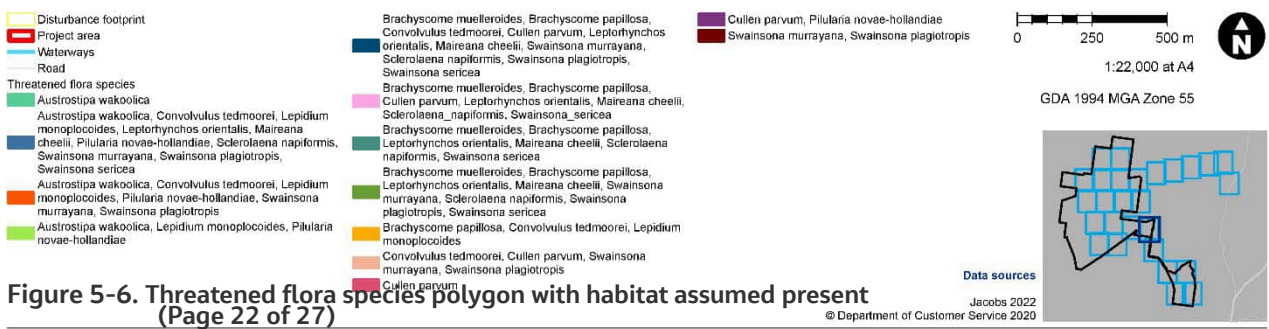
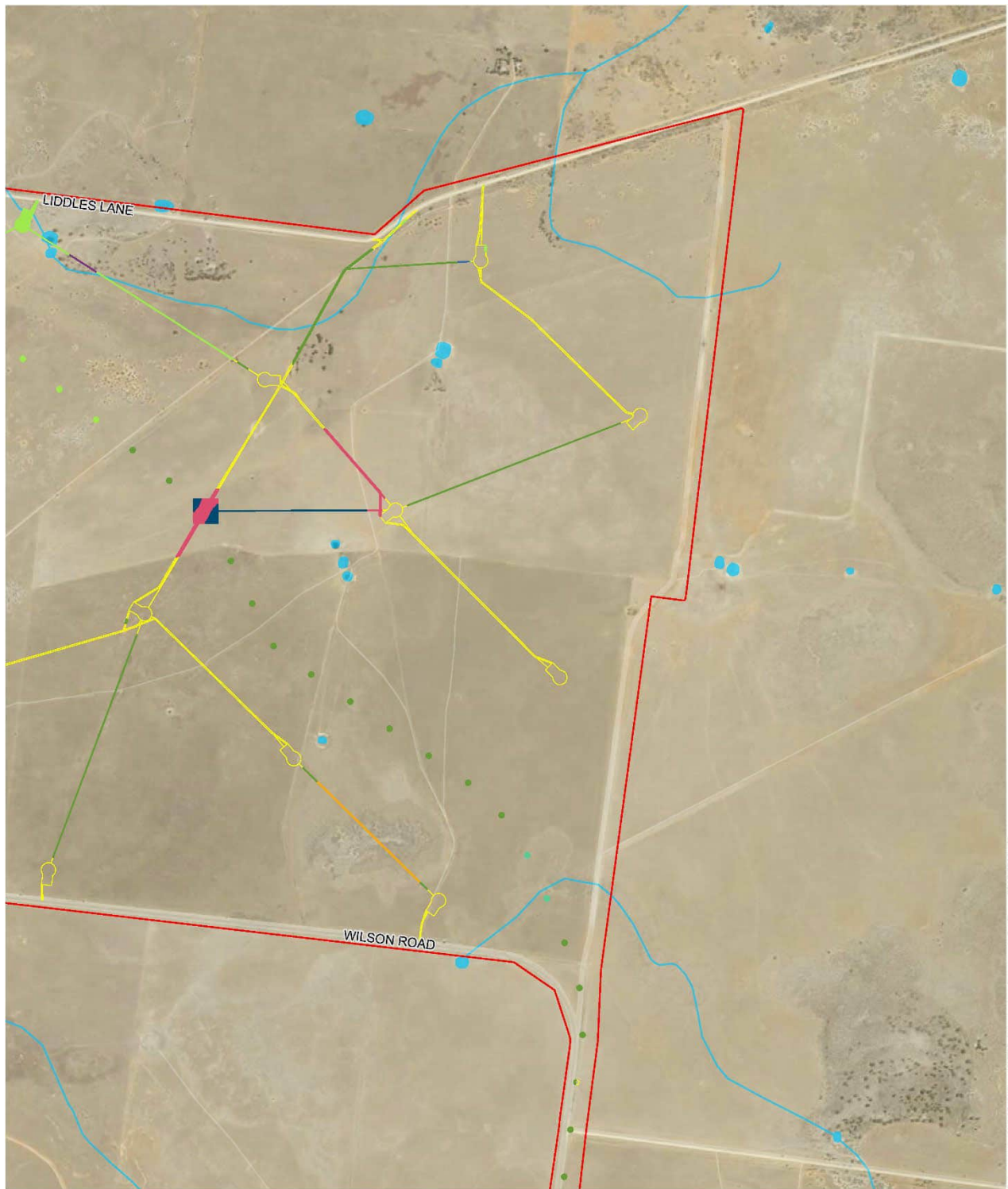
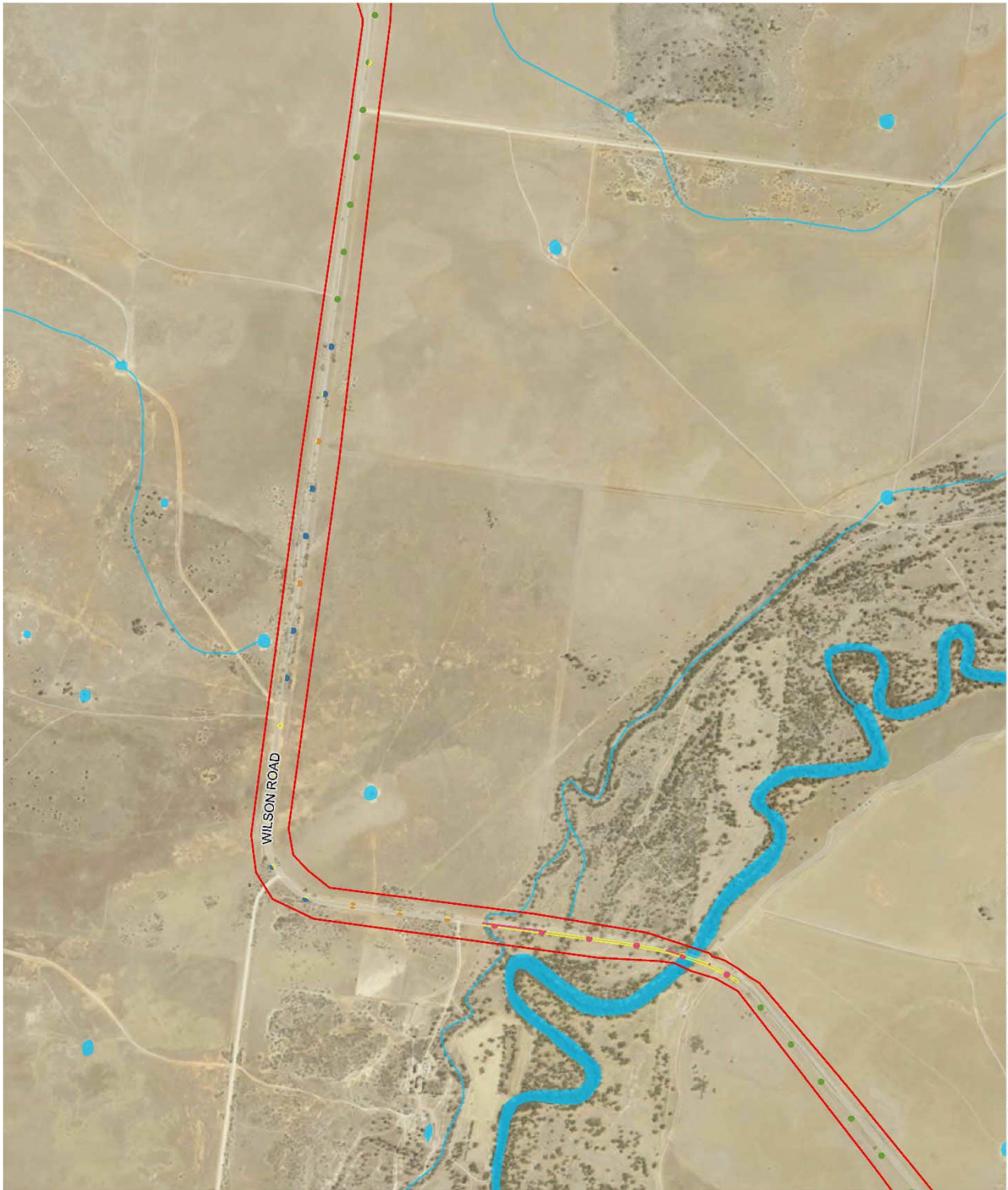


Figure 5-6. Threatened flora species polygon with habitat assumed present
(Page 22 of 27)



- ▭ Disturbance footprint
 - ▭ Project area
 - Wetlands
 - Road
- Threatened flora species**
- *Austroslipa wakoolica*, *Convolvulus tedmoorei*, *Lepidium monoplocoides*, *Leptorhynchus orientalis*, *Maireana cheelii*, *Ptilularia novae-hollandiae*, *Sclerolaena napiformis*, *Swainsona murrayana*, *Swainsona plagiotropis*, *Swainsona sericea*
 - *Brachyscome muelleroides*, *Brachyscome papillosa*, *Leptorhynchus orientalis*, *Maireana cheelii*, *Swainsona murrayana*, *Sclerolaena napiformis*, *Swainsona plagiotropis*, *Swainsona sericea*
 - *Convolvulus tedmoorei*, *Lepidium monoplocoides*, *Leptorhynchus orientalis*, *Maireana cheelii*, *Ptilularia novae-hollandiae*, *Swainsona murrayana*, *Sclerolaena napiformis*, *Swainsona sericea*
 - *Cullen parvum*

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Data sources
 Jacobs 2022
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Figure 5-6. Threatened flora species polygon with habitat assumed present (Page 23 of 27)



- ▭ Disturbance footprint
- ▭ Project area
- ▭ Waterways
- ▭ Road
- Threatened flora species**
- ▭ *Brachyscome muelleroides*, *Brachyscome papillosa*, *Leptorhynchus orientalis*, *Maireana cheeli*, *Sclerolaena napiformis*, *Swainsona sericea*
- ▭ *Brachyscome muelleroides*, *Brachyscome papillosa*, *Leptorhynchus orientalis*, *Maireana cheeli*, *Swainsona murrayana*, *Sclerolaena napiformis*, *Swainsona plagiotropis*, *Swainsona sericea*
- ▭ *Swainsona murrayana*, *Swainsona plagiotropis*

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55

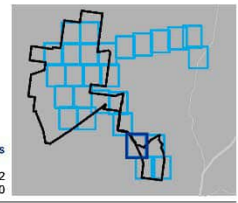
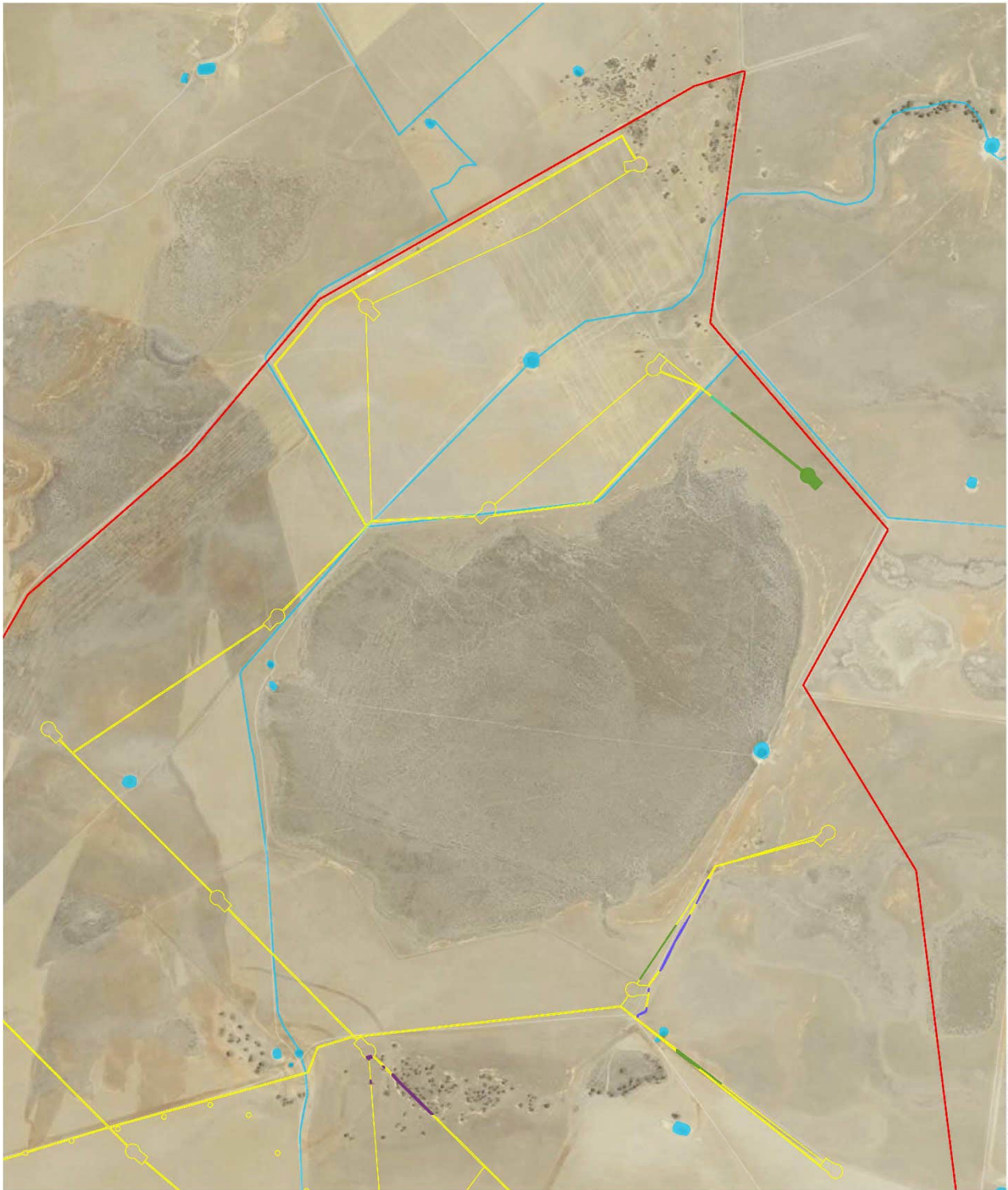


Figure 5-6. Threatened flora species polygon with habitat assumed present
 (Page 24 of 27)



- Disturbance footprint
- Project area
- Wetlanys
- Road
- Threatened flora species
- Austrostipa wakoolica*
- Brachyscome muelleroides*, *Brachyscome papillosa*, *Leptorhynchus orientalis*, *Maireana cheeli*, *Swainsona murrayana*, *Sclerolaena napiformis*, *Swainsona plagiotropis*, *Swainsona sericea*
- Cullen parvum*, *Pilularia novae-hollandiae*
- Pilularia novae-hollandiae*

0 250 500 m

1:22,000 at A4

GDA 1994 MGA Zone 55

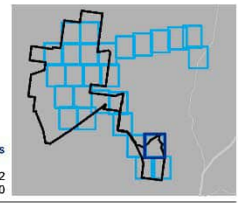


Figure 5-6. Threatened flora species polygon with habitat assumed present
 (Page 25 of 27)



- ▭ Disturbance footprint
- ▭ Project area
- Waterways
- Road
- Threatened flora species**
- ▭ *Austrostipa wakoolica*
- ▭ *Brachyscome muelleroides*, *Brachyscome papillosa*, *Leptorhynchus orientalis*, *Maireana cheeli*, *Sclerolaena napiformis*, *Swainsona sericea*
- ▭ *Brachyscome muelleroides*, *Brachyscome papillosa*, *Leptorhynchus orientalis*, *Maireana cheeli*, *Swainsona murrayana*, *Sclerolaena napiformis*, *Swainsona plagiotropis*, *Swainsona sericea*
- ▭ *Cullen parvum*, *Ptilularia novae-hollandiae*
- ▭ *Swainsona murrayana*, *Swainsona plagiotropis*

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Figure 5-6. Threatened flora species polygon with habitat assumed present
 (Page 26 of 27)



- ▭ Disturbance footprint
- ▭ Project area
- Wetlands
- Road
- Threatened flora species
 - ▭ *Austrostipa wakoolica*
 - ▭ *Brachyscome muelleroides*, *Brachyscome papillosa*
 - ▭ *Leptorhynchus orientalis*, *Maireana cheeli*, *Swainsona murrayana*, *Sclerolaena napiformis*, *Swainsona plagiotropis*, *Swainsona sericea*
 - ▭ *Cullen parvum*, *Ptilularia novae-hollandiae*

0 250 500 m
 1:22,000 at A4
 GDA 1994 MGA Zone 55



Figure 5-6. Threatened flora species polygon with habitat assumed present
 (Page 27 of 27)

Data sources
 Jacobs 2022
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5.3.2 Threatened fauna

Targeted surveys were undertaken for the threatened fauna species shown in **Table 5-5**. A total of 13 threatened species were recorded within the subject land, comprising 11 bird species (**Figure 5-7**) including:

- Spotted Harrier
- White-fronted Chat
- Dusky Woodswallow
- Little Eagle
- Square-tailed Kite
- Grey-crowned Babbler
- Superb Parrot
- Diamond Firetail
- Flame Robin
- Black Falcon
- Varied Sittella

Southern Myotis and Yellow-bellied Sheath-tail-bat are assumed to be present in areas with suitable habitat. Echolocation calls from Anabat devices for these species could not be positively confirmed.

Brown Treecreepers were recorded using Bioacoustics using Song Metres, however they do not qualify for inclusion under the eastern subspecies listing as the western boundary of the range of *Climacteris picumnus victoriae* runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell.

Plains-wanderer has important habitat in the subject land. Observations of two calling birds were recorded during diurnal surveys, however this species has a very similar call to Painted button Quail (*Turnix varius*) and identification could not be fully confirmed.

White-bellied Sea Eagle is known to occur in the Jerilderie region with a known breeding pair that regularly occupy a nest site located north of Jerilderie, but outside the Project area.

5.3.2.1 Spotted Harrier

The Spotted Harrier (listed vulnerable under the BC Act) occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. The Spotted Harrier occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The species builds stick nests in trees and lays eggs in spring (occasionally during autumn), with young remaining in the nest for several months. Whilst this species is a raptor, and therefore could be considered dual credit species, however, for this assessment is considered an ecosystem species, identifying nests is difficult and the species is considered opportunistic to use other nest sites once breeding completed.

In relation to the Project, there are some recent records within the subject land from 2011–2014. The species was recorded during bird surveys on the 17 November 2021. A total of three individuals were recorded, on different occasions, flying approximately five metres above the ground over exotic vegetation. Multiple stick nests were recorded within the subject land of suitable sizes for the Spotted Harrier. Additionally, there is suitable shrubland, grassland and woodland habitats within the subject land for this species. Therefore, due to the number of records within the locality, the stick nests recorded during surveys and the suitable habitat present within the subject land, this species is likely to utilise the environments within the Project area for foraging and breeding purposes.

5.3.2.2 Dusky Woodswallow

The Dusky Woodswallow (listed vulnerable under the BC Act) is found in open forests and woodlands and may be seen along roadsides and on golf courses. In the Project area, this species was recorded on one occasion during October 2021 and was observed foraging in Black Box woodland.

5.3.2.3 Varied Sittella

The Varied Sittella (listed vulnerable under the BC Act) is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. In the Project area, three individuals were observed on one occasion during utilisation surveys in July 2022 foraging in woodland.

5.3.2.4 White-fronted Chat

There are multiple records of the White-fronted Chat (listed vulnerable under the BC Act) within the locality ranging from 1997 to 2016, with some records existing within the subject land. The White-fronted Chat was recorded multiple times during targeted bird surveys in 2021. A total of 14 individuals were identified during surveys in October and November 2021, within PCT 13, PCT 17, PCT 26, PCT 44 and PCT 46. Suitable Semi-arid woodlands, Grasslands, Arid Shrublands and Wetland habitats are present within the subject land. Additionally, there were multiple open cup nests built within low vegetation recorded during surveys, suitable for the White-fronted Chat.

5.3.2.5 Little Eagle

Breeding habitat for the Little Eagle (listed vulnerable under the BC Act) is indicated by live (occasionally dead) large old trees within suitable vegetation and the presence of a male and female; or female with nesting material; or an individual on a large stick nest in the top half of the tree canopy. The survey for the Little Eagle focused on locating potential nest sites.

The required survey period for the Little Eagle includes August to October. Where a breeding site has been identified, in accordance with the BAM, the species buffer polygon should be established by providing a circular polygon with a 300 m radius around the nest tree. The purpose of the buffer, in relation to the Project, is to minimise disturbance and avoid clearing, during the development, within the areas essential for breeding. This includes habitat suitable for feeding and grooming perches and fledgling requirements. However, it does not account for foraging habitat. Additionally, Little Eagles are less likely than urban-adapted raptors to readily cross urban or peri-urban spaces to hunt.

The Little Eagle was recorded flying over cropping land in the south west of Project area during the surveys conducted in November 2021. A bird was also recorded over native grassland in the north of Project area. Foraging habitat is present for the Little Eagle and has potential to be nesting within the Project area. Of all nest trees recorded with suitable stick nest size in the Project area, no birds were observed utilising breeding habitat during the breeding period. Therefore, no species polygons were generated for species credits for this species. There are no historical records within the subject land, however there are several within the broader region. Records show the species is widespread within the locality, indicating that individuals would regularly use the habitats within the subject land.

5.3.2.6 Square-tailed Kite

One Square-tailed Kite was observed circling native grassland to the west of Wilson Road, located to the east of the Project area. This species generally occupies habitat with woodland or forest along waterways. The subject land generally lacks suitable foraging and breeding habitat for this species, except along Yanco Creek or Delta Creek.

To identify breeding habitat for the Square-tailed Kite, it is necessary to locate a Square-tailed Kite sitting on a stick nest or in attendance of a stick nest. The survey for the Square-tailed Kite focused on locating potential nest sites. Of all nest trees recorded with suitable stick nest size in the Project area, no birds were observed utilising breeding habitat during the breeding period. Therefore, no species polygons were generated for species credits for this species.

Records show the species is widespread within the locality, indicating that individuals would regularly use the habitats within the subject land.

5.3.2.7 White-bellied Sea Eagle

The White-bellied Sea-eagle is distributed around the Australian coastline, including Tasmania, and well inland along rivers and wetlands of the Murray Darling Basin. Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. This species is thought to have a nesting site a few kilometres to the south west of the Project area. White-bellied Sea Eagle is known to occur in the Jerilderie region with a known breeding pair known to regularly visit a nest site located near North Coree Road (pers comm. Wilandra Landholder), approximately 5 kilometres from Project area. There are no large waterbodies in the Project area, except Yanco Creek that would provide suitable foraging habitat for White-bellied Sea Eagle. A total of 15 large stick nests were recorded in the subject land (within 500 metres from disturbance footprint). Most of these nests were occupied by Wedge-tailed Eagles.

5.3.2.8 Plains-wanderer

The Plains-wanderer within the broader Riverina region is considered to comprise a subpopulation of the species at about 800 birds, with possibly less than 250 in dry years (NSW Scientific Committee, 2009). The extent of suitable habitat estimated in this assessment comprises the PCTs listed in the BioNet threatened species description for the species (DPE, 2022b). Within the study area, these comprise PCT 44 and PCT 46.

The number of birds from the broader population that occupy habitat with the impacted properties is unknown, however on the basis of potential habitat (i.e. Grassland), the disturbance footprint comprises about 128.12 hectares comprising a range of different grassland structures within PCTs 44, 45, and 46. Grassland varies in condition, species composition, and structure throughout the Project area depending on past and current land uses, including the grazing regime which affects grassland biomass. Importantly, as a ground dwelling bird, impacts of turbine strike and barotrauma are not considered relevant.

Important area mapping for Plains-wanderer (*Pedionomus torquatus*) was identified in the Project area (Figure 5-8). This land is considered important to support critical life stages of the species and are classed as species credits. The maps in relation to the Plains-wanderer, may include breeding areas or sites where multiple records have been located over multiple years. Important habitat maps are generally restricted to species that are highly mobile and difficult to reliably detect by survey, and where long-term location data exists. As the species is a dual credit species, where mapped important areas occur, survey is not required and presence is assumed. Any impacts to these areas will likely be serious and irreversible. Considerable effort was made to modify the Project design to avoid impacts to the Plains-wanderer important area mapping in the study area. Part of the important mapping occurs in confirmed degraded land, comprising of ploughed and cropping land, mainly south of Yanco Creek and classified as non-native vegetation or Category 1 – exempt land. A species polygon was generated for this species where important area mapping intercepted the disturbance footprint (vegetation zones), these locations are along existing access tracks to avoid and minimise impacts to high quality habitat. Figure 5-8 provides the important area mapping as habitat buffers that must be avoided during detailed design.

The presence of important area mapping within the disturbance footprint comprises 1.78 hectares (species polygon) within PCTs 17, 26, 22, 25 and 46. It is important to note that this habitat is associated with a series of very small fragments along existing farm tracks over a large area and is considered to be of low quality due to the land use type.

Plains-wanderer populations are known to occur in the Project area with important area mapping within the study area. Two tentative observations of Plains-wanderer were recorded in the Project area during the day on the 25 and 27 November 2021 during targeted flora transect surveys. Birds were heard calling and were immediately compared to a reference recording of the Plains-wanderer. However, Plains-wanderer call is very similar to Painted button Quail and was difficult to confirm.

5.3.2.9 Grey-crowned Babbler

A total of 70 individual Grey-crowned Babblers were recorded within the subject land during targeted bird surveys conducted in September 2021 and 20 November, using Bioacoustics using Song Metres. The species

was recorded across a range of woodland and grassland habitats. Paddock trees within the subject land can be important for this species as they can link remnant foraging habitat.

The Grey-crowned Babbler builds and maintains several conspicuous, dome-shaped stick nests about the size of a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year-round, and old nests are often dismantled to build new ones. Several small stick nests were observed during surveys. There are also multiple recent records of the species within the locality. Due to the number of records and the presence of suitable stick nests, it is indicated that the habitat within the subject land could be used for both breeding and foraging purposes.

5.3.2.10 Superb Parrot

Potential habitat for the Superb Parrot within the subject land comprises of PCT 9, PCT 11, PCT 13, PCT 26, PCT 28, PCT 45 and PCT 46. Superb Parrots require hollows for breeding which are greater than five centimetres in diameter and either greater than four metres above ground or in trees with a DBH of greater than 30 centimetres. There were multiple hollows recorded during surveys which are suitable for the Superb Parrot. Breeding habitat can be identified by the presence of habitat features and observed nest or two or more birds seen together.

A flock of seven Superb Parrots were observed outside of the Project area, located approximately 15 kilometres north, flying over Myall Woodland and Black Box Woodland. Although the species was not observed within the subject land, there is potential habitat present in the form of tree hollows and open woodland communities. There is potential for breeding opportunities for this species within the subject land, supported by numerous records within the locality. Therefore, for any potential breeding site within the subject land, in accordance with the BAM, the species polygon has been established by providing a circular buffer with a 100m radius around a nest tree. However, there is predicted to be no suitable breeding habitat, such as hollows in Eucalypt woodland, impacted by the Project.

5.3.2.11 Diamond Firetail

The Diamond Firetail can be found in grassy eucalypt woodlands, including Box-Gum Woodlands, present within the subject land. They also occur in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. The Diamond Firetail is often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up.

Suitable woodland and grassland habitat is present for the species within the subject land associated with PCT 9, PCT 11, PCT 13, PCT 16, PCT 19, PCT 26, PCT 28, PCT 44, PCT 45 and PCT 46. There are no records in the subject land, however numerous records occur within the surrounding 100 kilometres, the closest of which is about five kilometres to the west.

5.3.2.12 Flame Robin

The Flame Robin breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. They prefer clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. They also occasionally occur in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes.

Records show multiple observations within the broader locality, however none within the subject land. Surveys concluded that there is no suitable breeding habitat within the subject land. However, the species is likely to utilise habitat for roosting and foraging purposes, such as remnant paddock trees.

5.3.2.13 Black Falcon

One Black Falcon individual was observed within the subject land during surveys. There are some recent records within the subject land. The available habitats associated with the Project may provide suitable Semi-arid woodlands, Grasslands and Arid Shrublands and Wetland habitats for the Black Falcon. Additionally, there were multiple suitable stick nests recorded during surveys, one of which portrayed signs of being active, with fresh fur located at the base of the tree.

5.3.2.14 Southern Myotis and Yellow-bellied Sheathtail-bat

Two *Nyctophilus* species (*Nyctophilus gouldi* and *Nyctophilus geoffroyi*) have the potential to occur in the study area and overlap almost entirely in most frequency characteristics. All have steep near vertical call shapes. Calls belonging to the genus *Nyctophilus* could not be identified to genus level. Southern Myotis and *Nyctophilus* sp. complex have similar steep fragmented calls. Southern Myotis can be separated by shape and pulse interval <75ms and an initial slope of greater than 400 octaves per second (OPS), but cannot be reliably identified from their call. Poor quality, short or fragmented calls which had a call interval between 75 and 95ms and slope between 300 and 400 OPS could not be separated from the *Nyctophilus* sp. complex. Therefore this Southern Myotis is assumed present at locations with suitable habitat.

The Southern Myotis is a species credit species. Following the '*Species credit*' *threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method* (Office of Environment and Heritage, 2018) suitable habitats at locations with PCTs 7 and 9 within 200 m of any medium to large permanent creeks, rivers, lakes or other waterways (i.e. with pools/ stretches 3 m or wider). These suitable habitat areas have been mapped as habitat buffers displayed in **Figure 5-9** and includes a species polygon of 0.9 hectares (in PCTs 7 and 9).

Furthermore, surveys targeted bridges and culverts present within the subject land to detect the presence of breeding Southern Myotis. There were no signs of residing bats within these structures and were deemed unsuitable for breeding requirements. Therefore, there are no bridges, tunnels, culverts or other structures present in the subject land that would be suitable as potential breeding habitat for the Southern Myotis.

Some calls between 35–36.5Khz could not be differentiated between Eastern broad-nosed bat (*Scotorepens orion*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (listed vulnerable under BC Act) and Greater Broad-nosed bat (*Scoteanax rueppelli*) (listed vulnerable under BC Act). The Project area is out of their known range in the study area.

Chocolate wattled bat (*Chalinolobus morio*) calls were differentiated from *Vespadelus* sp. by the presence of a down-sweeping tail and pulse alternation on the majority of pulses. Eastern cave bat (*Vespadelus troughtoni*) (listed vulnerable under BC Act) overlaps in frequency with both Eastern Forest Bat (*Vespadelus pumilus*) and Little Forest Bat (*Vespadelus vulturinus*) and Chocolate wattled bat. However, some calls around 50Khz had a strong hook shape (reverse J) indicating the presence of Eastern cave bat.

Calls in the 20-22kHz range, their call shape and time between calls for Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) did not meet the criteria. Many bat experts suspect that Yellow-bellied Sheathtail-bat calls are *Austronomus* sp. shifting their call frequency when there are several *Austronomus* sp. Bats present in the area and / or atypical Gould's Wattled bat (*Chalinolobus gouldii*) calls possibly social calls (pers. comm Rob Gratton).

The Yellow-bellied Sheathtail-bat is an ecosystem species and is assumed to be present. This species roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, they tend to fly high and fast over the forest canopy, but lower in more open country. They forage in most habitats across a very wide range, with and without trees. Paddock trees within the subject land were identified as potential roosting habitat for the Yellow-bellied Sheathtail-bat. Suitable foraging habitat is also present. Historic records are numerous in the 100 km locality, particularly in Murray Valley National Park and along the Murray River, south of the Project.

The call data did not record Little Pied Bat (*Chalinolobus picatus*). This species is an ecosystem species and is assumed present. This species occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Little Pied Bat can roost in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.

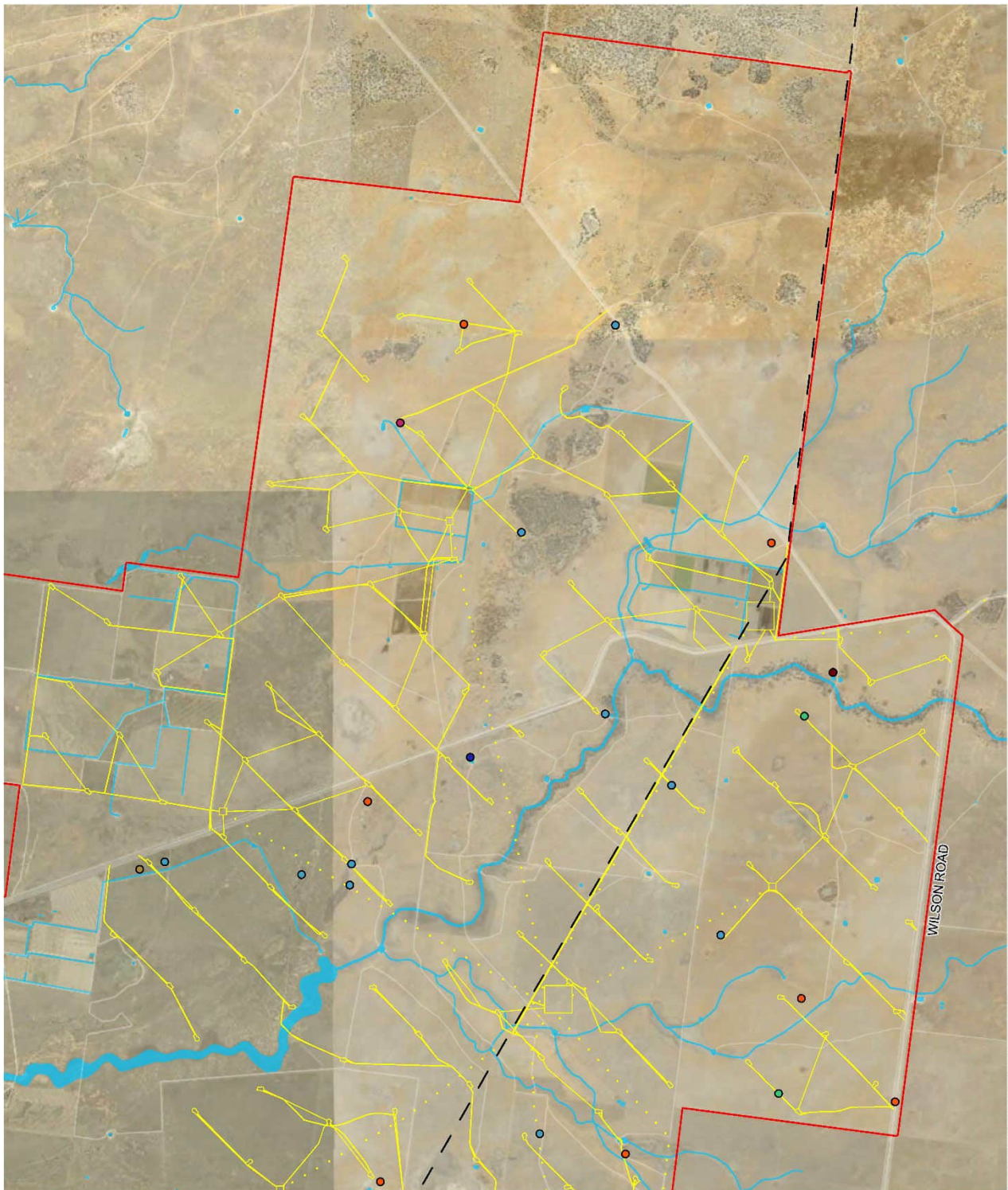
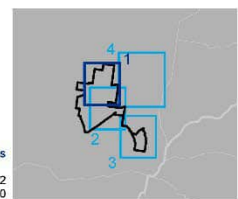


Figure 5-7. Threatened fauna recorded in the Project area
(Page 1 of 4)



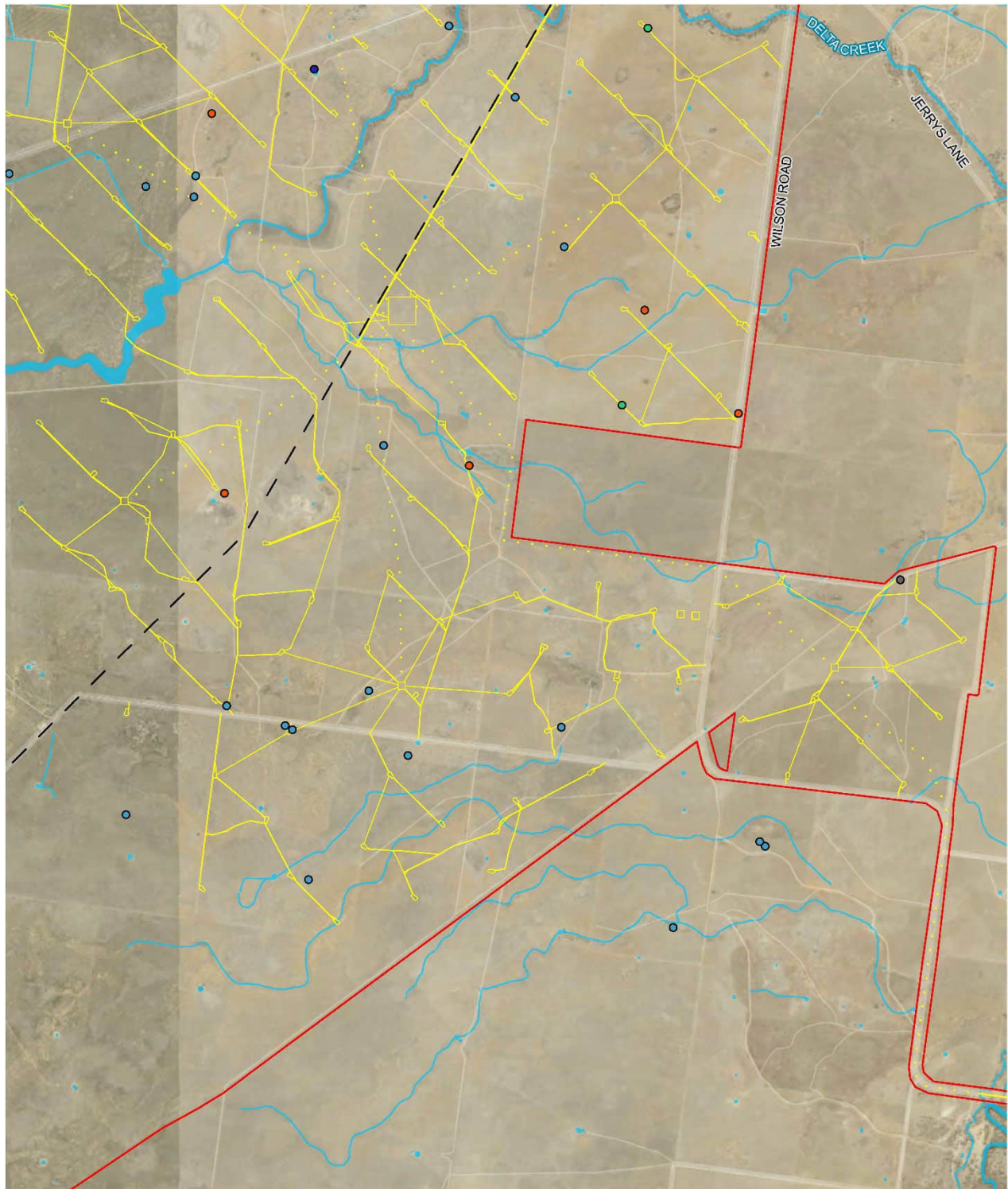
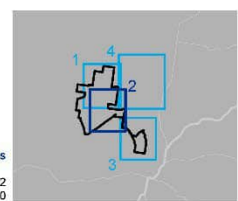
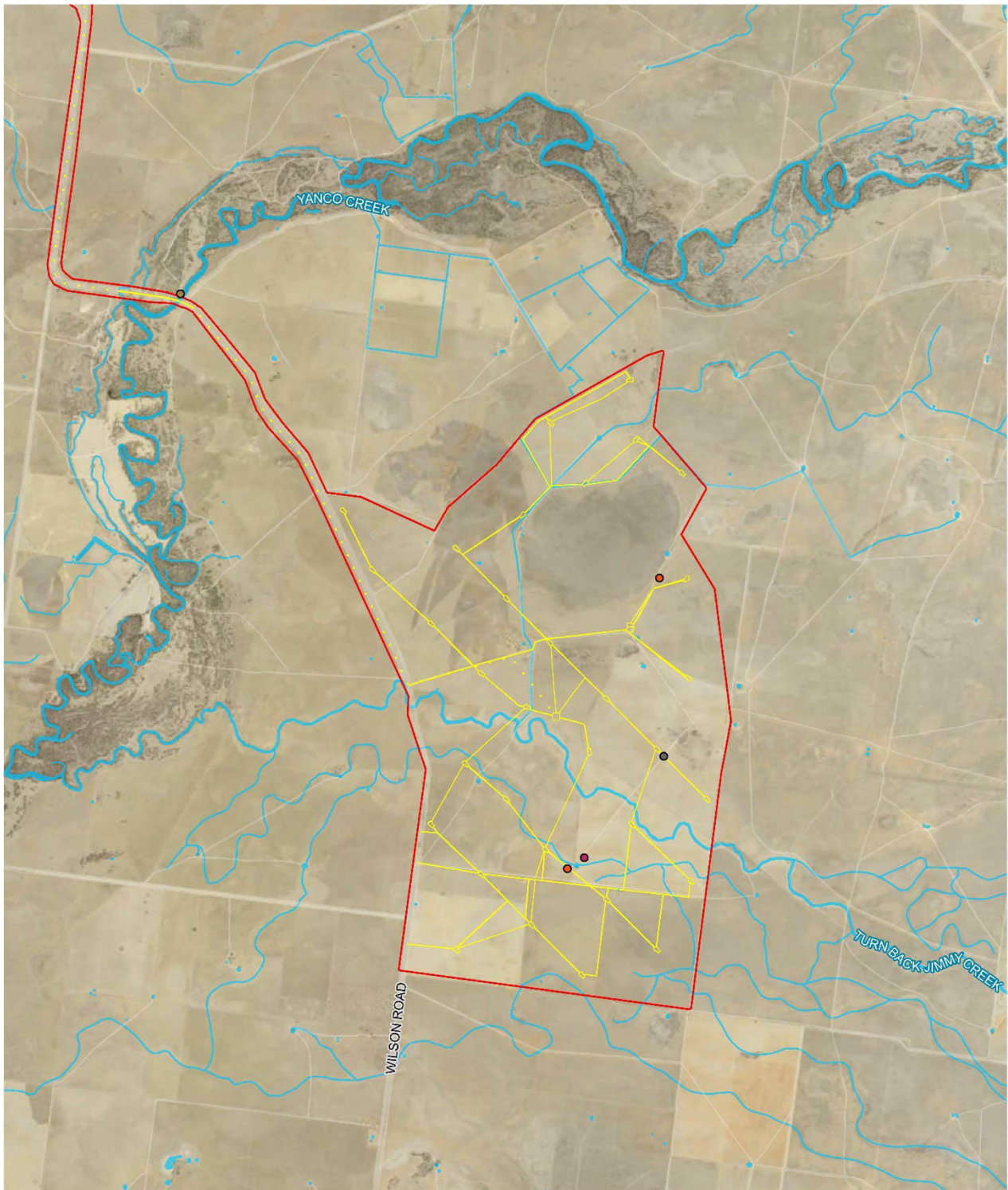


Figure 5-7. Threatened fauna recorded in the Project area
(Page 2 of 4)

Data sources
Jacobs 2022
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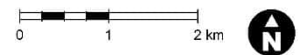




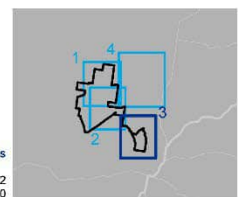
- Disturbance area
- Project area

- Threatened fauna**
- Brown Treecreeper (eastern subspecies)
 - Little Eagle
 - Spotted Harrier
 - White-fronted Chat

- Waterways
- Road



1:74,000 at A4
GDA 1994 MGA Zone 55



Data sources
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Figure 5-7. Threatened fauna recorded in the Project area
(Page 3 of 4)

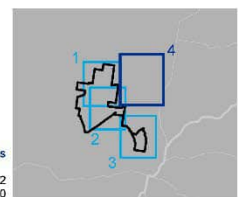
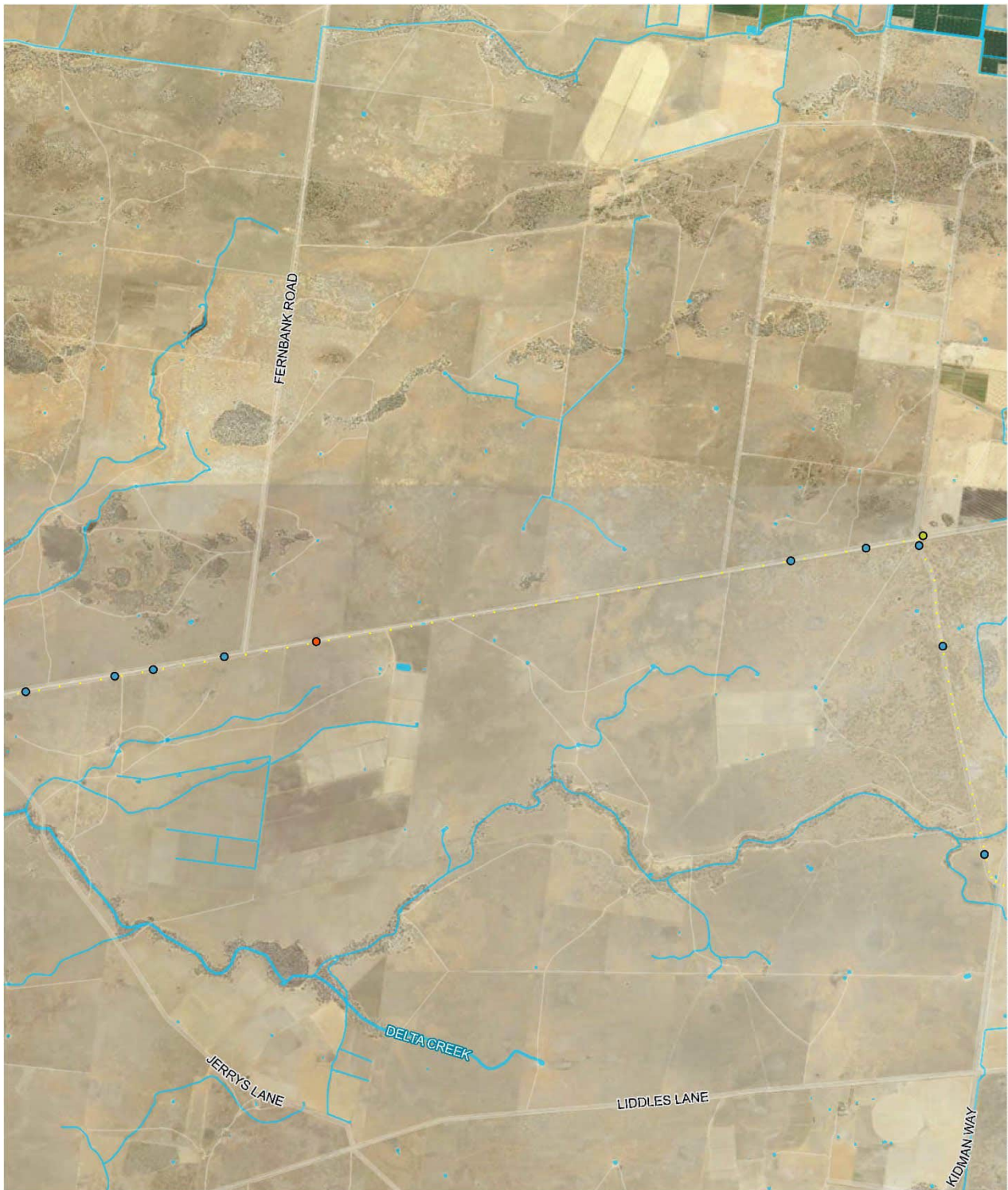


Figure 5-7. Threatened fauna recorded in the Project area
 (Page 4 of 4)

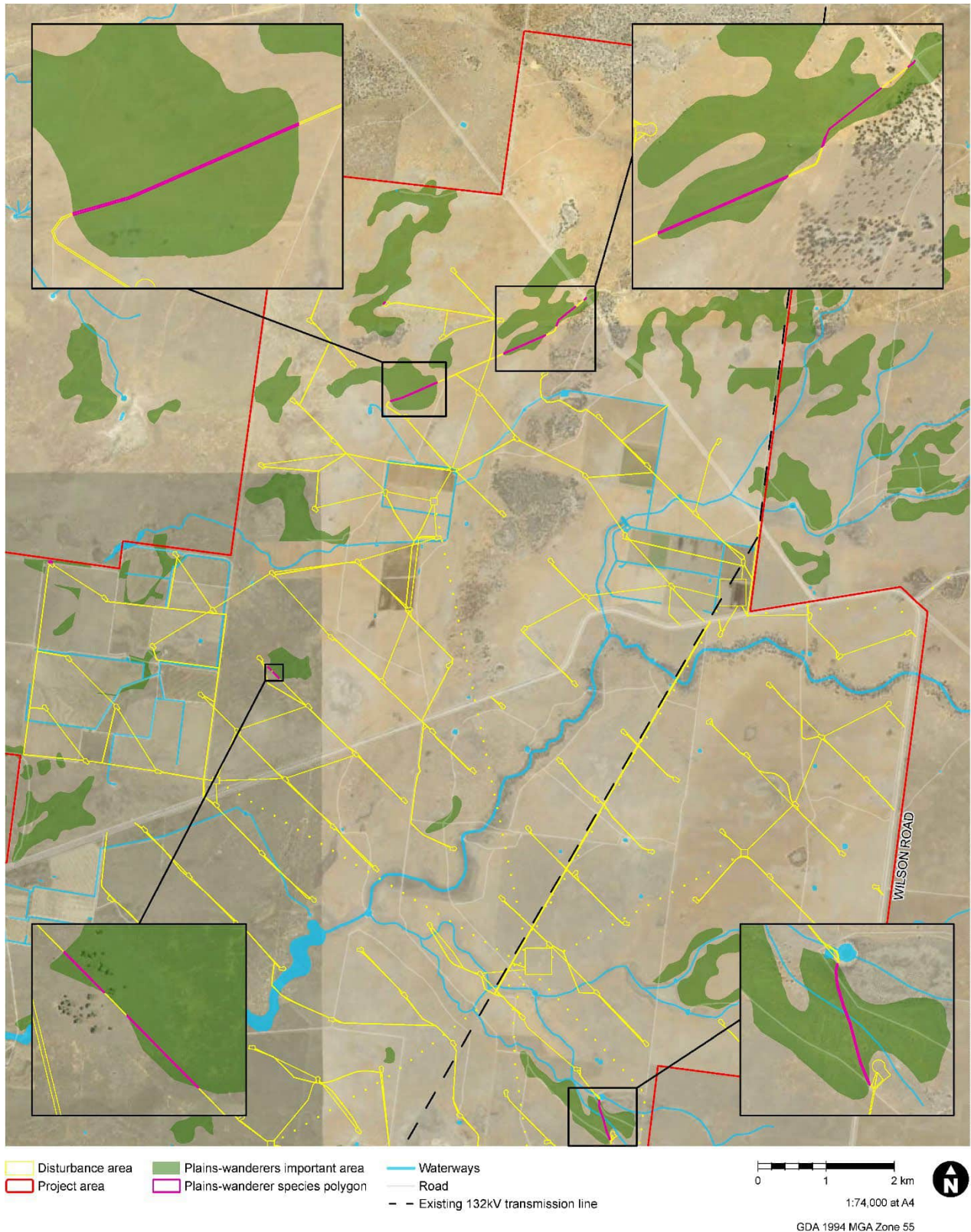
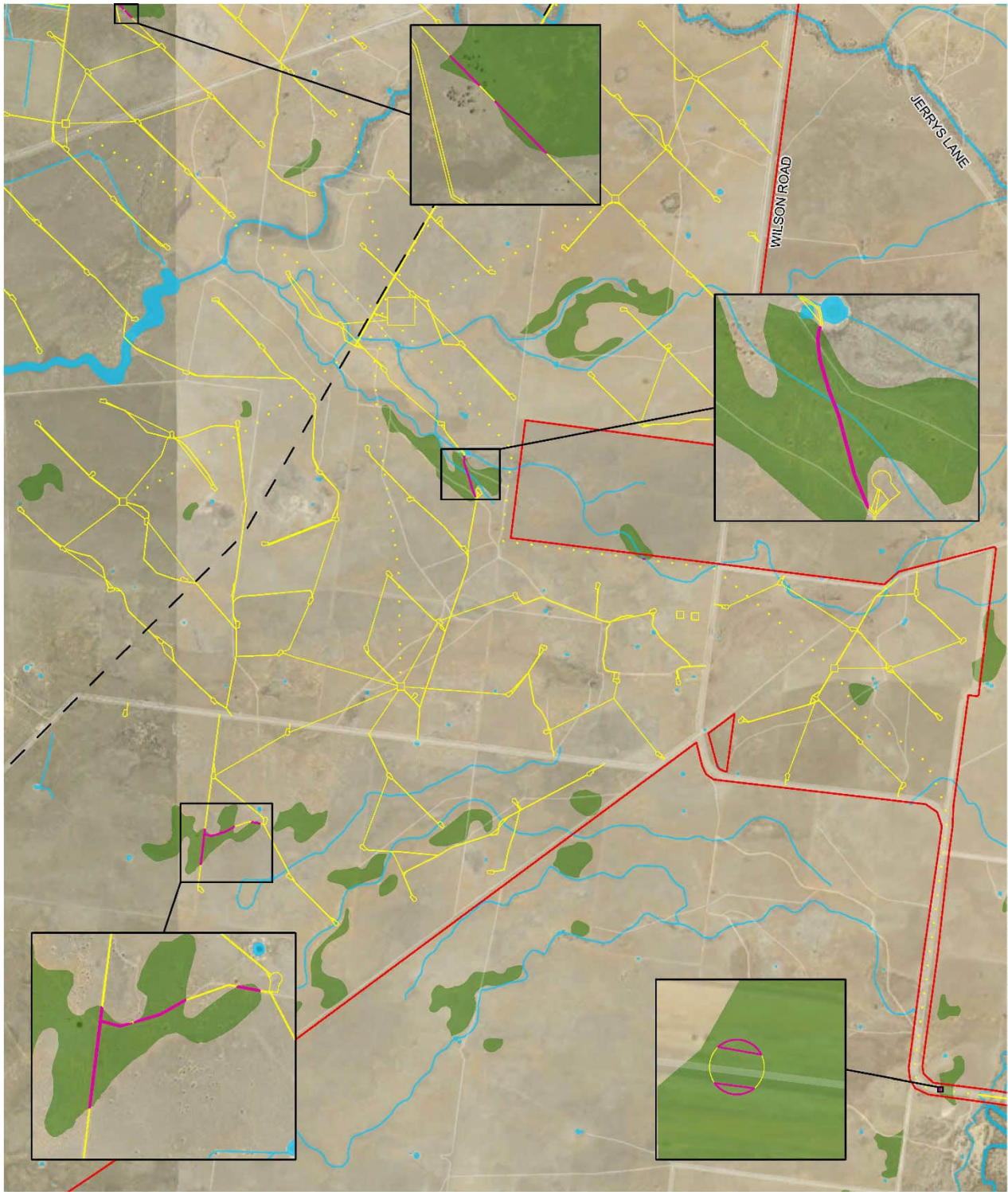


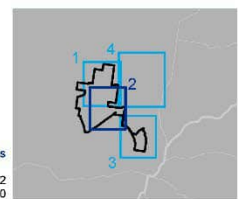
Figure 5-8. Plains-wanderer important area mapping and species polygon in Project area (Page 1 of 4)



- Disturbance area
- Project area
- Plains-wanderers important area
- Plains-wanderer species polygon
- Waterways
- Road
- Existing 132kV transmission line



1:74,000 at A4
GDA 1994 MGA Zone 55



Data sources
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Figure 5-8. Plains-wanderer important area mapping and species polygon in Project area (Page 2 of 4)



- Disturbance area
- Project area
- Plains-wanderers important area
- Plains-wanderer species polygon
- Waterways
- Road



1:74,000 at A4

GDA 1994 MGA Zone 55

Data sources

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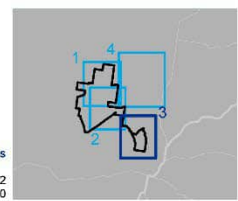


Figure 5-8. Plains-wanderer important area mapping and species polygon in Project area (Page 3 of 4)



Disturbance area
 Plains-wanderers important area
 Waterways
 Road

0 1 2 km

 1:90,000 at A4

 GDA 1994 MGA Zone 55

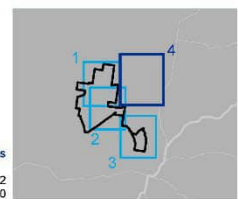


Figure 5-8. Plains-wanderer important area mapping and species polygon in Project area (Page 4 of 4)

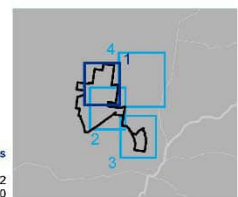
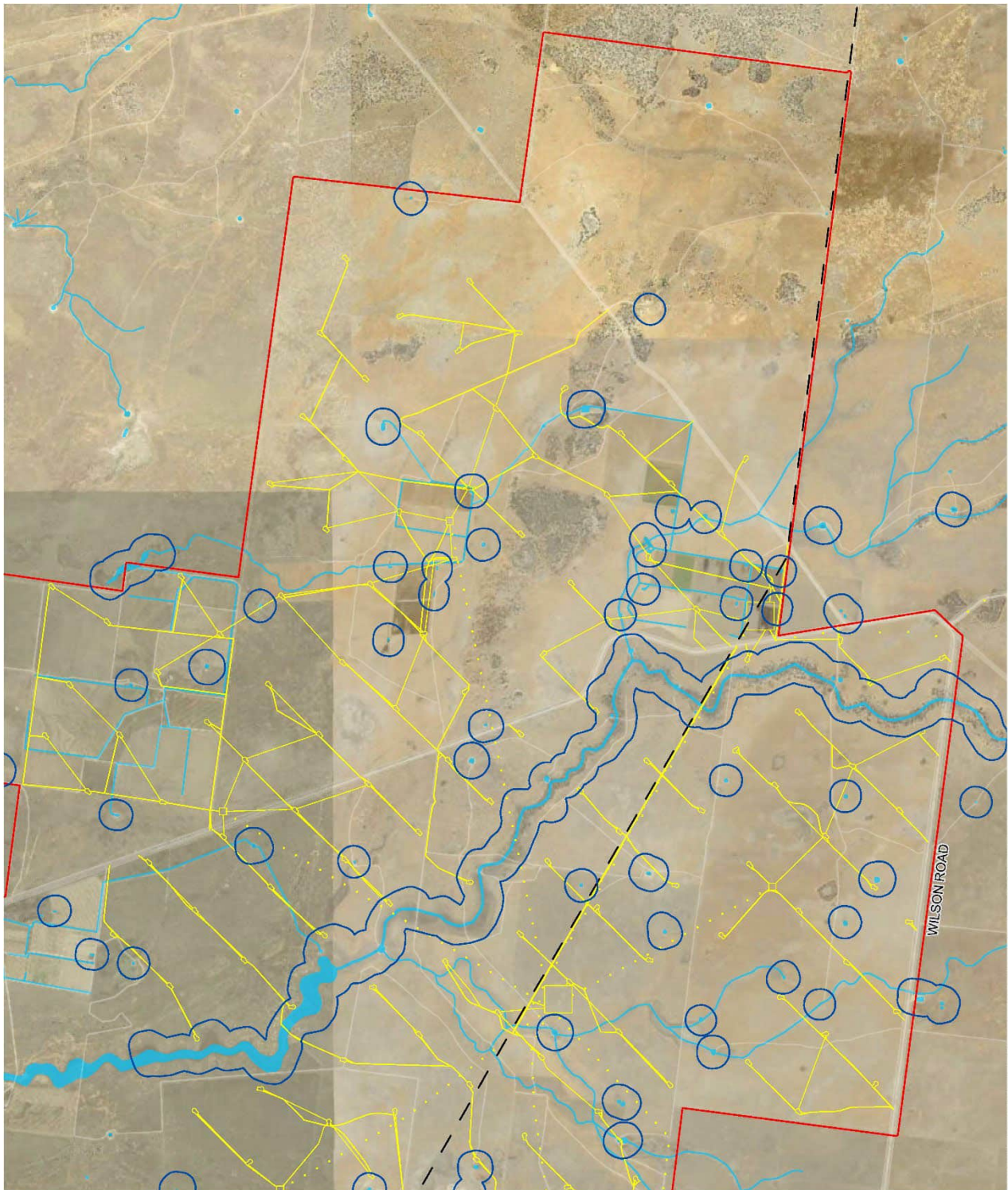


Figure 5-9. Southern Myotis habitat buffer and species polygon (Page 1 of 4)

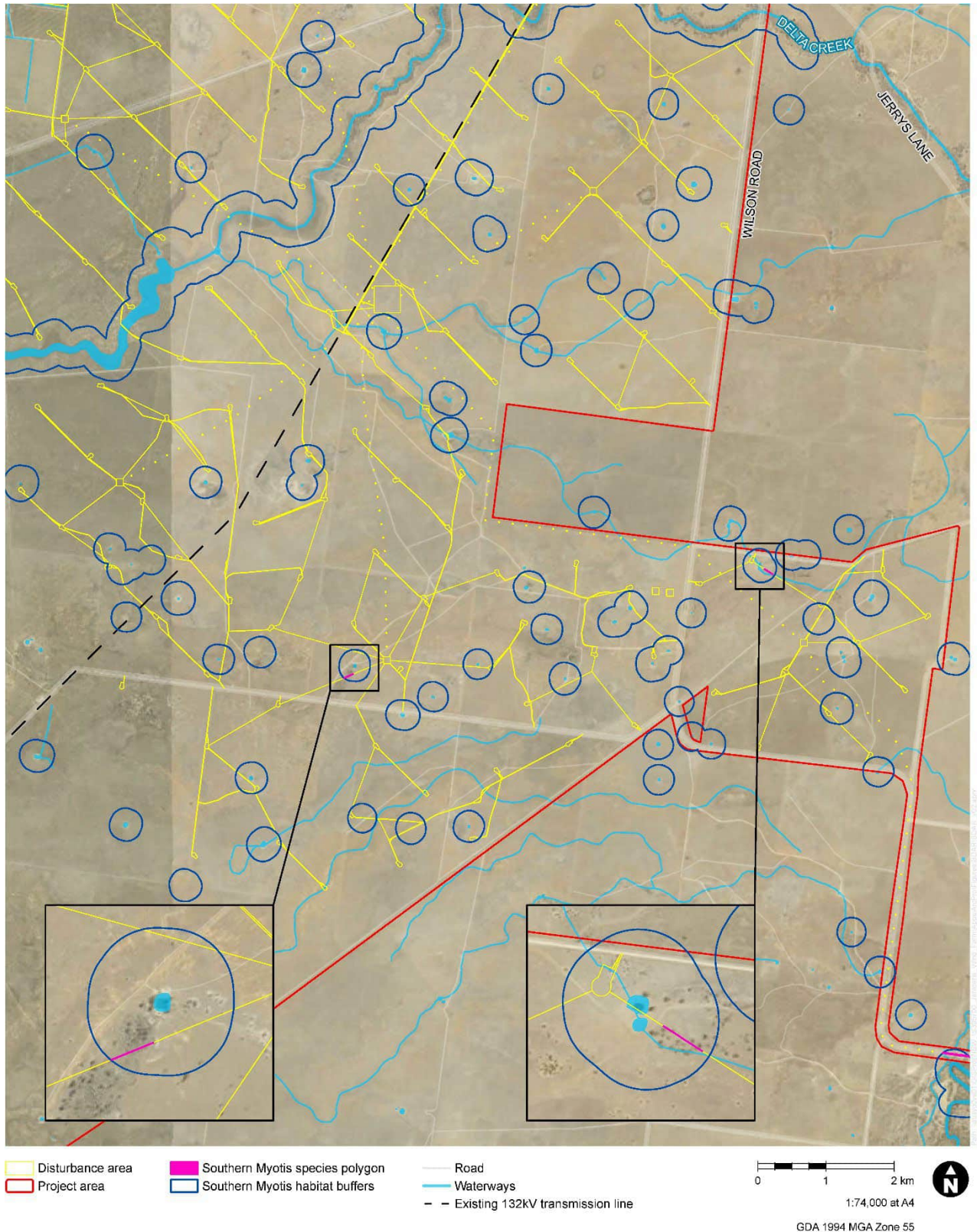
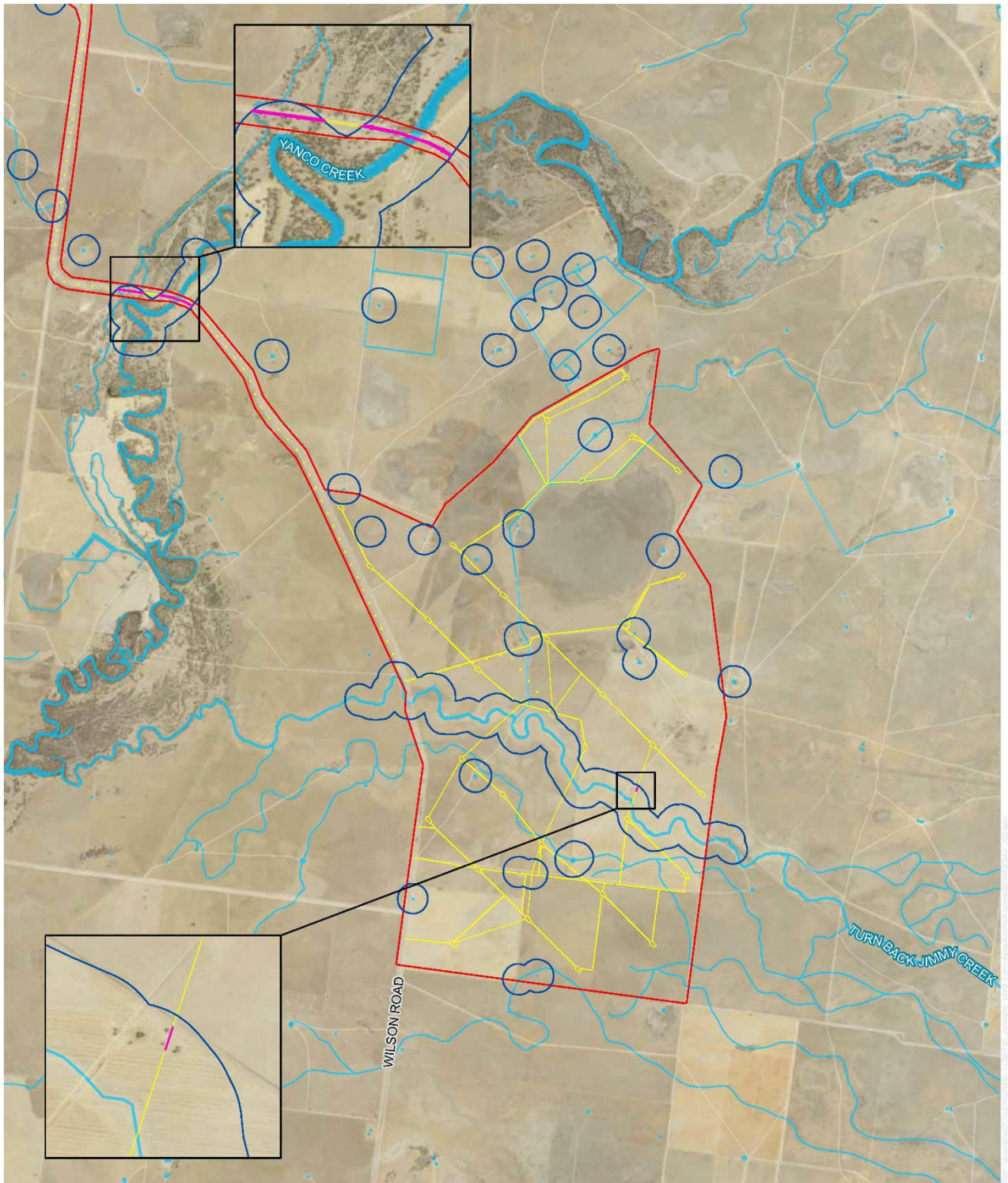


Figure 5-9. Southern Myotis habitat buffer and species polygon (Page 2 of 4)



- Disturbance area
- Project area
- Southern Myotis species polygon
- Southern Myotis habitat buffers
- Road
- Waterways

0 1 2 km
 1:74,000 at A4
 GDA 1994 MGA Zone 55

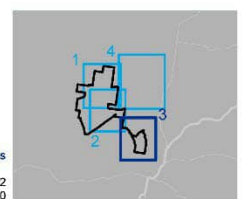


Figure 5-9. Southern Myotis habitat buffer and species polygon (Page 3 of 4)

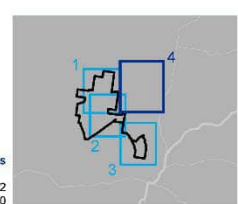
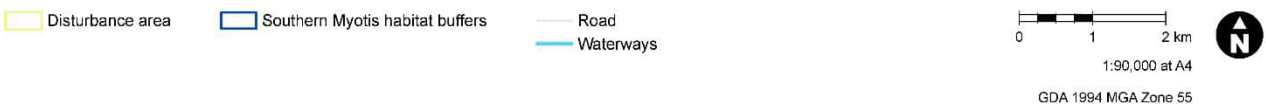


Figure 5-9. Southern Myotis habitat buffer and species polygon (Page 4 of 4)

6. Identification of prescribed impacts

This section identifies the potential prescribed biodiversity impacts on threatened species associated with the Project in accordance with Section 6 of the BAM. These are impacts that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. Prescribed impacts are often difficult to quantify or offset as they often affect unique biodiversity values that are often irreplaceable. Identification of potential prescribed impacts on threatened species or communities are outlined in **Table 6-1** as set out in section 6.1 of the Biodiversity Conservation Regulation 2017.

Table 6-1. Assessment of prescribed biodiversity impacts

Criteria for potential impact of the Project	Relevance	Threatened entities that use, are likely to use, or are part of the habitat feature.	Potential impacts and impact assessment location
Karst, caves, crevices, cliffs, and other features of geological significance as habitat of threatened species or ecological communities	There are no occurrences of karst, caves, crevices and cliffs or other geological features of significance within the study area. Although, several threatened microbat species may utilise caves and crevices for roosting, due to the lack of suitable structures, these species more likely utilise hollows and artificial structures.	N/A	Negligible Not required.
Rocks as habitat of threatened species or ecological communities	There are several small rocky areas of the study area, namely around farm dams and small burrow pits. However, these are minimal and there are no identified threatened species that utilise this as important habitat.	N/A	Negligible Not required
Human made structures as habitat of threatened species or ecological communities	There are some artificial human made structures within the Project area comprising various used and abandoned buildings and structures (ie. windmills, old buildings and farm dams). These artificial structures provide potential roosting habitat for microbat species that are known to occur or a highly likely to occur within the Project area. There is potential for four farm dams (0.11 ha) to be impacted by the Project. The current agricultural properties would remain operational.	Microbats	Minor Section 10.3
Non-native vegetation as habitat of threatened species or ecological communities	There is about 60.29 ha of non-native vegetation (5.58 ha in category 2 land) that would be impacted within the study area. This is predominantly cultivated land. Although, these areas are highly disturbed, they may provide suitable foraging habitat for threatened species such as Little Eagle, other raptors and microbats at locations near water. These areas are not considered suitable habitat for TECs, namely Natural Grasslands of the Murray Valley Plains listed critically endangered under the EPBC Act, which may have once existed in these areas.	Birds and bats	Minor Section 10.3
Habitat connectivity	The landscape itself has locally significant biodiversity links in a large mosaic of natural habitats comprising grasslands, open myall woodland, partly wooded sandhills, Eucalypt woodland and lignum swamps. These habitats provide dependable links for birds, microbats, and large macropods within existing sheep and cattle grazing practices. The woodland patches provide very important stepping stones for native fauna between open natural grassland. Creeks, drainage lines and large swamps with lignum and nitre goosefoot also provide important linkages for wildlife	Parrots, raptors, waterbirds, owls, microbats	Moderate Section 10.3

Biodiversity Development Assessment Report

Criteria for potential impact of the Project	Relevance	Threatened entities that use, are likely to use, or are part of the habitat feature.	Potential impacts and impact assessment location
	<p>movement in the landscape. Connectivity of threatened species habitat within the Landscape buffer has been historically impacted by land uses such as grazing and logging and has resulted in a fragmented landscape. Woodland areas are generally restricted to the riparian corridors, however natural grasslands persist across most of the Landscape buffer.</p> <p>The introduction of turbines, linear transmission line routes and access roads would impact connectivity for various threatened species in terrestrial and aerial habitats. Nevertheless, woodland areas have been avoided considerably through the design process.</p> <p>Several threatened species, including migratory species, utilise different habitats across the landscape for their lifecycle. The introduction of turbines, linear transmission line routes and access roads would impact connectivity for various threatened species across the landscape in terrestrial and aerial habitats. However, due to the location of key landscape resources in surrounding areas (ie. large wetlands), the Project is not anticipated to considerably impact the lifecycle of threatened species due to movement constraints.</p>		
Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	There are several waterways within the Project area including Delta Creek, Yanco Creek and Turn Back Jimmy Creek. Additionally, the Project area is a floodplain with flooding and temporary inundation occurring in various areas during high rainfall events. The Project is not expected to have a considerable impact on hydrological processes that sustain threatened species and TECs. Many riparian areas have been avoided through the design process.	N/A Minor	Section 10.3
Wind turbine strikes on protected animals	The wind turbines and associated infrastructure would have various impacts on protected fauna species. Impacts to aerial species include direct strike and potentially barotrauma.	Parrots, raptors, waterbirds, owls, microbats, migratory species	Moderate Section 10.3
Vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community	<p>Vehicular activity within the study area and on external roads accessing the site will increase during construction in associated TECs:</p> <ul style="list-style-type: none"> ▪ Natural Grasslands of the Murray Valley Plains listed as critically endangered under the EPBC Act ▪ Weeping Myall Woodlands listed as endangered under the EPBC Act ▪ Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed as endangered under the BC Act ▪ Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered under the BC Act. <p>Once the Project has been constructed, vehicle movements will be considerably reduced. However, it is not considered likely that this would result in a significant number of vehicle strikes on threatened species or parts of a TEC.</p>	Ground-dwelling birds	Minor Section 10.3

6.1 Impacts of wind farm strikes on protected animals

To adequately assess the potential prescribed impacts of the Project as a wind farm, background research and field surveys were undertaken. This aimed to identify key risks of wind farms developments in Australia and internationally and utilise that knowledge in the context of the Project. The assessment of wind farm related prescribed impacts included:

- Background research and literature review
- Bird utilisation survey
- Bat activity survey
- Species movement patterns
- Protected animals collision risk assessment.

These assessments are detailed in the following sections.

6.1.1 Background research and literature review

Direct strikes

Internationally, strike impacts to birds from wind farms have been extensively studied, however, little research has been undertaken in Australia. This lack of data limits understanding of species-specific and landscape scale differences in impacts (Hull, Stark, Peruzzo, & Sims, 2013).

Globally, impacts on bats species are poorly understood due to unanticipated impacts of windfarms to the taxa and our limited knowledge of their ecology (Grotsky et al., 2011). Overall impacts of wind farms are considered relatively low compared to other infrastructure, such as aviation and roadkill (Burgin & Brainwood, 2008; Smales, 2014). It is estimated that wind farms account for about 0.1% of global anthropogenic causes of bird deaths (Bennett, 2019).

It is generally agreed that the impacts of wind farms are species-, season- and site-specific with high flying and migratory species are at greater risk (Cryan & Barclay, 2009; Grotsky et al., 2011; Hull & Cawthen, 2013; Langston & Pullan, 2003; Rollins, Meyerholz, Johnson, Capparella, & Loew, 2012). Greater turbine height has also been associated with higher bird and bat mortality (Barclay, Baerwald, & Gruver, 2007; De Lucas, Janss, Whitfield, & Ferrer, 2008). Soaring birds with higher wing loading fly at fast speed and utilises updraft, however, they have lower manoeuvrability. It is well documented that this flight behaviour is related to increased collision risk and can be noted in the proportionally high number of raptors, vultures and ravens in collisions (De Lucas et al., 2008; Drewitt & Langston, 2006; Janss, 2000).

In a study of bird and bat fatalities from eight wind farms in south-eastern Australia, 24 bird species and four bat species have been recorded (Smales, 2014). The most frequently impacted species are medium to large birds which commonly fly at turbine heights (typically over 50m). The most commonly impacted species are Australian magpies (*Cracticus tibicen*), the Nankeen kestrel (*Falco cenchroides*) and Brown falcon (*Falco berigora*) which make up 24%, 15% and 12% of all species impacted, respectively (Smales, 2014).

Species presence and abundance at a site is not necessary representative of collision risk. This is obvious in relation to ground dwelling or low flying birds, however, other morphological, ecological and behavioural factors influence collision risk, even for high risk taxa (i.e. raptors).

In a Tasmanian study at two wind farms, only 18% and 21% of bird species known to use the sites have recorded collisions (Hull et al., 2013). Additionally, it has been observed that particular foraging behaviours (aerial searching, shrub searching, and feeding, aerial searching and pursuit in water or canopy searching) of the same taxa increased their risk of collisions compared to other behaviours (ambush predator, aerial pursuit, ground searching and feeding) (Hull et al., 2013). This has been noted by fatalities of some species of raptors (Wedge-tailed eagle, White-bellied sea-eagle, Swamp harrier, Brown falcon) on the same site where other species (Collared sparrowhawk, Brown goshawk, Grey goshawk) have not been impacted (Hull et al., 2013). Moreover, seasonal species behaviour can influence collision rates. For example, in a European study (De Lucas et al., 2008), fatalities were twice as high in winter than during the pre-breeding season although abundance was more than four times as high during winter.

Total mortality cannot be directly estimated from fatality counts as surveys are isolated and not conducted seasonally. However, data derived from three windfarms at Bluff Point and Studland Bay, Tasmania and Waubra, Victoria indicated about 1.5, 1.7 and 0.9 bird fatalities per turbine / per year, respectively (Smales, 2014).

Flight height has also been attributed to greater collision risk, however, investigation into ecological factors is largely absent. In Australia, collisions have been recorded for higher flying species of bats (Gould's wattled bat (*Chalinolobus gouldii*) and two *Vespadelus sp.*) where collisions of low flying species (Lesser Long-eared bat (*Nyctophilus geoffroyi*) and Tasmanian long-eared bat (*Nyctophilus sherrini*) (Oneill & Taylor, 1986)) known to use the same site have not been recorded (Hull & Cawthen, 2013).

Bat fatalities have been associated with difficulties of echolocation of the moving turbines (Cryan & Barclay, 2009). In a North American study, it was estimated that bats have about 0.25 seconds to change path due to the maximum distance of echolocation and the speed moving blades (Grodsky et al., 2011). Lower bat fatalities have also been recorded at non-operational wind turbines and meteorological towers (Arnett et al., 2008).

It has been postulated that vegetation clearing for construction of roads, powerline corridors and turbine foundations may attract bats towards turbines as it mimics natural flyways in the landscape (Kunz et al., 2007). However, as most turbine locations are in open air locations this is uncertain (Cryan & Barclay, 2009).

Barotrauma

Barotrauma is damage to the lungs and air-containing tissues as a result of changes in air pressure. Wind turbines create zones of low pressure as air flows over the blades in which flying fauna may be impacted (Baerwald, D'Amours, Klug, & Barclay, 2008; Kunz et al., 2007). Some microbats killed at wind farm sites have shown no signs of external injuries, however, have demonstrated internal haemorrhaging consistent with barotrauma (Baerwald et al., 2008; Kunz et al., 2007).

In a Canadian study, about 90% of bats demonstrated signs of internal injuries but only 50% demonstrated external injuries (Baerwald et al., 2008). However, several recent studies (Grodsky et al., 2011; Lawson et al., 2021; Rollins et al., 2012) have questioned the prevalence of barotrauma impacts indicating that direct strikes are likely the major cause of fatalities. Additionally, considering the magnitude of air pressure produced by wind turbines and the exposure thresholds of bats, to cause fatalities by barotrauma alone, a flight path that skim the surface of the blades would be required (Lawson et al., 2021).

Birds are considered less susceptible to barotrauma due to their lung structure (Baerwald et al., 2008), as such barotrauma is rarely considered an impact. Additionally, as most birds are diurnal, visual diversion out of a barotraumatic range is considered likely.

6.1.2 Collision data of currently operational NSW wind farms

There are currently 14 operating wind farms in NSW of which, five have recent publicly available collision data. Key features of these wind farms are provided in **Table 6-2**.

Table 6-2. Summary of key features of wind farms with collision data in NSW

Wind Farm	Region	Number of turbines	Rotor Sweep Height
Silverton Wind Farm	Far West Region, about 5km north of Silverton NSW	58	~30-155m
Gullen Range Wind Farm	Southern Tablelands, about 20km north-west of Goulbourn	73	~30-130m
White Rock Wind Farm	Northern Tablelands, about 20km west of Glen Innes	119	~30-150m
Sapphire Wind Farm	Northern Tablelands, about 25km west of Glen Innes	75	~74-200m
Bodangora Wind Farm	Central West, about 10km north of Wellington	33	~20-150m

Sources: Biosis 2021; Brett Lane and Associates 2016a, 2016b, 2017; Brett Lane and Associates 2017; Nature Advisory 2020b; Nature Advisory 2021, 2020a.

Collision data and mortalities are difficult to directly compare between wind farms as they differ in various features including their size, location and surrounding habitat. Additionally, the collision data and mortality data collected at each wind farm utilises different survey effort and methodologies. However, trends and similarities in fauna impacts can be observed. Strike rates are generally low with an estimation of about 0.4 collisions per turbine per year (Eco Logical, 2022). Collision rates also tend to decrease with an increased lower rotor sweep height (Eco Logical, 2022). This is to be expected as the majority of bird species are known to fly more frequently at lower heights (ie. 0-30m) whilst utilising the canopy vegetation or flying slightly above the canopy. As such, the higher the rotor sweep area is, the less likely interactions would occur with lower flying species.

Forty-seven bird species have been recorded. Of these, the Nankeen Kestrel (*Falco cenchroides cenchroides*), Australian Magpie (*Gymnorhina tibicen*) and Wedge-tailed Eagle (*Aquila audax*) were the most common, accounting for 20%, 14% and 11% of all records, respectively.

Ten bat species have been recorded. Of these the White-striped Freetail-bat (*Austronomus australis*) and Gould's Wattled Bat (*Chalinolobus gouldii*) were the most common, accounting for 30% and 26% of all records.

The full list of species that have been recorded in carcass surveys and are associated with collision impacts are listed in **Table 6-3**. When viewing this data, it should be noted that the numbers for each wind farm cover different survey periods and survey efforts. As such, the total number at each wind farm should not be directly compared. Additionally, the carcasses of some species would disappear faster than others, and thus likely be underrepresented in the data. For example, bat species and smaller bird species are removed by scavengers faster than larger bird species (ie. Wedge-tailed Eagle) (Brett Lane and Associates, 2017). However, the data does demonstrate the highest risk species which are common across all wind farms.

Table 6-3. Bird species identified in carcass and feather spot surveys in operation NSW windfarms

Common Name	Scientific Name	BC Status	EPBC Status	Wind farm and time period					Total
				Silverton 2018-20	Gullen Range 2015-17	White Rock 2017-19	Sapphire 2018-22	Bodangora 2019-21	
Nankeen Kestrel	<i>Falco cenchroides cenchroides</i>	P			12	5		53	70
Australian Magpie	<i>Gymnorhina tibicen</i>	P			18	7	4	20	49
Wedge-tailed Eagle	<i>Aquila audax</i>	P		2	12	9	3	13	39
Australian Raven	<i>Corvus coronoides</i>	P			4			16	20
Galah	<i>Eolophus roseicapilla</i>	P			2			17	19
Brown Falcon	<i>Falco berigora</i>	P			3			13	16
Crimson Rosella	<i>Platycercus elegans</i>	P			14				14
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	P			13	1			14
Australian Wood Duck	<i>Chenonetta jubata</i>	P			5	4	2	2	13
Noisy Miner	<i>Manorina melanocephala</i>	P						10	10
Pied Currawong	<i>Strepera graculina</i>	P			1			6	7
Crested Pigeon	<i>Ocyphaps lophotes</i>	P					3	3	6
Eastern Rosella	<i>Platycercus eximius</i>	P					1	4	5
Grey Teal	<i>Anas gracilis</i>	P			4				4
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V				1	3	4
Magpie-lark	<i>Grallina cyanoleuca</i>	P						4	4
Musk Lorikeet	<i>Glossopsitta concinna</i>	P				2	1	1	4
Red-rumped Parrot	<i>Psephotus haematonotus</i>	P						4	4
Apostlebird	<i>Struthidea cinerea</i>	P						3	3
Common Starling	<i>Sturnus vulgaris</i>				3				3
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	P			3				3
White-throated Needletail	<i>Hirundapus caudacutus</i>	P	V,C,J,K		2	1			3

Biodiversity Development Assessment Report

Common Name	Scientific Name	BC Status	EPBC Status	Wind farm and time period					Total
				Silverton 2018-20	Gullen Range 2015-17	White Rock 2017-19	Sapphire 2018-22	Bodangora 2019-21	
Australian Hobby	<i>Falco longipennis</i>	P						2	2
Black Falcon	<i>Falco subniger</i>	V,P						2	2
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	P			1		1		2
Grey Butcherbird	<i>Cracticus torquatus</i>							2	2
Grey Fantail	<i>Rhipidura albiscapa</i>	P				1		1	2
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	P			2				2
Little Raven	<i>Corvus mellori</i>	P			2				2
Pacific Black Duck	<i>Anas superciliosa</i>	P			2				2
Striated Pardalote	<i>Pardalotus striatus</i>	P			1			1	2
Tawny Frogmouth	<i>Podargus strigoides</i>	P					2		2
White-faced Heron	<i>Egretta novaehollandiae</i>	P			2				2
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	P		1					1
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	P			1				1
Brown Goshawk	<i>Accipiter fasciatus</i>	P				1			1
Common Bronzewing	<i>Phaps chalcoptera</i>	P			1				1
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	P			1				1
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	P			1				1
Pacific Baza	<i>Aviceda subcristata</i>	P					1		1
Peregrine Falcon	<i>Falco peregrinus</i>	P			1				1
Red Wattlebird	<i>Anthochaera carunculata</i>	P			1				1
Rufous Songlark	<i>Cincloramphus mathewsi</i>	P						1	1
Sacred Kingfisher	<i>Todiramphus sanctus</i>	P						1	1
Spotted Harrier	<i>Circus assimilis</i>	V,P			1				1

Common Name	Scientific Name	BC Status	EPBC Status	Wind farm and time period					Total
				Silverton 2018-20	Gullen Range 2015-17	White Rock 2017-19	Sapphire 2018-22	Bodangora 2019-21	
Whistling Kite	<i>Haliastur sphenurus</i>	P				1			1
Willie Wagtail	<i>Rhipidura leucophrys</i>	P						1	1

Table 6-4. Bat species identified in carcass and feather spot surveys in operation NSW windfarms

Common Name	Scientific Name	BC Status	EPBC Status	Wind farm and time period					Total
				Silverton 2018-20	Gullen Range 2015-17	White Rock 2017-19	Sapphire 2018-22	Bodangora 2019-21	
White-striped Freetail-bat	<i>Austronomus australis</i>	P		4	36	10		19	69
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	P		2	16	10		31	59
Southern Forest Bat	<i>Vespadelus regulus</i>	P			2			19	21
Large Forest Bat	<i>Vespadelus darlingtoni</i>	P			18			2	20
Little Mastiff-bat	<i>Mormopterus planiceps</i>	P						17	17
Little Forest Bat	<i>Vespadelus vulturnus</i>	P			7			8	15
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	P			6		1	2	9
Unidentified Eptesicus	<i>Vespadelus sp.</i>	P			5			4	9
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>	P			2			3	5
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V,P				1		3	4
Inland Free-tailed Bat	<i>Mormopterus petersi</i>	P		1					1

P: Protected, V: Vulnerable

Many other species commonly recorded at the wind farms, however, are not represented in the carcass data as they are low-risk and typically fly outside of the RSA. Identifying this level of risk is easier for bird species as they can be recorded during diurnal bird utilisation surveys in which the species and flight height is recorded from visual observations. However, this is more difficult for bat species as ultrasonic call recording must be used to identify species. As such, it is worth noting the species of bats that were frequently recorded at these wind farms were not represented in the mortality data. Therefore, the following are bat species that potentially have lower collision risk as they may not fly at RSA height (note that the RSA for these windfarms varies and is between ~30-200m):

- Bristle-faced Freetail Bat (*Setiostrotris eleryi*) – Endangered under BC Act
- Corben's Long-eared Bat (*Nyctophilus corbeni*) - Vulnerable under BC Act and EPBC Act
- Common Bent-wing Bat (*Miniopterus schreibersii*) - Vulnerable under BC Act
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) - Vulnerable under BC Act
- Large-footed Myotis (*Myotis macropus*) - Vulnerable under BC Act.

Additionally, except for the Corben's Long-eared Bat, all of the above species are not in a genus of which is known from carcass surveys. However, the Corben's Long-eared Bat is in the same genus as the Lesser Long-eared Bat (*Nyctophilus geoffroyi*) which has been recorded in carcass surveys at Gullen Range and Bodangora wind farms

6.1.3 Proposed wind farms in Riverina and Murray Regions

There are currently no operational wind farms within the Riverina and Murray Regions (LGAs of Albury, Berrigan, Carrathool, Edward River, Federation, Griffith, Hay, Leeton, Murray River, Murrumbidgee and Narrandera). However, there are three known wind farms in planning stages:

- Yanco Delta Wind Farm (this Project)
- Baldon Wind Farm (about 117 km west of the Project)
- Keri Keri Wind Farm (about 128 km west of the Project)
- Burrawong Wind Farm (about 157 km west of the Project).

The scoping reports for Burrawong Wind Farm (NGH 2021) and Keri Keri Wind Farm (Acciona 2022) indicate similar biodiversity constraints as the Project. Key features of the Burrawong Wind Farm and Keri Keri Wind Farm are outlined in **Table 6-5**.

Table 6-5. Key features of the Burrawong Wind Farm and Keri Keri Wind Farm

Feature	Burrawong Wind Farm (NGH 2021)	Keri Keri Wind Farm (Acciona 2022)
Estimates number WTGs	107	176
Blade tip height	maximum 300m	291.5m
Hub height	maximum 200m	Maximum 200m
Generating capacity	750MW	1,003MW
Species identified as vulnerable to collision with WTGs	Not specified	Wedge-tailed Eagle, Black Kite, Nankeen Kestrel, Brown Falcon, Black Falcon It was noted that the level of use of the site by these species was considered low

6.1.4 Bird utilisation survey

Methodology

Seasonal bird utilisation surveys were undertaken to target protect bird species inform potential prescribed impacts including the risk of collision with turbine blades. It was also used to inform the targeted species surveys for candidate species as described in **Section 5.2.2.1**.

Background research and data sources were reviewed to identify all protected bird species records within 20 kilometres of the Project area. Information from relevant literature and incidental species sightings during other surveys were used to inform surveys.

Seasonal bird utilisation surveys were conducted over four survey events in November 2021, February 2022, May 2022 and July 2022. These comprised fixed-point surveys conducted at up to 46 locations across the Project area. Several survey locations were omitted during some surveys due to safety and accessibility issues. Surveys were repeated eight times at each location including morning and evening surveys (generally within 3 hours of dawn and dusk) in each of the four seasons (Spring 2021 to Winter 2022). This methodology aimed to capture seasonal and temporal changes, including migration and species behaviour. Incidental (roaming) bird observations were also recorded across the Project area (refer to **Section 5.2.2.2**).

The surveys were undertaken over a 20 minute period at each location by two ecologists. Observations were made for all species within 360 degrees of the survey location at up to 100 m for small birds and 800 m for large birds. The following data was recorded:

- Bird species
- Number of birds
- Height of bird observations above the ground in bands of 0-20m, 20-50m, or >50m
- Weather conditions, habitat features and species behaviour
- Survey details including date, start and end times, site location.

The survey locations were selected to represent likely turbine positions identified early in the Project design and to obtain data at potential impact locations. They were distributed in different vegetation formations as a surrogate for habitat types. As the design developed, some turbine locations moved to avoid other environmental constraints. Additionally, the locations of some surveys were moved to nearby suitable positions in times of poor weather conditions and inaccessibility. The locations and survey timing are shown in **Figure 5-3**.

In the assessment of the data, seasons were defined by 3-month intervals as Summer (Nov-Jan), Autumn (Feb-Apr), Winter (May-July) and Spring (Aug-Oct). Birds were grouped into general 'guilds' to illustrate the diversity recorded within the Project area and facilitate the impact assessment.

Results - species richness and abundance

A total of 116 bird species were recorded within the Project area. The total list of species is provided in **Appendix H**.

The species richness (number of different species) represents about 34% of the diversity in the Riverina Region (of about 345 species, DPE 2022b). The number of species varied across seasons with the most diversity in Summer, with 83 species recorded and the lowest diversity in Winter with 60 species recorded. The diversity of migratory and nomadic species marginally changed with the most diversity in Spring. **Figure 6-1** outlines the species diversity across seasons.

Species abundance (total bird count) was generally different across seasons with the highest abundance in Summer and lowest in Winter. **Figure 6-1** outlines the species richness and abundance across seasons.

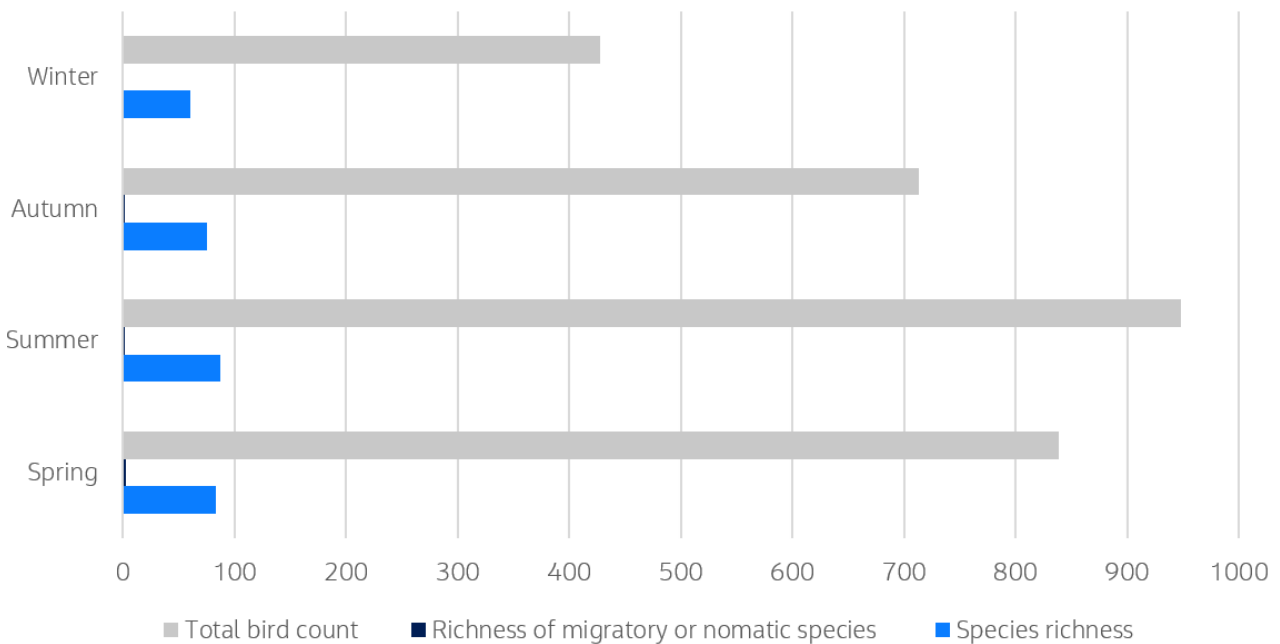


Figure 6-1. Summary of species richness and abundance in the Project area across seasons

The most common species recorded in the Project area were the Galah (*Eolophus roseicapilla*), Common Starling (*Sturnus vulgaris*), Blue Bonnet (*Northiella haematogaster*), Red-rumped Parrot (*Psephotus haematotus*) and Australian Magpie (*Gymnorhina tibicen*), with 1659, 1215, 1142 and 1022 observations, respectively. These five species make up 40% of all bird observations.

Of the 116 bird species recorded, 14 species were only recorded once, and 46 species were recorded less than 10 times.

The most diverse guild of birds was the insectivores (ie. honeyeaters, robins, thornbills, wrens) which made up about 47% of all species observed. Although only 10 parrot species were recorded, they were the second-most recorded group after the insectivores. This can be attributed to the high number of Blue Bonnets and Red-rumped Parrots in the Project area. A summary of the bird guild diversity and abundance is shown in Figure 6-2 and Figure 6-3.



Figure 6-2. Summary of diversity of guilds

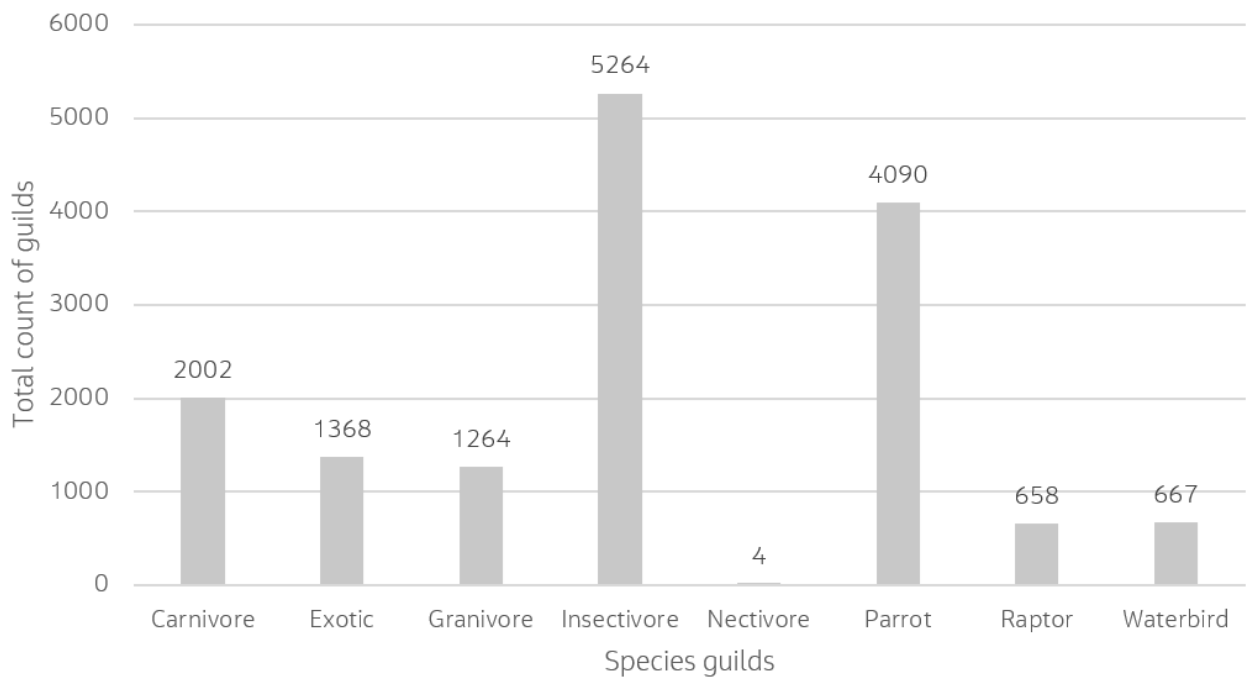


Figure 6-3. Summary of total counts of bird guilds

Flight heights

Most bird species (60%) were only recorded at flight heights of up to 20 m. Recorded observations within the 0-20 m flight height make up the majority of observations. This is generally expected as the tree canopy across the Project area is about 10-15 m high and most species utilise this height to forage and move between vegetation patches. Species that were only observed in the 0-20 m height are typically smaller birds with strong affiliations to vegetation. However, many records are also of raptors and other species that have been recorded at higher elevations, albeit often come to the ground to forage (i.e. Wedge-tailed Eagle).

Only 17 bird species were observed at >50 m, and thus within the RSA height. These typically were large raptors flying in thermals and medium sized parrots travelling across the landscape. The most common species recorded at this >50 m height were the Nankeen Kestrel, Galah and Wedge-tailed Eagle. Additionally, several duck species, ravens and raptors were recorded at this elevation. A comparison of the guilds recorded in the >50 m height are shown in Figure 6-4.

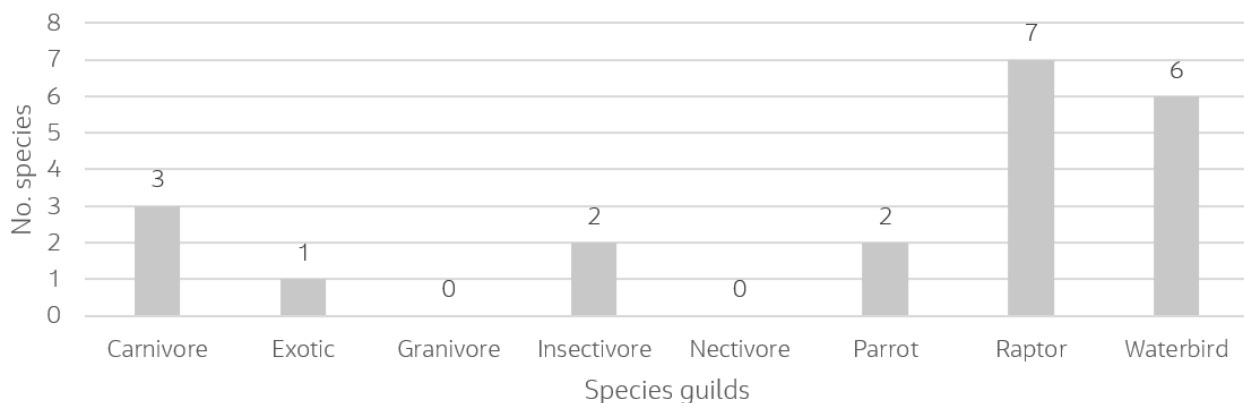


Figure 6-4. Comparison of the guilds recorded in the >50 m height

The number of species observed <50 m varied across seasons, generally with more species recorded in Spring and Autumn. Notably, smaller bodied birds were not recorded over <50 m during Summer and Winter (i.e. ducks, Galahs, swallows and martins). This may be due to unfavourable weather conditions. The White-

browed Woodswallow was only recorded <50 m during Spring, which can be attributed to its migratory behaviour. Two species that were recorded <50 m across all seasons included.

The Wedge-tailed Eagle and Brown Falcon were recorded <50 m in all seasons, and the Nankeen Kestrel was recorded in every season except Summer.

Migratory paths

Two species that have been recorded or have moderate to high likelihood of occurring within the Project area are listed migratory species under the EPBC Act. These species are as follows:

- White-throated Needletail (*Hirundapus caudacutus*) – moderately likely to occur
- Swift Parrot (*Lathamus discolor*) – moderately likely to occur.

White-throated Needletail is almost exclusively aerial, from heights of 1 – 1000 metres above the ground. They are often sighted before storms, low-pressure troughs, approaching cold fronts and occasionally bushfire due to the swarming of insects the conditions result in (DPE, 2021b). They occur over most types of habitats but are recorded most often above wooded areas including open forests and rainforests, over heathland, and may also fly between and in clearings – less commonly they are recorded flying above woodland, grasslands or swamps (DAWE, 2022e). There are uncertainties around the number of individuals likely to use the airspace in the Project area and ability to estimate impacts on an ecologically significant proportion of their population at a national and international scale.

There is limited nectar producing woodland patches in the Project area to regularly attract foraging Swift Parrot, but the groups of birds may fly through the location on occasion.

6.1.5 Bat activity survey

Methodology

Bat activity surveys were undertaken to target candidate threatened species identified in **Section 5.2.2.6** to inform potential prescribed impacts including the risk of collision with turbine blades and of barotrauma.

Background research and data sources were reviewed to identify all protected bat species records within 20 kilometres of the Project area. Information from relevant literature and incidental species sightings during other surveys were used to inform surveys.

Bat activity surveys were conducted between 13-17 November 2021 (15 trap nights), 4-18 February 2022 (10 trap nights), 9-11 May 2022 (6 trap nights) and 11-15 July 2022 (14 trap nights). There was a combined total of 45 trap night using ultrasonic call recording devices such as Anabat Express detectors (Titley Scientific). Devices were positioned within 200 m of suitable habitat (ie. available waterbodies, artificial structures, hollow bearing trees) and on elevated structures (ie. windmills) where available. The height of Anabat devices varied (2-10 metres) due to access and safety climbing old windmills. Bat surveys were conducted in accordance with methods described in the *Survey Guidelines for Australia's Threatened Bats* (Commonwealth of Australia, 2010) and the *Species credit threatened bats and their habitats* (OEH, 2018).

The locations of call detection devices are shown in **Figure 5-3**.

Results

The surveys positively identified 11 bat species, including:

Protected species

- White-striped freetail Bat (*Austronomus australis*)
- Chocolate Wattled Bat (*Chalinolobus morio*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)
- Long-eared Bat complex (*Nyctophilus sp.*)
- South-eastern Free-tailed Bat (*Ozimops planiceps*)
- Ride's Free-tailed Bat (*Ozimops ridei*)
- Inland Free-tailed Bat (*Ozimops petersii*)
- Inland Broad-nosed Bat (*Scotorepens balstoni*)
- Large Forest Bat (*Vespadlus darlingtoni*)
- Little Forest Bat (*Vespadelus vulturinus*)
- Southern Forest Bat (*Vespadelus regulus*).

Southern Myotis and Yellow-bellied Sheath-tail Bat are assumed present based on suitable habitat in the subject land.

Several other call signatures were not positively identified with the results being limited to a species group or genus. However, the options of possible species within a suitable distribution are included in the list above.

Echolocation call data over four seasons is presented in **Table 6-6** and **Figure 6-5**. The level of bat activity is represented as the number of calls for each species per sampling night. The summer 2022 had the highest bat activity in the Project area over the 10 night sampling period and recorded all 11 bat species. The Gould's Wattled Bat has the highest mean number of bat calls over the entire sampling period. Of the 11 species recorded, only four had a mean bat activity above 10 calls per day, namely Gould's Wattled Bat, Chocolate Wattled Bat, *Ozimops* spp., and *Vespadelus* spp. These species were considered in the most abundant based on bat activity data.

It should be noted that bat call data was not collected at repeatable sampling locations and each Anabat device was placed in a different location in the Project area for each sampling event. This aimed to spatially capture the presence of bat species. This means that data indicating a lower activity of a bat species doesn't necessarily show a decline in activity over a specific period because the micro-habitat would be different for each sampling event.

Table 6-6. Microchiropteran bat activity recorded as call trap rate (no. of calls per trap day) over four seasons (2021-2022)

Sampling period	BnB sp	CWB	GWB	InBn B	LiBn B	LiFB	Nycto sp	Ozi sp	PetFreB	RiFreB	SFreB	Vesp sp	WsFB
Spring	0.5	14.9	61.0	2.7	1.4	1.8	1.3	18.0	1.7	0.0	6.7	18.4	0.2
Summer	6.7	22.2	328.4	1.0	12.9	9.4	0.8	64.3	1.5	0.4	11.1	56.4	10.7
Autumn	0.0	0.3	41.2	0.2	0.2	0.2	0.2	15.7	0.0	0.0	8.3	0.0	1.3
Winter	0.1	17.2	2.8	0.0	0.3	26.0	0.0	6.3	0.0	0.0	3.9	11.2	0.0
Mean	1.8	13.7	108.4	1.0	3.7	9.3	0.6	26.1	0.8	0.1	7.5	21.5	3.1
SE	3.3	9.4	148.7	1.2	6.2	11.8	0.6	26.0	0.9	0.2	3.0	24.5	5.1

- BnB sp - *Scotorepens balsoni* / *S. greyii*
- CWB - *Chalinolobus morio*
- GWB - *Chalinolobus gouldii*
- InBnB - *Scotorepens balstoni*
- LiBnB - *Scotorepens greyii*
- LiFB - *Vespadelus vulturus*
- Nycto sp - *Nyctophilus geoffroyi* / *gouldi*
- Ozi sp - *Ozimops planiceps* / *ridei*
- PetFreB - *Ozimops petersii*
- RiFreB - *Ozimops ridei*
- SFreB - *Ozimops planiceps*
- Vesp sp - *Vespadelus darlingtoni* / *regulus* / *vulturus*
- WsFB - *Austronomus australis*

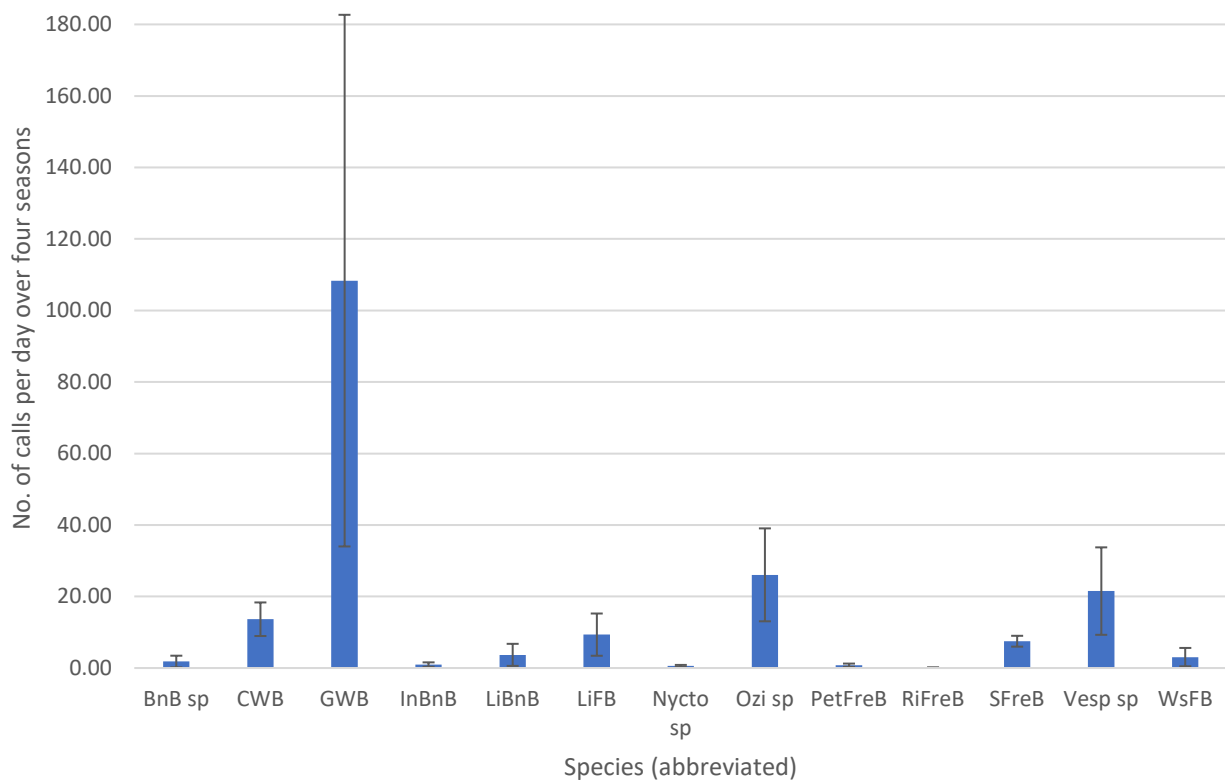


Figure 6-5. Mean number of calls per day of different bat species recorded over four sampling events (2021-2022)

6.1.6 Protected animal collision risk assessment

The risk of fauna collision based on various factors contributing to the likelihood of collision with the WTGs and the significance of the consequence. The likelihood of collision is species specific and site specific. The species and numbers of collisions are dependent on the locality (ie. if the species is present in the area) and on the features of the wind farm such as the height and number of the WTGs as well as site design. The consequence of collision addresses the potential outcomes to the entire species and population viability as a result of collisions.

Species at risk of collision

Flight height is considered the key factor in potential collision with turbines. WTGs are expected to have a maximum tip height of 270 metres and a blade length of up to 110 metres. As such, all species recorded in the <50 metres flight zone are considered to be at most risk of direct strikes. Additionally, abundance of species within the Project area increases probability of strikes.

Table 6-10 outlines the species most at risk of direct strikes based on survey data and literature and provides justification on whether they are considered for detailed assessment. It should be noted that although the impacts of other wind farms have been reviewed as part of this assessment (refer to Section 6.1.1) the WTGs in the Project would generally be taller. As such, the risk level for many species impacted in other wind farms is lower as they do not utilise aerial habitat at the turbine height.

Species have been considered for further assessment if it meets one or more of the following criteria:

- Is a listed threatened species
- The species is nomadic, vagrant or an altitudinal migrant
- Is one of the top five most abundant resident aerial species (native) recorded over four seasons
- A species that was recorded utilising the airspace greater than 50 m above ground (strike zone)

- A threatened species recorded from 10km radius but not recorded on site
- Candidate species not recorded.

These species are listed and assessed in **Table 6-10**.

Collision risk assessment

This risk assessment has been adapted from the method used at Gullen Wind Farm (Brett Lane and Associates, 2017), and in more recent wind farm impact assessments (EcoLogical, 2022). It has been applied to the Project to identify at-risk species that would require additional collision modelling and monitoring. The likelihood and consequence criteria are provided in **Table 6-7** and **Table 6-8**. The associated risk ranking is provided in **Table 6-9**.

This assessment has been applied to each of the identified at-risk species. The outcomes are provided in **Table 6-10**.

Table 6-7. Likelihood criteria

Likelihood	Description
Almost certain	It is very probable that the risk event could occur in any year (>90%)
Likely	It is more probable than not that the risk event could occur in any year (>50%)
Possible	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 probably that the risk event could occur in any year. It is possible, but unlikely except in exception circumstances (<5%)

Table 6-8. Consequence criteria

Consequence	Description
Negligible	Occasional individuals lost but no reduction in local or regional population viability
Minor	Repeated loss of small numbers of individuals but no reduction in local or regional population viability
Moderate	Moderate loss in numbers of individuals, leading to a minor reduction in localised or regional population viability for between one and five years
Major	Major loss in numbers, leading to reduction in regional or state population viability for between five and ten years
Critical	Extreme loss in numbers of individuals, leading to reduction in regional or state population viability for a period of at least 10 years

Table 6-9. Risk ranking

Likelihood	Consequence				
	Negligible	Minor	Moderate	Major	Critical
Almost certain	Low	Medium	High	Severe	Severe
Likely	Very Low	Medium	Medium	High	Severe
Possible	Very Low	Low	Medium	High	Severe
Unlikely	Very Low	Low	Low	Medium	High
Rare	Very Low	Very Low	Low	Medium	High

Table 6-10. Collision risk assessment

Species	Reason for assessment						Likelihood	Consequence	Risk rating
	Threatened species	Nomadic / Vagrant / Migrant species	Top 5 most abundant (protected species)*	Utilise airspace >50 m	Records from 10km radius	Candidate species not recorded			
Birds									
Australian Bustard					Y	Y	Rare	Moderate	Low
Australian Magpie			Y	Y	Y		Possible	Minor	Low
Australian Raven				Y	Y		Possible	Minor	Low
Australian Shelduck		Y		Y	Y		Possible	Minor	Low
Australian Wood Duck				Y	Y		Possible	Minor	Low
Banded Lapwing		Y			Y		Rare	Moderate	Low
Barking Owl	Y				Y	Y	Rare	Moderate	Low
Black Falcon	Y				Y		Possible	Major	High
Black Kite				Y	Y		Possible	Moderate	Medium
Black-chinned Honeyeater	Y				Y		Unlikely	Moderate	Low
Black-fronted Dotterel		Y			Y		Rare	Moderate	Low
Black-shouldered Kite				Y	Y		Possible	Moderate	Medium
Black-tailed Godwit						Y	Unlikely	Moderate	Low
Blue-billed Duck	Y				Y		Rare	Moderate	Low
Brown Falcon				Y	Y		Possible	Moderate	Medium
Brown Goshawk				Y	Y		Possible	Moderate	Medium
Bush Stone-curlew	Y				Y	Y	Rare	Moderate	Low
Curlew Sandpiper						Y	Rare	Moderate	Low
Diamond Firetail	Y				Y		Unlikely	Moderate	Low
Dusky Woodswallow	Y				Y		Unlikely	Moderate	Low

Biodiversity Development Assessment Report

Species	Reason for assessment						Likelihood	Consequence	Risk rating
	Threatened species	Nomadic / Vagrant / Migrant species	Top 5 most abundant (protected species)*	Utilise airspace >50 m	Records from 10km radius	Candidate species not recorded			
Flame Robin	Y				Y		Unlikely	Moderate	Low
Fork-tailed Swift		Y		Y	Y		Possible	Moderate	Medium
Galah			Y	Y	Y		Likely	Minor	Medium
Great Cormorant		Y		Y	Y		Possible	Minor	Low
Grey Teal				Y	Y		Possible	Minor	Low
Grey-crowned Babbler	Y				Y		Unlikely	Moderate	Low
Little Eagle	Y				Y		Unlikely	Major	Medium
Little Raven			Y	Y	Y		Possible	Moderate	Medium
Major Mitchell's Cockatoo	Y				Y	Y	Rare	Moderate	Low
Masked Owl	Y				Y	Y	Rare	Moderate	Low
Nankeen Kestrel				Y	Y		Possible	Moderate	Medium
Pacific Black Duck				Y	Y		Possible	Minor	Low
Painted Honeyeater	Y				Y	Y	Rare	Major	Medium
Pelican		Y			Y		Rare	Moderate	Low
Plains-wanderer	Y				Y		Rare	Moderate	Low
Plumed Whistling-Duck		Y			Y		Rare	Moderate	Low
Rainbow Bee-eater		Y			Y		Possible	Moderate	Medium
Red-rumped Parrot			Y	Y	Y		Possible	Minor	Low
Regent Honeyeater	Y				Y	Y	Rare	Moderate	Low
Regent Parrot (eastern subspecies)						Y	Rare	Moderate	Low
Restless flycatcher		Y					Rare	Moderate	Low
Silvereye		Y			Y		Rare	Moderate	Low

Biodiversity Development Assessment Report

Species	Reason for assessment						Likelihood	Consequence	Risk rating
	Threatened species	Nomadic / Vagrant / Migrant species	Top 5 most abundant (protected species)*	Utilise airspace >50 m	Records from 10km radius	Candidate species not recorded			
Spotted Harrier	Y				Y		Possible	Major	High
Square-tailed Kite	Y			Y	Y		Possible	Major	High
Superb Parrot	Y				Y		Possible	Major	High
Swift Parrot	Y					Y	Rare	Moderate	Low
Tree Martin				Y	Y		Possible	Moderate	Medium
Varied Sittella	Y				Y		Rare	Moderate	Low
Wedge-tailed Eagle				Y	Y		Possible	Moderate	Medium
Whistling Kite				Y	Y		Possible	Moderate	Medium
White-bellied Sea-Eagle	Y				Y	Y	Possible	Moderate	Medium
White-browed Woodswallow			Y	Y	Y		Possible	Moderate	Medium
White-faced Heron				Y	Y		Possible	Moderate	Medium
White-fronted Chat	Y				Y		Unlikely	Moderate	Low
White-throated Needletail	Y				Y	Y	Possible	Major	High
Bats									
White-striped freetail Bat			Y	Y	Y		Possible	Minor	Low
Chocolate Wattled Bat			Y	Y	Y		Possible	Minor	Low
Gould's Wattled Bat			Y	Y	Y		Possible	Minor	Low
Long-eared Bat complex					Y		Unlikely	Minor	Low
South-eastern Free-tailed Bat			Y		Y		Possible	Minor	Low
Ride's Free-tailed Bat			Y		Y		Possible	Minor	Low
Inland Free-tailed Bat			Y		Y		Possible	Minor	Low
Inland Broad-nosed Bat					Y		Unlikely	Minor	Low

Biodiversity Development Assessment Report

Species	Reason for assessment						Likelihood	Consequence	Risk rating
	Threatened species	Nomadic / Vagrant / Migrant species	Top 5 most abundant (protected species)*	Utilise airspace >50 m	Records from 10km radius	Candidate species not recorded			
Large Forest Bat			Y		Y		Possible	Minor	Low
Little Forest Bat			Y	Y	Y		Possible	Minor	Low
Southern Forest Bat			Y	Y	Y		Possible	Minor	Low
Southern Myotis	Y				Y		Unlikely	Moderate	Low
Yellow-bellied Sheathtail Bat	Y			Y	Y		Unlikely	Moderate	Low
Little Pied Bat	Y				Y		Unlikely	Moderate	Low

*top five most abundant species are shown for both bird and bats. Bats abundance is based on bat activity using number of calls per night and species are grouped to genus.

6.1.7 Disturbance zones

The Project has been designed to position wind turbines at locations at least 100 metres away from biodiversity habitat features that attract interactions with protected fauna and threatened fauna. This included:

- Stick nests and hollow bearing trees where possible, particularly large stick nests used by Wedge-tailed Eagle
- Riparian corridors
- Eucalypt woodland edges, where possible
- Permanent waterbodies or lying depressions/Lignum swamps.

6.1.8 Summary of protected animals at risk of wind turbine strikes

A summary of protected animals with a medium to high risk of being impacted by wind turbines is presented in **Table 6-11**. The high risk rating for affect species is a result of:

- Known or expected flight with relative abundance in the Project area
- Known susceptibility to blade strike at wind farms
- Likelihood to fly within the RSA and consequence of blade strike (i.e. threatened species).

There is a low risk rating of bats being impacted by wind turbines.

Although seasonal bird utilisation surveys collected comprehensive bird data across the Project area, there are uncertainties around the number of individuals of species not recorded, including Black Falcon and White-throated Needletail which have potential to use the airspace in the Project area. Some nomadic and migratory birds may only utilise the airspace at different periods of the year or at times of flooding or other climatic events. There is a chance or possibility that blade strike impacts will seriously disrupt the lifecycle of bird populations in the Project area due to the uncertainties around the number of individuals occupying the air space at risk of blade strike collision.

Table 6-11. Summary of protected species with a medium to high risk rating with prescribed impacts from WTGs

Species	Threatened species	SAIL entity	Risk rating
Black Kite	-	No	Medium
Black-shouldered Kite	-	No	Medium
Brown Falcon	-	No	Medium
Brown Goshawk	-	No	Medium
Fork-tailed Swift	-	No	Medium
Galah	-	No	Medium
Little Eagle	Vulnerable BC Act	No	Medium
Little Raven	-	No	Medium
Nankeen Kestrel	-	No	Medium
Painted Honeyeater	Vulnerable BC Act & EPBC Act	No	Medium
Tree Martin	-	No	Medium
Rainbow Bee-eater	-	No	Medium
Wedge-tailed Eagle	-	No	Medium
White-bellied Sea Eagle	Vulnerable BC Act	No	Medium
Whistling Kite	-	No	Medium
White-browed Woodswallow	-	No	Medium
White-faced Heron	-	No	Medium

Biodiversity Development Assessment Report

Species	Threatened species	SAIL entity	Risk rating
Black Falcon	Vulnerable BC Act	No	High
Spotted Harrier	-	No	High
Square-tailed Kite	-	No	High
Superb Parrot	Vulnerable BC Act & EPBC Act	No	High
White-throated Needletail	Vulnerable EPBC Act	No	High

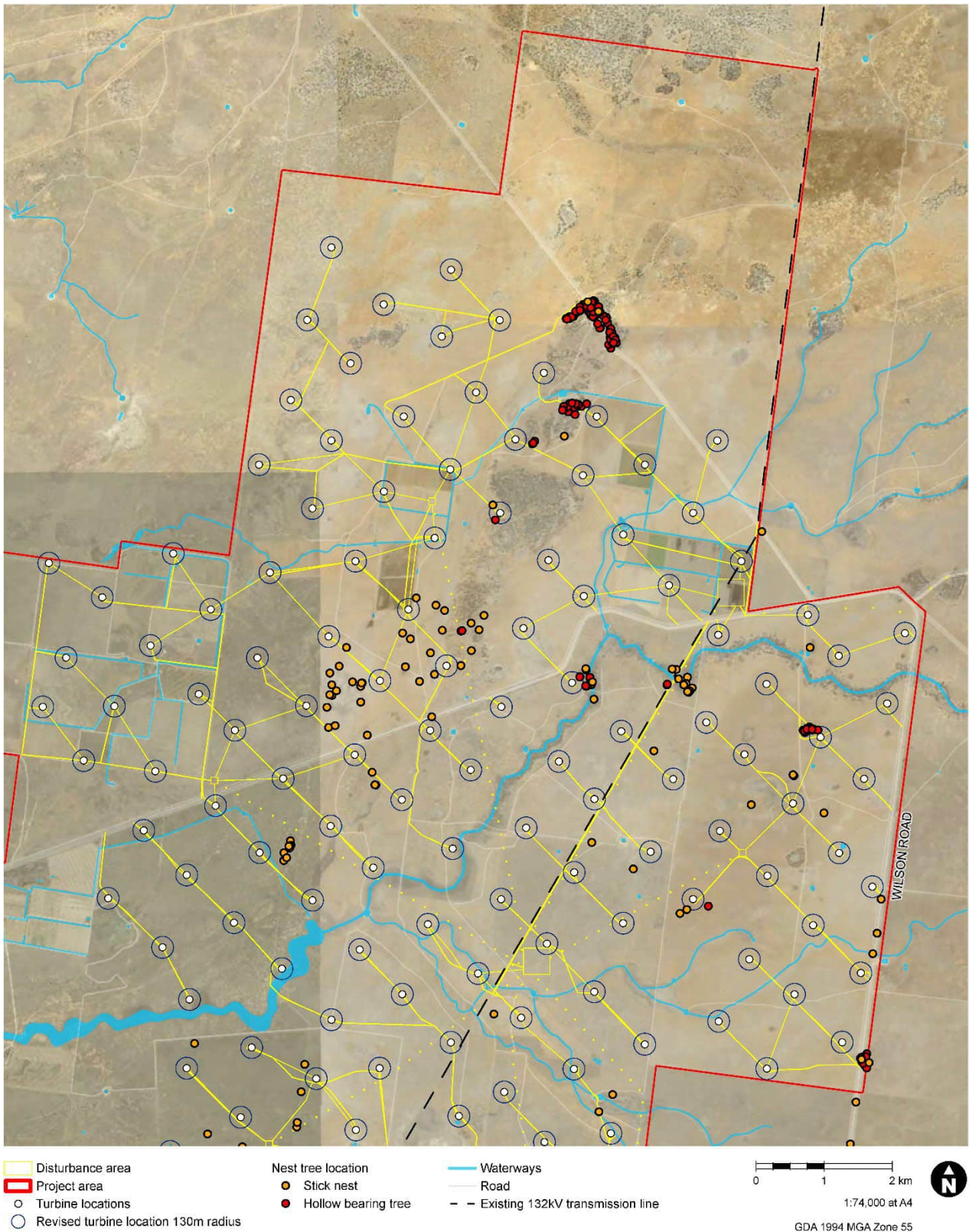
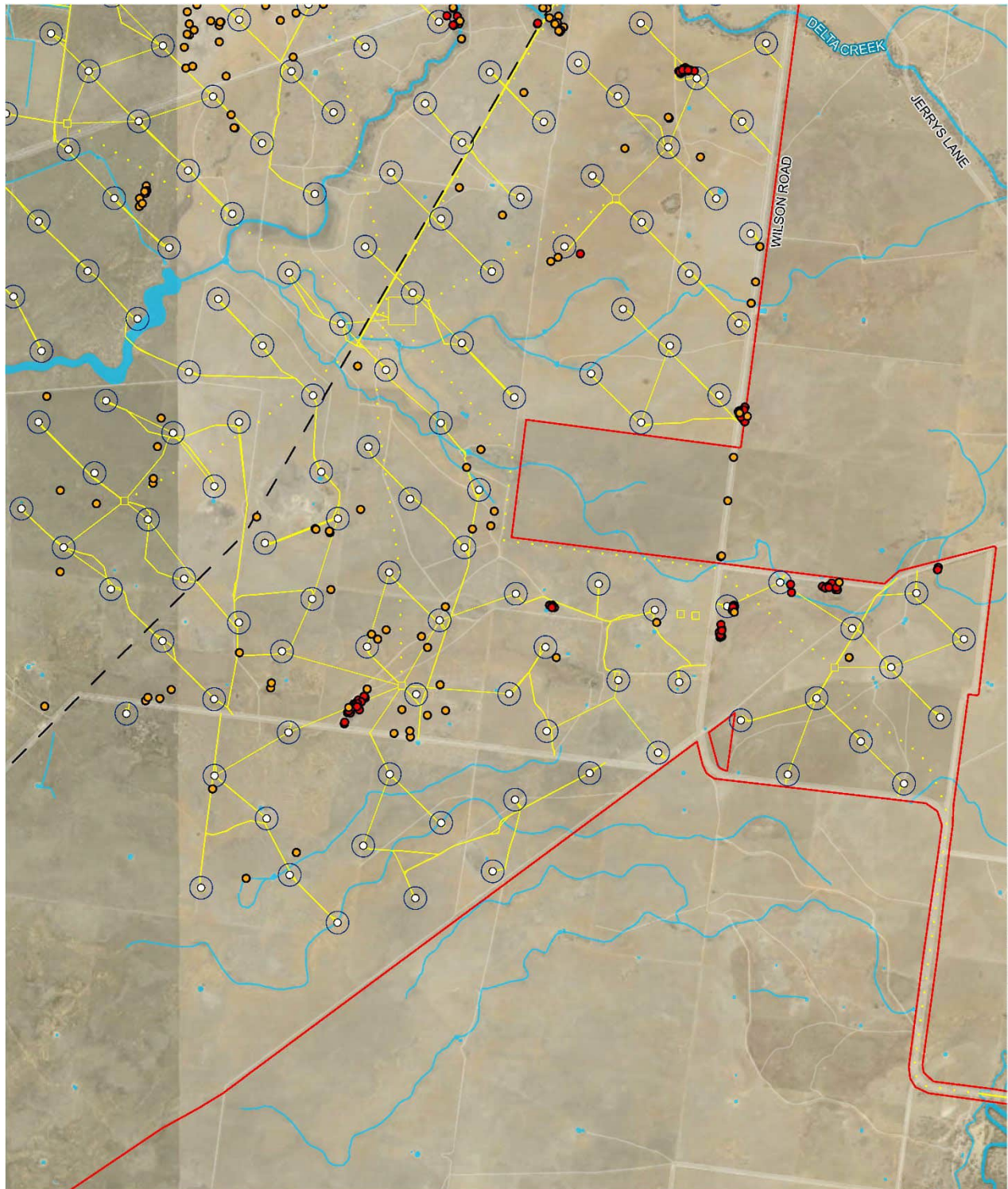


Figure 6-6. Wind turbine disturbance zones (Page 1 of 4)



Disturbance area	Nest tree location	Waterways	0 1 2 km
Project area	Stick nest	Road	N
Turbine locations	Hollow bearing tree	Existing 132kV transmission line	1:74,000 at A4
Revised turbine location 130m radius			GDA 1994 MGA Zone 55

Data sources

- Jacobs 2022
- © Department of Customer Service 2020

Figure 6-6. Wind turbine disturbance zones (Page 2 of 4)

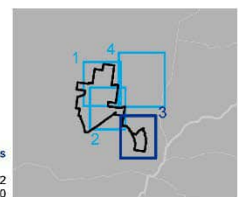
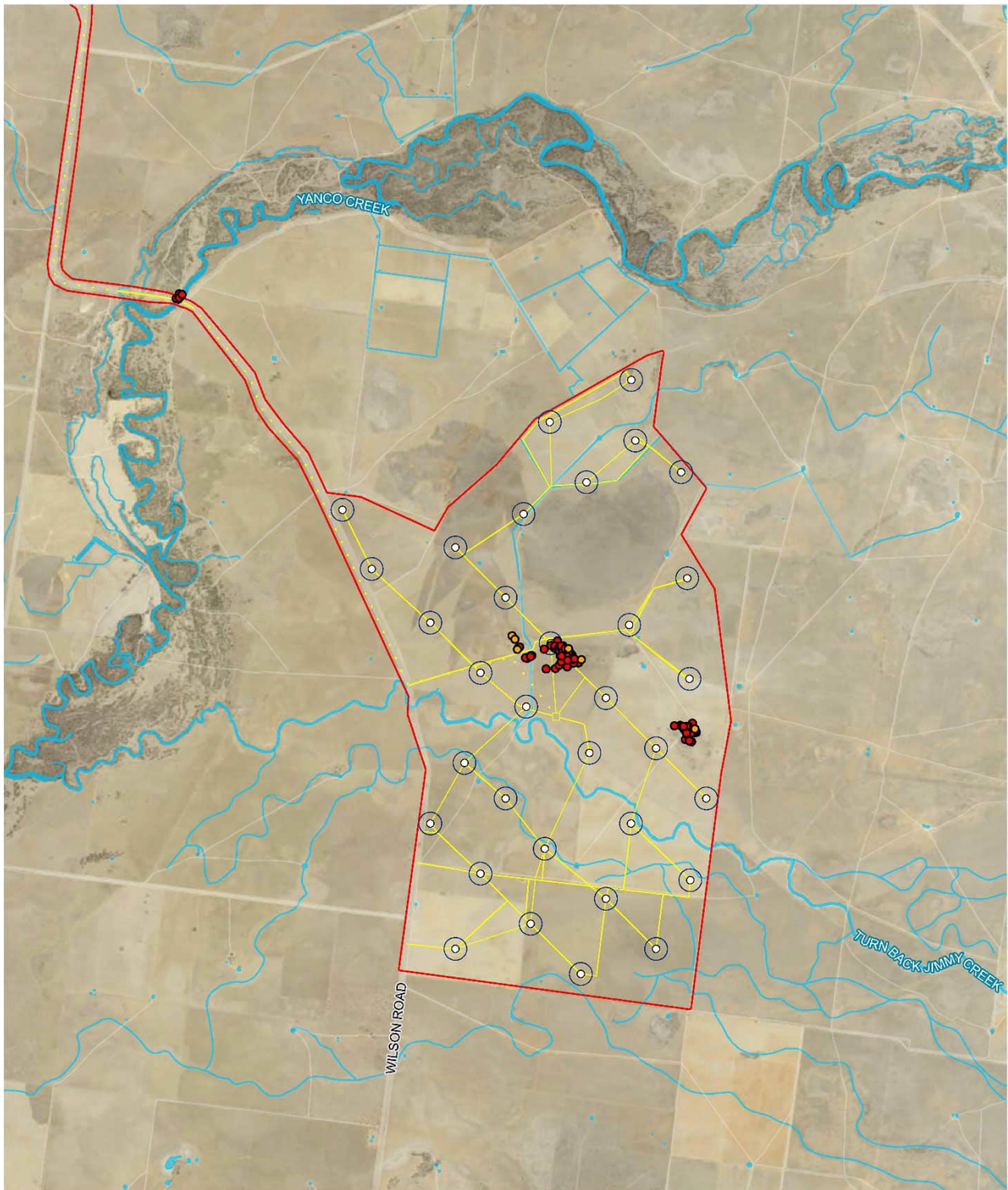
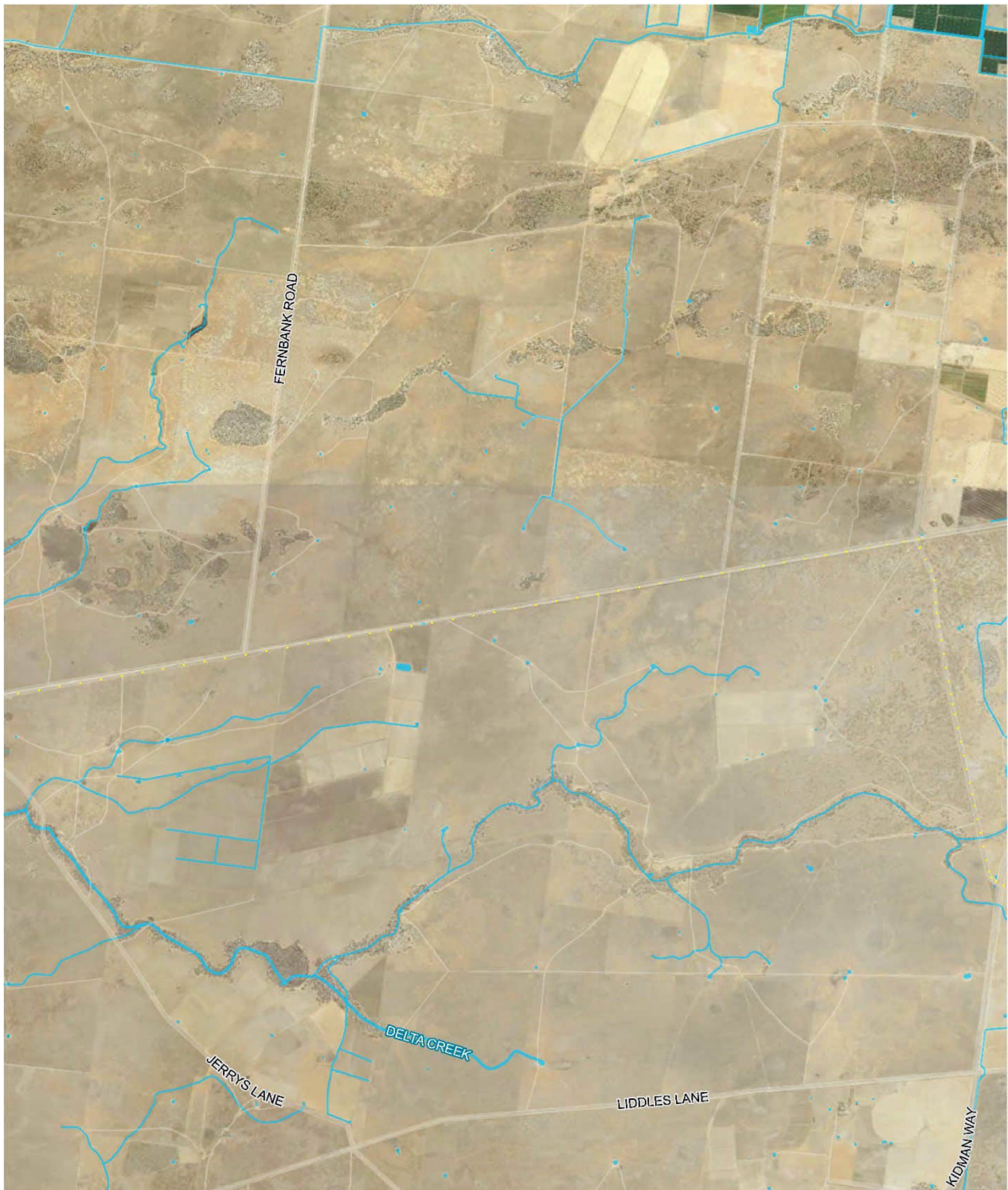


Figure 6-6. Wind turbine disturbance zones (Page 3 of 4)



Disturbance area

 Waterways
 Road




1:90,000 at A4

GDA 1994 MGA Zone 55

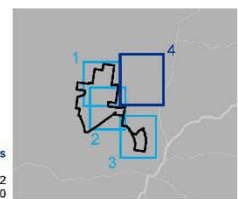


Figure 6-6. Wind turbine disturbance zones (Page 4 of 4)

7. Aquatic assessment

7.1 Methodology

The methodology for assessment of potential aquatic ecology impacts arising from the Project is outlined in the following section and has broadly included:

- Desktop review and analysis of existing aquatic ecosystem information to understand the existing environment
- Identification of potential risks to aquatic ecology based on existing conditions, proposed Project design and construction methodology
- Recommendations for appropriate treatment measures to mitigate the impacts of construction and operation on aquatic ecosystems.

7.1.1 Background research and key information sources

The desktop assessment involved review of public database searches, available literature, water quality data, and previous reports relevant to the Project Area. Information sources included:

- Bionet – the Atlas of NSW Wildlife Threatened Species Profile Databases (DPE, 2022) (accessed December 2021) which were searched for records of Commonwealth and state listed aquatic flora and fauna within the study area.
- Atlas of Living Australia (ALA, 2022) (accessed December 2021), which was searched for records of Commonwealth and state listed aquatic flora and fauna within the study area.
- EPBC Protected Matters Search Tool (DCCEEW, 2022)
- Key Fish Habitat (KFH) mapping and threatened species distribution mapping (DPI, 2022) (accessed December 2021) available on the NSW Fisheries data portal, which were examined to determine aquatic values and potential presence of threatened species in the study area.
- Atlas of GDEs (Bureau of Meteorology, 2017)
- SEED – NSW Wetlands mapping (NSW Government, 2022)
- Australian Wetlands Database (Department of the Environment and Energy, 2019).

Aquatic habitats within the Project area were assessed against the Policy and guidelines for fish habitat conservation and management – Update 2013 (NSW Department of Primary Industries, 2013) and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003). The Aquatic Ecology in Environmental Impact Assessment – EIA Guideline (Lincoln Smith, 2003) was used to guide the level of aquatic assessment required. There is enough existing information to describe the existing aquatic environment and to assess the quality and importance of the aquatic environments to be impacted by the Project. As such, this assessment was based on a review of existing information and a habitat assessment.

7.1.2 Likelihood of occurrence assessments

The database and literature review were used to identify rare or threatened species and threatened communities potentially occurring within the Project area. The likelihood of occurrence assessment was completed to determine the likelihood of each species' presence within the Project area based on considerations of habitat present and the dates and number of previous records of each species. The criteria used for evaluating likelihood of occurrence of each species is presented in **Table 7-1**.

Table 7-1. Likelihood assessment criteria for threatened species

Likelihood	Criteria
Present	Species known to occur within the Project area
Likely	Species likely to occur within the Project area based on proximity and timing of previous records, and suitability of habitat present
Possible	Potentially suitable habitat occurs within Project area and species' known range encompasses the Project area. Species recorded historically in the study area, and generally within the last 30 years
Unlikely	Species' known range encompasses the Project area, but suitable habitat does not occur within the Project area, or occurs within the Project area but with generally low quality and quantity. Species recorded historically in the study area but generally not within the last 30 years.

7.1.3 Impact assessment

The following section outlines the methodology for assessing impacts to aquatic ecosystems from the construction and operation of the Project. The results of the impact assessment are presented in **Section 10.2.3**.

7.1.3.1 Identification of impacts

An important component of the assessment is to identify potential impacts to aquatic ecosystems from the Project. Identified impacts can then be managed or mitigated during design, construction and operation.

7.1.3.2 Risk assessment

A risk assessment approach has been adopted for determining the magnitude of risks to aquatic ecosystems within the study area. The risk assessment is based on the principles and procedures of the *Australian/New Zealand Standard for Risk Management ISO 31000:2009* (Standards Australia 2009; AZ/NZS 4360:1999) and has been adapted for the types of values present in the study area and the nature of threats associated with the Project.

The risk assessment uses a combination of *likelihood* of an impact occurring and the *consequence* of that impact if it occurs. The combination of likelihood and consequence determines the level of risk.

Likelihood is typically based on the chance of an event or impact occurring (refer to **Table 7-2**). Consequence is based on the predicted response if the threat occurs and is based on sensitivity to the threat, specific habitat requirements, life history cues and population size, mobility, and ability to resist or recover from an impact (refer **Table 7-3**). The combination of likelihood and consequence results in a risk ranking (refer to **Table 7-4**). **Table 7-5** provides a summary description of the risk categories and implications for identified values.

Likelihood and consequence criteria have been adapted from the Threatened Species Status Assessment Manual (<https://www.awe.gov.au/environment/biodiversity/threatened/publications/seap-manual>) as a way for establishing whether the Project could have an adverse effect on the population, habitat or life history needs of a threatened species.

Table 7-2. Likelihood criteria for standard risk assessment

Score	Likelihood	Description
1	Rare	The outcome is not expected to occur; no record of occurring but not impossible; may occur in exceptional circumstances
2	Unlikely	The outcome will only occur in a few circumstances; uncommon but known to occur elsewhere
3	Possible	The outcome may occur; some evidence to support it will happen
4	Likely	The outcome will occur in most circumstances
5	Almost certain	The outcome is expected to occur

Table 7-3. Consequence criteria

Consequence	Negligible 1	Minor 2	Moderate 3	Major 4	Critical 5
Impact on population ¹	Minimal impact on local population numbers; area affected negligible compared to total population; minimal or acceptable impact on population size	Minor impact on local population numbers. Population in other locations not impacted	Moderate impact on local population numbers. Some impacts on populations in other locations; moderate and/or short-term effects	Major population reduction or loss of local population; recovery measure takes years to decades; serious and significant impact on species	Population reduction which may result in species extinction; recovery period is greater than decades; very significant and serious impact on high value species
Fragmentation of habitat/loss of habitat connectivity/reduce the areas of occupancy ²	Minimal losses of local habitat only, recovery likely in a relatively short period of time; threats are covered by current management or legislation	Minor losses of local habitat requiring recovery over short term	Moderate loss of local habitat requiring recovery over a short to medium term and resulting in loss of connectivity between habitats at a local scale	Loss of local habitat with no potential for recovery, or partial loss of habitat across large areas and/or with limited potential for recovery in the medium to long term. Results in a net reduction in connectivity over a large area	Complete loss of local habitat with no potential for recovery and loss of habitat in other locations with limited potential for recovery in the long term resulting in a significant impact on habitat connectivity over a large area
Loss of habitat connectivity/movement	No loss of connectivity at any time	Loss of connectivity at some points in time but not when movement is critical for breeding	Loss of connectivity at some points including occasional periods when movement is critical for breeding	Loss of connectivity at some points in time including frequent periods when movement is critical for breeding	Loss of connectivity at all times
Loss of habitat critical to the survival of the species ³	Minimal modification, destruction, removal or decrease of local habitat only, recovery likely in a relatively short period of time; insignificant impact to habitat or threat activity only occurs in a very small area of habitat; limited damage to minimal area of low significance; minor effects on physical environment	Minor modification, destruction, removal or decrease of local habitat requiring recovery over short term	Moderate modification, destruction, removal or decrease of local habitat requiring recovery over a short to medium term and resulting in loss of connectivity between habitats at a local scale	Modification, destruction, removal or loss of local habitat with no potential for recovery, or partial loss of habitat across large areas and/or with limited potential for recovery in the medium to long term. Results in a net reduction in connectivity over a large area; habitat is affected which may endanger the species and habitat long term survival – 70-90% habitat affected or removed; 30% fragile habitat affected or removed; 10-20% critical habitat affected or removed	Significant impact resulting in the removal, destruction, fragmentation and degradation of habitat; the entire habitat is in danger of being affected or removed, that >90% habitat, >50% fragile habitat, and >30% critical habitat

Biodiversity Development Assessment Report

Consequence	Negligible 1	Minor 2	Moderate 3	Major 4	Critical 5
Disruption to breeding cycle ⁴	Minimal impact on any aspect of the breeding cycle	Minor disruption to the breeding cycle; biota adapted to occasional disturbance and able to recover quickly	Moderate disruption to breeding cycle resulting in modification of behaviour both within the direct impact zone and at nearby locations; long term recruitment and/or population dynamics are not adversely impacted	Direct impacts on breeding cycle resulting in a net decline in size of the population	Complete disruption of breeding cycles over several seasons with significant population decline and possible extinction if breeding no longer occurs within the life span of affected biota
Impact of invasive species and/or disease ⁵	Minimal impact on local population numbers or habitat quality	Minor impact on local population numbers or habitat quality. Population in other locations not impacted	Moderate impact on local population numbers or habitat quality. Some impacts on populations in other locations	Major population reduction or loss of local population or loss of habitat quality	Population reduction which may result in species extinction loss of critical habitat extent or quality
Impact on species migration	Minimal impact on species migratory patterns	Results in minor behavioural modification on a local scale or impacts to physical conditions of animal interfering with migration for the short term only. Unlikely to negatively impact on the overall success of migration	Results in modification of behaviour or animal conditions such that there is potential for medium term impacts, with some possibility of individuals failing to complete migration	Results in modification of behaviour or animal condition such that there is potential for medium to long term impacts, both locally and in nearby locations, with some individuals failing to complete migration	Significant impact resulting in either complete failure, or failure of majority of individuals, to complete migration in that cycle

¹ Refers to the proportional changes to the numbers of individuals; change in the size of the population

² Refers to the physical destruction of the species habitat and/or alteration to hydrological regime or water quality that makes habitat unsuitable

³ Refers to species habitat resource includes modify, destroy, isolate or decrease the availability or quality of habitat

⁴ Breeding cycle including activities associated with breeding (migration, spawning, recruitment success). Assessment assumes that the species is present in the affected area during the breeding cycle

⁵ Refers to any invasive species that is harmful to the species becoming established in the species habitat and introduced disease that may cause the species to decline

(adapted from <https://www.awe.gov.au/environment/biodiversity/threatened/publications/seap-manual>)

Table 7-4. Risk ranking

Likelihood	Consequence				
	Negligible	Minor	Moderate	Major	Critical
Almost certain	Low	Medium	High	Severe	Severe
Likely	Very Low	Medium	Medium	High	Severe
Possible	Very Low	Low	Medium	High	Severe
Unlikely	Very Low	Low	Low	Medium	High
Rare	Very Low	Very Low	Low	Medium	High

Table 7-5. Summary of risk impact description

Risk Rating	
Very low	<ul style="list-style-type: none"> No reasonable prospect that existing values will be impacted
Low	<ul style="list-style-type: none"> Localised impacts on species that are common and widespread across the landscape No specific risk management action required
Medium	<ul style="list-style-type: none"> Possible impact on species of local or regional conservation significance at the site scale but with no consequence for the species at the regional scale The threat has the potential to occur, but it is not likely to cause significant environmental harm Impacts can be easily mitigated
High	<ul style="list-style-type: none"> Impacts on EPBC Act or FM Act listed species / communities at the site scale but with no consequence for the species at the regional scale The threat will occur and will have harmful consequences Risk management is essential but is likely to be successful at mitigation impacts
Severe	<ul style="list-style-type: none"> Impact on EPBC Act or FM Act listed species / communities at the site scale but with consequence for the species at the regional scale The threat is likely to occur and will have very harmful consequences Risk management may not be sufficient to mitigate impacts

7.1.3.3 Identification of mitigation and management measures

Mitigation and management measures are considered to reduce the magnitude of the potential impact to have less significant, and ultimately be deemed acceptable. Measures are typically applied where impacts are considered to be unacceptable. The objective of assigning such measures is to reduce the severity of the potential impact to the extent that the overall residual significance of the events becomes insignificant.

Monitoring confirms whether impacts are as predicted or whether further management or mitigation may be required to manage the impact post construction of the Project. Mitigation and management measures, including monitoring procedures are described in **Section 12**.

7.2 Sensitive Receiving environments

Construction of the Project would involve a range of activities including vegetation clearing and subsequent mulching, earthworks, trenching, concrete works and the establishment of a construction compound. These construction activities present a potential risk to downstream water quality if appropriate management measures are not implemented, monitored and maintained throughout the construction phase.

There are three named waterways, as well as several minor, unnamed drainage depressions situated within the study area. The Project intersects with two ephemeral creeks in the northern and southern portions of the Project area, including Delta Creek in the north, and Turn Back Jimmy Creek in the south. The only perennial waterway, Yanco Creek, is located between the northern and southern portions of the Project area. All three waterways have been deemed sensitive receiving environments.

Determination of SREs has considered the following:

- Key Fish Habitat
- Threatened aquatic species
- Threatened aquatic ecological communities.

7.2.1 Key Fish Habitat

Key fish habitats are aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. One of the key objectives of the FM Act is to conserve key fish habitats, which have been mapped within NSW by DPI (2013). According to DPI (Fisheries) Key Fish Habitat (KFH) mapping (DPI, 2022), Yanco Creek and Turn Back Jimmy Creek are considered KFH. Delta Creek is not mapped as KFH although mapping predicts it to host threatened species habitat.

In proximity to the Project Area, Yanco Creek is a ninth order, permanently flowing waterway with a well-defined channel. There is significant aquatic habitat available, including lots of large woody debris, exposed roots and some instream and riparian vegetation. According to the Protected Matters Search Tool (DCCEEW, 2022) and NSW threatened species habitat mapping (DPI, 2022), Yanco Creek is predicted habitat for the Flathead Galaxias (*Galaxias rostratus*), Silver Perch (*Bidyanus bidyanus*) and Murray Cod (*Maccullochella peelii*). Therefore, in accordance with DPI (Fisheries) policy and guidelines (2013), Yanco Creek is categorised as Type 1 – Highly Sensitive Key Fish Habitat.

Turn Back Jimmy Creek is a third order, ephemeral drainage depression with minimal/no channel definition. The channel acts as a flood runner between Colombo Creek in the east and Yanco Creek in the west. The channel does not exhibit any significant aquatic habitat features, however it is predicted habitat for the Flathead Galaxias (*Galaxias rostratus*) and Silver Perch (*Bidyanus bidyanus*) (DPI, 2022). Therefore, in accordance with DPI (Fisheries) policy and guidelines (2013), Turn Back Jimmy Creek is categorised as Type 1 – Highly Sensitive Key Fish Habitat.

At the Project crossing site, Delta Creek is a second order, ephemeral creek with minor channel definition and some wetland vegetation present, i.e. Lignum (*Muehlenbeckia cunninghamii*). Delta Creek is not mapped as Key Fish Habitat, although its mapped as predicted habitat for the Flathead Galaxias (*Galaxias rostratus*) and Silver Perch (*Bidyanus bidyanus*) (DPI, 2022). As such, in accordance with DPI (Fisheries) policy and guidelines (2013), Delta Creek should be categorised as Type 1 – Highly Sensitive Key Fish Habitat. Despite this categorisation, it is considered unlikely that Delta Creek provides habitat for threatened species due to its ephemeral nature and a lack of connection to any downstream major waterways.

7.2.2 Threatened fish

Based on the current indicative distribution of threatened species in NSW provided by DPI (Fisheries) (DPI, 2022), the Flathead Galaxias (*Galaxias rostratus*) and Silver Perch (*Bidyanus bidyanus*) have predicted distribution in Delta Creek, Yanco Creek and Turn Back Jimmy Creek. According to the Protected Matters Search Tool (PMST), Murray Cod (*Maccullochella peelii*), Trout Cod (*Maccullochella macquariensis*) and Macquarie Perch (*Maccullochella macquariensis*) species or species habitat may also occur within the area (DCCEEW, 2022).

Murray Cod and Silver Perch area considered to have a high potential to occur in Yanco Creek near the Project area. The Delta Creek and Turn Back Jimmy Creek do not have permanent water within the Project area and may only flow during large flood events.

Table 7-6 outlines the Commonwealth and state listed aquatic species that are predicted to occur within the study area and provides an assessment of likelihood of occurrence based on database searches (DCCEEW, 2022; DPE, 2022), predicted habitat and the predicted distribution maps for threatened species listed under the FM Act (DPI 2022).

Potential impacts on threatened fish populations and key fish habitats have been addressed in the detailed impact assessment (refer to **Section 12** and **Appendix K**). Key aquatic habitats and threatened fish populations are mapped on **Figure 7-2**.

Table 7-6. Likelihood of occurrence of commonwealth and state listed threatened aquatic species

Common Name	Species Name	EPBC Act	FM Act	Distribution and preferred habitat	Likelihood and occurrence
Murray Cod	<i>Maccullochella peelii</i>	V	-	<p>The Murray Cod occurs naturally in the watercourses of the Murray-Darling Basin (ACT, SA, NSW and Vic) and was formerly widespread in lower and mid altitudes of the Murray-Darling Basin, however the species now has patchy distribution (Lintermans, 2007).</p> <p>Preferred habitat for both juvenile and adult Murray Cod generally consists of deep holes in low-flowing rivers, and particularly around instream rocks, woody debris, fallen trees or undercut banks which provide shelter and protection from predators (Lintermans, 2007)</p>	Possible - Large-bodied channel specialist. Prefers deeper waters of main channel of River Murray and larger tributaries. Yanco Creek is mapped as predicted habitat (DCCEEW, 2022) however available habitat is not considered suitable and there are no records of species within proximity of the Project (ALA, 2022; DPE, 2022).
Silver Perch	<i>Bidyanus bidyanus</i>	CE	V	<p>The Silver Perch was once widespread with a distribution range including most of the Murray-Darling Basin and extending through drainage lines within western NSW. The species has experienced dramatic decline throughout the region. It is suggested that the current species distribution is likely to be limited to a portion of the mid-Murray River below Yarrawonga Weir, as well as several of its anabranches and tributaries and the Murrumbidgee River.</p> <p>The species are found in a wide range of habitats in the Murray-Darling system. Their preferred habitat is generally found in fast-flowing, more open sections of river (DPI, 2017a) but they can also be found in lowland, turbid and slow-flowing rivers (Lintermans, 2007).</p>	Possible - Main channel specialist. Typically inhabits deeper flowing waters of the River Murray and larger tributaries. Delta Creek, Yanco Creek and Turn Back Jimmy Creek are mapped as predicted habitat for this species (DPI, 2022), however available habitat is not considered suitable and there are no records of species within proximity of the Project (ALA, 2022; DPE, 2022).
Flathead Galaxias	<i>Galaxias rostratus</i>	CE	CE	<p>The Flathead Galaxias was historically known from the Southern Murray-Darling Basin including the Macquarie, Lachlan, Murrumbidgee and Murray Rivers with patchy recordings (Lintermans, 2007).</p> <p>It is generally found in still and gently moving waters of small streams, lakes, lagoons, billabongs and backwaters. Its habitat consists of coarse sand or mud substrate and aquatic vegetation (DPI, 2014).</p>	Possible - Species prefer still or slow-moving water bodies such as wetlands and lowland streams. Delta Creek, Yanco Creek and Turn Back Jimmy Creek are mapped as predicted habitat for this species (DPI, 2022). Habitat may be suitable in Yanco Creek in proximity of the Project, and in Delta Creek and Turn Back Jimmy Creek when water is present. There are no records of species within proximity of the Project (ALA, 2022; DPE, 2022).

Biodiversity Development Assessment Report

Common Name	Species Name	EPBC Act	FM Act	Distribution and preferred habitat	Likelihood and occurrence
Trout Cod	<i>Maccullochella macquariensis</i>	E	E	<p>Often confused with the Murray Cod and only formally recognised as a separate species in 1972, the Trout Cod is endemic to the southern Murray-Darling system including the Murrumbidgee, Murray and Macquarie Rivers. There are only three known self-sustaining populations left in the wild. The largest is in the River Murray below Yarrowonga and small translocated populations in Cataract Dam and upper reaches of Sevens Creek (Lintermans, 2007).</p> <p>The species also prefers similar habitat to the Murray Cod such as deep pools and instream cover such as large boulders, fallen trees and woody debris (DPI, 2017b).</p>	<p>Possible - Large-bodied channel specialist. Prefers deeper waters of main channel of River Murray and larger tributaries. No records within the study area based on survey evidence or database searches (ALA, 2022; DPE, 2022), however the species has been recorded in the Murrumbidgee River upstream.</p>
Macquarie Perch	<i>Macquaria australasica</i>	E	E	<p>The Macquarie Perch is a riverine species, typically found in the cool upper reaches of the Murray-Darling river system. In NSW, natural inland populations are isolated to the upper reaches of the Lachlan, Goulburn and Murrumbidgee Rivers. Translocated populations in NSW are found in the Mongarlowe River, Queanbeyan River upstream of the Googong Reservoir and in Cataract Dam (Lintermans, 2007).</p> <p>The fish prefers clear water and deep, rocky holes with abundant cover such as aquatic vegetation, large boulders, debris and overhanging banks (DPI, 2016a).</p>	<p>Possible - No records within the study area based on database searches (ALA, 2022; DPE, 2022). The species has potential to occur within the study area (DAWE, 2022), however the available aquatic habitat is not preferred for this species. No further assessment required.</p>

EPBC Act 1999 status: Critically endangered (CR), Endangered (E), Vulnerable (VU); FM Act 1994 status: Endangered Ecological Community (EEC); Critically endangered (CE), Endangered (E), Vulnerable (V)

7.2.3 Threatened aquatic ecological communities

The Project area lies wholly within the endangered ecological community (EEC) known as ‘the Lower Murray River Drainage System’ (Lower Murray River EEC). The Lower Murray River EEC encompasses all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut Rivers, as well as their tributaries and branches. This includes Delta Creek, Yanco Creek and Turn Back Jimmy Creek (refer **Figure 7-1**).

The Lower Murray River EEC occurs in a lowland riverine environment, characterised by meandering channels and wide floodplains. The land is generally flat to gently sloping. In their natural state, these lowland rivers experience extremely variable flows, ranging from floods to droughts. Lowland rivers provide a wide range of habitats for fish and invertebrate, including pools, runs or riffles, backwaters and billabongs, large woody habitats and aquatic plants. Floodplains also provide a mosaic of habitat types, including permanent and temporary wetland, as well as terrestrial habitats (DPI, 2007).

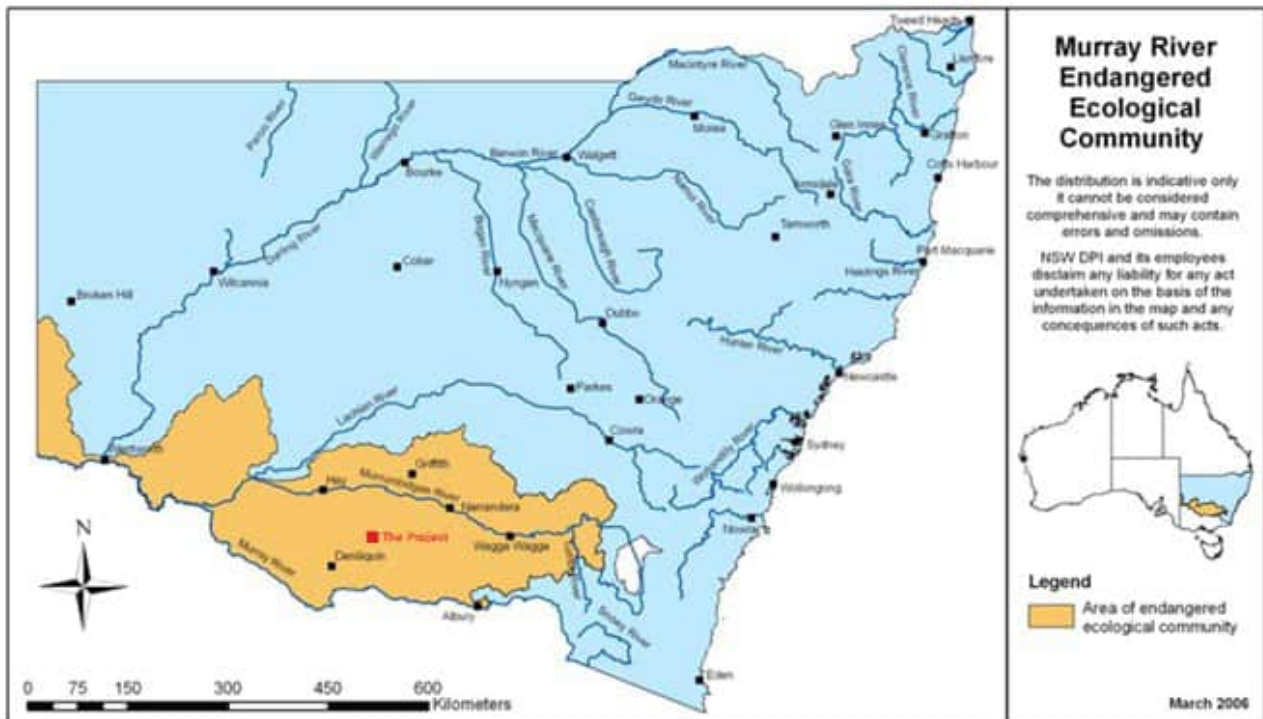


Figure 7-1. Map of Lower Murray EEC Source: DPI, 2007), the project area in red

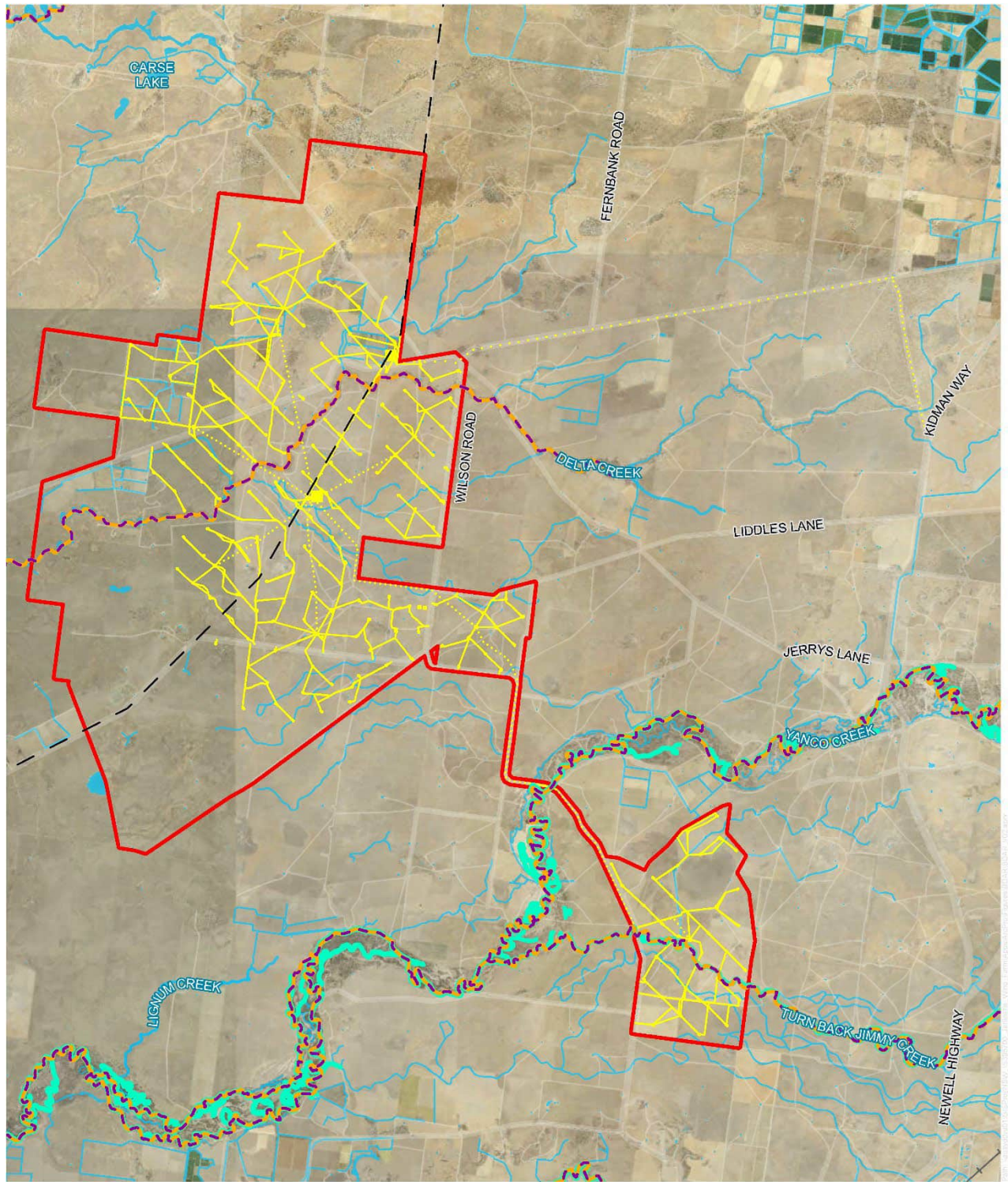


Figure 7-2. Aquatic habitats

Jacobs | NSW Spatial | Buildings & Infrastructure | Eastern Asia Pacific | www.jacobs.com

Data sources
 Jacobs 2022
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8. Assessment for Matters of National Environmental Significance

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places – defined as matters of national environmental significance (MNES). Matters relevant and applicable to this assessment include:

- World heritage properties
- National heritage places
- Wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed)
- Nationally threatened species and ecological communities
- Migratory species.

For threatened biodiversity and migratory species listed under the EPBC Act which were identified in habitats within the subject land, or considered at least moderately likely to occur, significance assessments have been completed in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013) (see **Appendix I, Appendix J** and **Table 8-1**). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not a remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

8.1 World heritage properties and national heritage places

The subject land contains no World Heritage Properties or National Heritage Places according to the PMST.

8.2 Wetlands of international and national importance

The 500 m landscape buffer of the Project area contains no wetlands of international or national importance. The nearest wetland of international importance, identified by the PMST, is the Hattah-Kulkyne Lakes, located approximately 200 – 300 km downstream of the Project area. The Coorong, and Lakes Alexandrina and Albert Wetland, located 500 – 600 km downstream of the Project area, Riverland, located 400 – 500 km downstream of the Project area and Banrock Station Wetland Complex, located 400 - 500 km downstream of the Project area. These wetlands of international or national importance identified by the PMST, are considered too great of a distance to be affected directly or indirectly by the development.

8.3 Threatened ecological communities

According to the PMST, the following EPBC Act listed TECs have been identified as may occur or likely to occur within the Project area:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia – endangered ecological community under EPBC Act (likely to occur)
- Natural Grasslands of the Murray Valley Plains – critically endangered ecological community under EPBC Act (known to occur)
- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions – endangered ecological community under EPBC Act (may occur)
- Weeping Myall Woodlands – endangered ecological community under EPBC Act (likely to occur)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – critically endangered ecological community under EPBC Act (likely to occur)

- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains – critically endangered ecological community under EPBC Act (known to occur).

Of these, two TECs were confirmed within the Project area:

- Weeping Myall Woodlands - EEC under EPBC Act
- Natural Grasslands of the Murray Valley Plains – CEEC under EPBC Act.

Consequently, a significant impact on Natural Grasslands of the Murray Valley Plains is expected, as there may be a chance that the Project will adversely affect habitat critical to the survival of an ecological community.

8.4 Threatened species

The results of desktop review identified the following number of important biodiversity values within 10 km of the Project area (primarily sourced from the BAM Calculator, BioNet records (DPE, 2022b) and the PMST (DAWE, 2022a), and threatened fish maps (DPI, 2022)):

- 70 listed threatened species
- 10 listed migratory species
- 17 listed marine species
- 5 listed fish species.

Refer to **Appendix N** for a list of species identified in the PMST.

Seventeen of the EPBC listed flora species identified in the PMST were not found within or adjacent to the Project area during the surveys undertaken for this BDAR. As such, these species are considered unlikely to be impacted. Additionally, twenty EPBC listed fauna species were assessed as low or unlikely to occur, on basis of unsuitable habitat and lack of records in the locality. Targeted surveys for the remaining seven EPBC Act listed threatened fauna were conducted for this BDAR and included targeted surveys (refer to **Section 5.2.2**).

Assessment of significance have been conducted for threatened species, populations and communities that were recorded in the Project area during field surveys or were identified as having a moderate or higher potential to occur in the Project area based on the presence of habitat (**Appendix J** and **Appendix K**). A summary of conclusions from the assessment is presented in **Table 8-1**. For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). The conclusions of these assessments were that the proposed activity is not expected to have a significant impact on these threatened species.

8.4.1 Threatened flora

The following flora species are confirmed or have a moderate to high likelihood occurring in the Project area:

- *Austrostipa wakoolica* – endangered under EPBC Act (moderate likely)
- Sand-hill spider-orchid (*Caladenia arenaria*) – endangered under EPBC Act (moderate likely)
- Winged Peppergrass (*Lepidium monoplacoides*) – endangered under EPBC Act (moderate likely)
- Turnip Copperburr (*Sclerolaena napiformis*) – endangered under EPBC Act (highly likely)
- Slender Darling Pea (*Swainsona murrayana*) - vulnerable under EPBC Act (confirmed)
- Red Darling Pea (*Swainsona plagiotropis*) - vulnerable under EPBC Act (highly likely)
- Claypan Daisy (*Brachyscome muelleroides*)- vulnerable under EPBC Act (moderate likely)
- Mossy Daisy (*Brachyscome papillosa*) - vulnerable under EPBC Act (moderate likely)
- Chariot Wheels (*Maireana cheelii*) – vulnerable under EPBC Act (moderate likely).

8.4.2 Threatened fauna

The following fauna species are known or have a moderate to high likelihood occurring in the Project area:

- Plains-wanderer (*Pedionomus torquatus*) – critically endangered under EPBC Act (confirmed)
- Superb Parrot (*Polytelis swainsonii*) – vulnerable under EPBC Act (confirmed)
- Painted Honeyeater (*Grantiella picta*) – vulnerable under EPBC Act (moderately likely)
- White-throated Needletail (*Hirundapus caudacutus*) – vulnerable/ migratory under EPBC Act (highly likely).

The following fauna species have a low likelihood of occurring in the Project area but have been included in the MNES assessment as a precaution:

- Regent Honeyeater (*Anthochaera phrygia*) – critically endangered under EPBC Act
- Swift Parrot (*Lathamus discolor*) - critically endangered under EPBC Act (low likely)
- Southern Bell Frog (*Litoria raniformis*) – vulnerable under EPBC Act.

Blade strike collisions from wind farms are known threats to the White-throated Needletail. The number of individuals using the airspace in the Project area is unknown and there's a high level of uncertainty estimating the actual impacts on an ecologically significant proportion of their population at a national and international scale. As a result, the operation of up to 208 turbines may have potential impacts on this species. Consequently, a significant impact on this species is expected, as there may be a chance that the Project will seriously disrupt the lifecycle of an ecologically significant proportion of their populations.

8.5 Migratory species

Based on the results of the PMST, 12 listed migratory or marine species may occur in the broader locality (see **Appendix N**). Suitable habitat does not exist within the Project area for most migratory or marine species identified by the database searches. The following migratory or marine species are considered moderately likely to occur in, or adjacent to, the Project area based on the presence of suitable habitats:

- Rainbow bee-eater (*Merops ornatus*) – marine under EPBC Act (confirmed)
- Fork-tailed Swift (*Apus pacificus*) – marine/migratory under EPBC Act (moderately likely)
- Common Sandpiper (*Actitis hypoleucos*) – marine/migratory under EPBC Act (moderately likely)
- Sharp-tailed Sandpiper (*Calidris acuminata*) – marine/migratory under EPBC Act (moderately likely)
- Pectoral Sandpiper (*Calidris melanotos*) – marine/migratory under EPBC Act (moderately likely)
- Cattle Egret (*Ardea ibis*) – marine under EPBC Act (moderately likely)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) – marine under EPBC Act (moderately likely)
- Black-eared Cuckoo (*Chalcites osculans*) – marine under EPBC Act (moderately likely)
- Blue-winged Parrot (*Neophema chrysostoma*) – marine under EPBC Act (moderately likely)
- Latham's Snipe (*Gallinago hardwickii*) – marine/migratory under EPBC Act (moderately likely)
- Satin Flycatcher (*Myiagra cyanoleuca*) - marine/migratory under EPBC Act (moderately likely)
- Yellow Wagtail (*Motacilla flava*) - marine/migratory under EPBC Act (moderately likely).

8.6 Summary findings of the assessment of significance

The conclusion of each assessment of significance under the EPBC Act for threatened entities are presented in **Table 8-1**. The full assessment of significance is provided in **Appendix J** and **Appendix K**.

Table 8-1 Summary of assessment of significance findings for threatened entities

EPBC listed entity	*Assessment of significance questions (EPBC Act)									Important population+	Likely significant impact	
	1	2	3	4	5	6	7	8	9			
Threatened ecological communities												
Natural Grasslands of the Murray Valley Plains	Y	N	Y	N	N	Y	Y	NA	NA	NA		Yes
Weeping Myall Woodlands	Y	N	N	N	N	N	Y	NA	NA	NA		No
Threatened flora												
<i>Austrostipa wakoolica</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Caladenia arenaria</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Lepidium monoplacoides</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Sclerolaena napiformis</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Swainsona murrayana</i>	Y	N	N	N	N	N	N	N	N	Yes		No
<i>Swainsona plagiotropis</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Brachyscome muelleroides</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Brachyscome papillosa</i>	Y	N	N	N	N	N	N	N	N	NA		No
<i>Maireana cheelii</i>	Y	N	N	N	N	N	N	N	N	NA		No
Threatened fauna												
Plains-wanderer	Y	Y	Y	Y	Y	Y	N	N	Y	NA		Yes
Swift Parrot	N	N	N	N	N	N	N	N	N	NA		No
Regent Honeyeater	N	N	N	N	N	N	N	N	N	NA		No
Painted Honeyeater	N	Y	N	N	N	N	N	N	N	No		No
Superb Parrot	N	Y	N	N	N	N	N	N	N	No		No
White-throated Needle-tail	Y	N	N	N	N	Y	N	N	Y	No		Yes
Southern Bell Frog	N	N	N	N	N	N	N	N	N	NA		No
Silver Perch,	N	N	N	N	N	N	N	N	N	NA		No
Murray Cod,	N	N	N	N	N	N	N	N	N	NA		No
Trout Cod,	N	N	N	N	N	N	N	N	N	NA		No
Macquarie Perch	N	N	N	N	N	N	N	N	N	NA		No
Flathead Galaxias	N	N	N	N	N	N	N	N	N	NA		No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

*An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- 1) reduce the extent of an ecological community
- 2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- 3) adversely affect habitat critical to the survival of an ecological community
- 4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
- 5) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
- 6) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
 - assisting invasive species, that are harmful to the listed ecological community, to become established, or
 - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
- 7) interfere with the recovery of an ecological community.

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- 1) Lead to a long-term decrease in the size of a population
- 2) Reduce the area of occupancy of the species
- 3) Fragment an existing population into two or more populations

Biodiversity Development Assessment Report

- 4) Adversely affect habitat critical to the survival of a species
- 5) Disrupt the breeding cycle of a population
- 6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- 7) Result in invasive species that are harmful to a species becoming established in the species' habitat
- 8) Introduce disease that may cause the species to decline
- 9) Interfere with the recovery of the species.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- 1) lead to a long-term decrease in the size of an important population of a species
- 2) reduce the area of occupancy of an important population
- 3) fragment an existing important population into two or more populations
- 4) adversely affect habitat critical to the survival of a species
- 5) disrupt the breeding cycle of an important population
- 6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- 7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- 8) introduce disease that may cause the species to decline, or
- 9) interfere substantially with the recovery of the species.

+An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source population either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range.

9. Impact avoidance and minimisation

This section of the BDAR outlines the efforts taken to avoid and minimise impacts on biodiversity in accordance with Section 7 of the BAM. A key part of management of biodiversity for this Project is the application of the 'avoid, minimise and offset' hierarchy as follows:

- 1) Avoid and minimise impacts as the highest priority incorporating effective and feasible mitigation measures
- 2) Offset where residual, significant unavoidable impacts will occur (if required).

9.1 Locating the Project to avoid and minimise direct and indirect impacts on biodiversity values

The following analysis and discussion provides a demonstration of how the Project has avoided and minimised direct and indirect impacts on biodiversity values.

9.1.1 Preliminary constraint assessment

A detailed biodiversity constraints assessment was completed in February 2022 to document biodiversity surveys undertaken since September 2021. This assessment identified key biodiversity values in the Project area including threatened species, populations and ecological communities listed under the BC Act and EPBC Act. This assessment was undertaken using information from both a desktop review and field surveys, including targeted flora surveys, rapid vegetation mapping and amphibian habitat assessments. A biodiversity constraints map was generated to assist with decisions around selective avoidance of key biodiversity values.

These outputs aided in the disturbance footprint selection process and played an important role in the feasibility and design of infrastructure to avoid and or minimise impacts on conservation significant biodiversity.

The constraints assessment identifies the following key biodiversity constraints within the Project area:

- Likely or confirmed of one critically endangered ecological community and one endangered ecological community listed under the EPBC Act.
- Likely or confirmed of six SAI entities
- Likely or confirmed occurrence of two endangered ecological communities listed under the BC Act.
- Known and potential habitat for a range of BC Act listed threatened plant species and threatened fauna, including vegetation associated with habitat for 34 candidate species credit species
- Known and potential occurrence of eleven threatened flora species, eleven threatened fauna and twelve migratory and/or marine fauna species listed under the EPBC Act
- Riparian areas (including drainage lines), buffer zones, an endangered aquatic ecological community, GDEs and key fish habitat and threatened fish populations
- Locally significant fauna habitat and biodiversity links for maintaining landscape connectivity
- Important nesting areas for birds of prey, including presence of confirmed nest sites.

The constraints analysis highlighted that large areas of Natural Grassland of the Murray Valley Plains and Weeping Myall Woodland in high condition occur in the Project area and represent a risk in terms of biodiversity loss. This presented opportunities to avoid and modify the disturbance footprint in these key areas to reduce the loss of biodiversity.

9.1.2 Designing the Project to avoid and minimise direct and indirect impacts on biodiversity values

The Project has implemented changes to the design since it began in September 2021. The biodiversity constraints assessment identified key locations with high biodiversity conservation value to avoid or minimise impacts. This was informed by biodiversity field surveys, including a rapid PCT mapping survey. The constraints assessment also identified disturbed sites with exotic vegetation, existing access tracks and agricultural cropping land as opportunities to move infrastructure to avoid high biodiversity values.

Additional targeted flora surveys were undertaken at locations of identified threatened flora populations such as *Swainsona murrayana* and *Swainsona sericea* to avoid impacts to these populations. As a result, these surveys focussed on identifying alternative routes where populations were absent to avoid known populations.

The revised footprint also includes:

- A reduction of WTGs from 245 to 208
- Internal cabling is a 0.5 metre wide trench located near access tracks and would allow native vegetation to regeneration on the surface
- Point to point WTG connections to minimise vegetation removal, where feasible.
- Multiple access points off existing roads to minimise disturbance.

During the development of the Project, considerable attention and flexibility was given to the avoidance of the important local habitats. The outcomes of the constraints assessment, ongoing field surveys and advice from BCS of DPE identified the following key biodiversity values that have been avoided and impacts minimised to the greatest extent possible:

- Plains-wanderer (SAIL) important area mapping
- Natural Grasslands of the Murray Valley Plains CEEC
- SAIL entities
- Threatened flora populations (such as *Swainsona murrayana* and *Swainsona sericea*)
- Eucalypt woodland with hollow bearing trees,
- Paddock trees with large stick nests, typically for Wedge-tailed Eagle and other raptor species,
- Creeks/riparian areas, low lying areas with Lignum/Nitre Goosefoot swamps, and wetlands (if any)
- Proximity of Project footprint to known biodiversity conservation sites.

Further verification of PCTs and vegetation condition from ongoing collection of field data throughout 2022 developed a broadscale vegetation class (habitat types) map for the Project area and provided opportunities to identify areas of non-native vegetation/cropping land and lower condition vegetation. Large areas of non-native vegetation/cropping land were used in the Project design to establish 56 WTGs/hardstands and collector substation, central primary substation, including associated access tracks and cabling.

The internal track network and ploughed boundary tracks of properties within the Project area were mapped where possible during field surveys to identify alternative access routes to WTGs with an attempt to reduce biodiversity impacts, particularly to Natural Grassland of the Murray Valley Plains CEEC. Existing access tracks varied in condition and width. Some tracks are well-made with embankments and swales and regularly used by landholders, others had regenerating native grassland and were irregularly used. Further avoidance of natural grassland was undertaken with the identification of large paddocks with non-native vegetation. The wind farm was designed to utilise these locations as a priority over native vegetation.

Any impacts to Plains-wanderer important area mapping is likely to be serious and irreversible. Considerable effort was made to modify the Project design to avoid impacts to the Plains-wanderer important area mapping in the study area. Part of the important mapping occurs in confirmed degraded land, comprising of ploughed and cropping land, mainly south of Yanco Creek and classified as non-native vegetation or Category 1 – exempt land. A species polygon was generated for this species where important area mapping

intercepted the disturbance footprint (vegetation zones), these locations are along existing access tracks to avoid and minimise impacts to high quality habitat (see **Figure 5-8**).

The avoidance and minimisation of native vegetation and grassland habitats also allowed for impact minimisation on suitable habitat for threatened flora species, including SAI entities:

- *Brachyscome muelleroides*
- *Caladenia arenaria*
- *Convolvulus tedmoorei*.

Comprehensive targeted surveys also aided in identifying suitable habitat areas where species are considered absent. Due to the access restrictions (i.e. inclement weather conditions) and the large scale of the project, survey gaps of suitable habitat for threatened flora remain and presence is assumed for associated flora, including SAI entities.

The Project design was modified to avoid habitat buffers of known threatened flora populations recorded in September 2021, including *Swainsona murrayana* and *Swainsona sericea*. It was not possible to make amendments to the current disturbance footprint with the discovery of additional threatened *Swainsona murrayana* populations recorded in September 2022. Any impacts to these populations will require biodiversity offsets.

The process of avoidance and minimisation of direct and indirect impacts on biodiversity values was achieved using a range of ESRI software tools with numerous spatial layers to manually refine, modify or remove parts of the Project footprint.

9.1.3 Locating and designing the Project to avoid and minimise prescribed impacts

Some types of Projects may have impacts on biodiversity values in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat. For many of these impacts, the biodiversity values may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical.

Chapter 6 of the BAM (2020) identifies actions that are prescribed as impacts to be assessed under the biodiversity offsets scheme as per clause 6.1 of the *Biodiversity Conservation Regulation 2017*. Such prescribed impacts (including direct and indirect impacts) are impacts:

- a. on the habitat of threatened species or ecological communities associated with:
 - i. karst, caves, crevices, cliffs, and other geological features of significance, or
 - ii. rocks, or
 - iii. human made structures, or
 - iv. non-native vegetation
- b. on areas connecting threatened species habitat, such as movement corridors
- c. that affect water quality, water bodies and hydrological processes that sustain threatened entities (including from subsidence or upsidence resulting from underground mining)
- d. on threatened and protected animals from turbine strikes from a wind farm
- e. on threatened species or fauna that are part of a TEC from vehicle strikes.

The following analysis and discussion provides a demonstration of how the project has avoided and minimised prescribed impacts.

9.1.3.1 Non-native vegetation

A total 60.29 ha of the disturbance footprint comprises non-native vegetation that is established on cultivated land as exotic grassland and is dominated by annual exotic species (54.71 ha and 5.58 ha in category 1 exempt land and category 2 land, respectively). No native plant species were observed at these locations following rapid floristic surveys. This land is considered degraded and no vegetation integrity or targeted threatened flora surveys were completed. Non-native vegetation provides suitable foraging habitat for some threatened species such as Little Eagle and microbats at locations near water.

Further verification of PCTs and vegetation condition from ongoing collection of field data throughout 2022 developed a broadscale vegetation class (habitat types) map for the Project area and provided opportunities to identify areas of non-native vegetation/cultivated land and lower condition vegetation. This allowed for further avoidance and minimisation of impacts to native vegetation and higher quality threatened species habitat.

9.1.3.2 Habitat connectivity

Impacts to connectivity and species movement cannot be avoided in this landscape and given the proposed removal of vegetation along a linear infrastructure and wind turbines. Grassland fragmentation and creation of new edges has potential to interrupt wildlife movement passages for grassland specialists such as Plains-wanderer. This would be most notable during construction, when species would be discouraged from moving through the Project area.

9.1.3.3 Water quality and hydrology

The Project was designed to avoid and minimise infrastructure near creeks/riparian areas, low lying areas with Lignum/Nitre Goosefoot swamps, and wetlands. Changes in soil and hydrologic quality are abiotic impacts may still occur at minor access track and cabling crossing and transmission line easement near Yanco Creek.

9.1.3.4 Turbine strike

A number of Project design modifications to reduce number of turbines in landscape to maintain air space connectivity and distance from native vegetation. A reduction of WTGs from 245 to 208. Large areas of non-native vegetation/cropping land were used in the Project design to establish 56 WTGs/hardstands and three substations including associated access tracks and cabling. Wind turbines were designed away from known locations of paddock trees, where possible, including near sandhills with active large stick nests, typically occupied by Wedge-tailed Eagle and other raptor species.

9.1.3.5 Vehicle strikes on threatened animals that are part of a TEC

Increased vehicle movements during construction and decommissioning of the Project have the potential to result in fauna mortality from vehicle strikes. These potential impacts can be avoided and managed and will be addressed in the biodiversity management plan, and include examples such as on-site education, identifying and reporting hazards as they occur during construction, and setting appropriate working hours and vehicle speed limits.

9.2 Summary of measures to avoid and minimise impacts

A summary of avoidance and minimisation measures for direct, indirect and prescribed impacts is presented in Table 9-1.

Table 9-1. Summary of avoidance and minimisation measures for direct, indirect and prescribed impacts

Action	Outcome	Timing	Responsibility
Avoidance and minimisation measures for direct and indirect impacts			
Avoidance of native vegetation and threatened species habitat	Further verification of PCTs and vegetation condition from ongoing collection of field data throughout 2022 developed a broadscale vegetation class (habitat types) map for the Project area and provided opportunities to identify areas of non-native vegetation/cultivated land and lower condition vegetation.	Early Project planning	The Proponent
Avoidance of Plains-wanderer important area mapping	Considerable effort was made to modify the Project design to avoid impacts to the Plains-wanderer important area. This required positioning of WTGs and associated infrastructure (i.e. access tracks and cabling outside of	Early Project planning	The Proponent

Biodiversity Development Assessment Report

Action	Outcome	Timing	Responsibility
	important area mapping. This resulted in a re-configuration of the project design, especially in the north of the Project area where there is large areas of important mapping. A WTG was also removed from the design to avoid habitat.		
Avoidance and minimise of Eucalypt and Cypress trees and woodland and hollow bearing trees	<p>A large number of hollow-bearing trees and stick nests were recorded in the Project area. Many of these breeding structures are in Eucalypt woodland patches and scattered Cypress Pine trees and are unlikely to be directly impacted during vegetation clearing in the disturbance footprint. Impact to Eucalypt woodland patches (PCTs 7, 9 and 13) comprise 2.01 ha, however this is generally confined to ground trenching for cabling and limited impacts to trees will occur. Proposed powerlines across the Yanco Creek may result in trimming and lopping of Eucalyptus camaldulensis (PCT 7). Two medium sized hollow bearing trees are located in the disturbance footprint for cabling and will be avoided during construction.</p> <p>Although River Red Gum and Black Box trees are within the disturbance footprint, actual direct impacts will be avoided. Cabling traverses woodland areas and only understorey and ground layer are likely to be disturbed but no direct impact to trees is expected. There's potential for trimming and lopping of branches for the transmission line crossing over the Yanco Creek, but these impacts will be thoroughly mitigated.</p>	Early Project planning	The Proponent
Avoidance and impact minimisation of threatened flora populations	The Project design was modified to avoid habitat buffers of threatened flora populations recorded in September 2021, including <i>Swainsona murrayana</i> and <i>Swainsona sericea</i>	Early Project planning	The Proponent
Avoidance and minimisation measures for direct, indirect and prescribed impacts			
Project design modifications to reduce number of turbines in landscape to maintain air space connectivity and turbines with a 100 m disturbance buffer to position away from woodland edges, riparian corridors	<p>A reduction of WTGs from 245 to 208. Large areas of non-native vegetation/cropping land were used in the Project design to establish 56 WTGs/hardstands and three substations including associated access tracks and cabling.</p> <p>Wind turbines were moved away from known locations of paddock trees, where possible, including near sandhills with active large stick nests, typically occupied by Wedge-tailed Eagle and other raptor species.</p>	Early Project planning	The Proponent
Impacts on water quality and hydrological processes and that sustain threatened species	The Project was designed to avoid and minimise infrastructure near creeks/riparian areas, low lying areas with Lignum/Nitre Goosefoot swamps, and wetlands. Changes in soil and hydrologic quality are abiotic impacts may still occur at minor access track and cabling crossing and transmission line easement near Yanco Creek.	Early Project planning	The Proponent

10. Assessment of impacts

10.1 Direct impacts

10.1.1 Removal of native vegetation and threatened ecological communities

The direct impact associated with vegetation clearing has been calculated using the 'disturbance footprint'.

This BDAR has assessed the study area for its biodiversity values so that if the disturbance footprint may need to shift slightly during detailed design, noting the calculation of impact area has been restricted to the disturbance footprint for this stage of the development assessment. Project impacts and offset obligations will be revised throughout the life of the Project, further details of this are provided in **Section 14**.

While the Project design has avoided and minimised large areas of native vegetation clearing including in areas classified as non-native vegetation, the Project will result in the direct removal of native vegetation (173.39 hectares). The installation of underground cabling will require a narrow clearing of the groundcover and avoid trees and large shrubs where possible. The groundcover may also regenerate naturally overtime during the operation of the Project. However, given the uncertainty of future recovery of the ground cover, these areas have assumed total clearing and full VI loss. A description of the development activities proposed during both construction and operation is provided in **Section 2** and is the basis for calculating vegetation integrity loss, and impact on threatened species.

The estimated total clearing of vegetation in the disturbance footprint consists of ten PCTs as described in **Table 10-1**. The vegetation integrity loss is also presented in **Table 10-1**. The Project will result in the total loss of vegetation integrity for all impacted PCTs.

There will be direct impacts with the clearing of four threatened ecological communities, including:

- Natural Grasslands of the Murray Valley Plains listed critically endangered under the EPBC Act – 88.33 hectares
- Weeping Myall Woodlands listed endangered under the EPBC Act – 29.69 hectares
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed endangered under the BC Act – 31.09 hectares
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed endangered under the BC Act – 10.28 hectares.

The biodiversity credit requirements for these impacts are outlined in **Section 14**. Vegetation clearing as part of this Project would directly impact a TECs listed under the BC Act and EPBC Act.

A large number of hollow-bearing trees and stick nests were recorded in the Project area. Many of these breeding structures are in Eucalypt woodland patches and scattered Cypress Pine trees and are unlikely to be directly impacted during vegetation clearing in the disturbance footprint. Impact to Eucalypt woodland patches (PCTs 7, 9 and 13) comprise 2.01 hectares, however this is generally confined to ground trenching for cabling and limited impacts to trees will occur. Proposed powerlines across the Yanco Creek may result in trimming and lopping of *Eucalyptus camaldulensis* (PCT 7). Two medium sized hollow bearing trees are located in the disturbance footprint for cabling and will be avoided during construction.

The transmission line forms part of the disturbance footprint as part of Project works, in accordance with the requirements of (and information provided under) the BAM. Biodiversity values were assessed for direct and indirect impacts at each pole location. The transmission line itself avoids impacts to biodiversity values across grassland and woodland. However, indirect impacts were assessed to consider uncertain operational impacts associated with collision and electrocution of birds and bats with transmission line. This assessment was informed by the bird and bat field survey data to assess prescribed impacts associated with wind turbine blade strike.

Road upgrades within the Project area were assessed as part of the study area. Field surveys were undertaken for each proposed upgrade. The field assessment found that very small areas of native vegetation may require disturbance in the Project area at the junctions of Moonbria Lane/Wilson Road, Liddles Lane/Wilson

Road and Jerrys Lane/ Liddles Lane. These roads have wide man-made embankments and swales that are maintained by Council to drain water from the roads. As a result, these roads are considered to be category 1 – exempt land within the envelope of the roads and biodiversity values do not need to be assessed, except prescribed impacts where relevant.

Preliminary locations for road upgrades outside of the Project area have been assessed as part of a desktop review in Section 2.3 of the BDAR and included review of regional biodiversity maps. Road upgrades outside of the Project area are not expected to impact on biodiversity values. Based on the desktop assessment and review of aerial imagery, the proposed works occur within road envelopes and not within vegetated areas. The identification of prescribed impacts was also reviewed at these locations.

Table 10-1 Summary of direct impacts on native vegetation and threatened ecological communities

Vegetation zone	Plant community type name	TEC status BC Act	EPBC Act	Area in disturbance footprint (ha)	VI score (loss)
1	River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)	None	None	1.10	37.7
2	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)	None	None	0.22	33.1
3	Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)	None	None	0.58	61.1
4		None	None	0.11	48.9
5	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)	None	None	1.86	94
6	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26)	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EEC	Weeping Myall Woodlands EEC	27.00	50.1
7			Not listed	1.40	30.9
8			Weeping Myall Woodlands EEC	2.10	82.2
9			Weeping Myall Woodlands EEC	0.59	34.9
10	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28)	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions EEC	None	10.28	28.2
11	Forb-rich Speargrass – Windmill Grass - White Top grassland of the Riverina Bioregion (PCT44)	None	Natural Grasslands of the Murray Valley	32.99	99.4

Vegetation zone	Plant community type name	TEC status		Area in disturbance footprint (ha)	VI score (loss)
		BC Act	EPBC Act		
			Plains CEEC		
12		None	Not listed	3.15	84.5
13	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)	None	Natural Grasslands of the Murray Valley Plains CEEC	1.42	90.9
14		None	Not listed	0.81	68.7
15	Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46)	None	Natural Grasslands of the Murray Valley Plains CEEC	31.29	92.1
16		None	Not listed	13.32	67.3
17		None	Natural Grasslands of the Murray Valley Plains CEEC	23.49	97.7
18		None	Not listed	22.51	83.3
19	Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160)	None	None	0.03	80.3
Total				173.39	

10.1.2 Removal of habitat for threatened species

The direct impacts on threatened species habitat associated with the clearing of native vegetation are outlined in **Table 10-2**. Other impacts to threatened species habitat, including impacts to connectivity and species movement, impacts to non-native vegetation and disturbed areas, and impacts to water quality and hydrology are discussed in **Section 10.2**.

Threatened flora

The estimated total clearing of native vegetation will result in the direct removal and permanent loss of habitat for threatened flora species.

The estimated total clearing of native vegetation will result in the direct removal and permanent loss of habitat assumed to be occupied by following threatened flora species:

- *Austrostipa wakoolica* – 19.57 hectares
- *Brachyscome muelleroides* (SAll entity) – 23.57 hectares
- *Brachyscome papillosa* – 23.60 hectares

- *Caladenia arenaria* (SAll entity) – 1.49 hectares
- *Convolvulus tedmoorei* (SAll entity) - 14.23 hectares
- *Cullen parvum* – 35.29 hectares
- *Lepidium monoplocoides* - 12.92 hectares
- *Leptorhynchos orientalis* – 25.75 hectares
- *Maireana cheelii* – 25.75 hectares
- *Pilularia novae-hollandiae* – 14.43 hectares
- *Sclerolaena napiformis* 25.75 hectares
- *Swainsona murrayana* 32.12 hectares (includes 1.69 ha of confirmed populations)
- *Swainsona plagiotropis* – 28.94 hectares
- *Swainsona sericea* – 27.24 hectares.

For threatened populations of *Swainsona murrayana*, a direct count of individuals located within the study area was made to quantify the impact of the Project for the species. A species polygon was developed for *Swainsona murrayana* in accordance with paragraph 5.2.5.3 of the BAM, by adding a 30 m buffer around the individual plant locations (**Figure 5-5**). The species polygon for *Swainsona murrayana* with known populations comprises 1.69 ha in disturbance footprint. An additional 30.43 hectares of assumed habitat for *Swainsona murrayana* is present within the disturbance footprint which comprises a total species polygon of 32.12 hectares.

A 30 m buffer was also applied to threatened populations of *Swainsona sericea*, however the Project was designed to avoid direct impacts on these threatened populations.

In areas with suitable habitat for threatened flora where targeted surveys were not undertaken, habitat is assumed present in associated PCTs. A species polygon has been created at these locations in associated PCTs within the disturbance footprint to determine species credit offsets all 14 threatened flora and is summarised in **Table 10-2** and illustrated in **Figure 5-6**.

As described in **Section 9**, considerable effort was made to avoid areas of native vegetation and suitable habitat for threatened species by designing the Project in non-native vegetation comprising 60.29 hectares. Many of the proposed access tracks have been aligned with existing farm tracks of varying condition to minimise impacts on suitable habitat threatened flora. This was achieved successfully with the full avoidance of the known *Swainsona sericea* population. However, because there are survey gaps remaining in areas with suitable habitat for threatened flora these population must be assumed present.

Threatened Fauna

The estimated total clearing of native vegetation will result in the direct removal and permanent loss of habitat that was confirmed to be occupied and utilised by the following threatened fauna species (refer to **Table 10-3**):

- Southern Myotis - 0.9 hectares
- Plains-wanderer – 1.78 hectares.

For threatened fauna, the area of habitat (species polygon) associated with the species was calculated. For **Southern Myotis**, this included the area of native vegetation (Zone 1 – PCT 7 and Zone 2- PCT9) within a 200 m buffer around Yanco Creek (PCT7) and woodland near farm dams (PCT9) that also intersected with the disturbance footprint. The vegetation zones surrounding Yanco Creek and some farm dams may be used for breeding and roosting, on the basis that tree hollows are present.

The **Plains-wanderer** 'important habitat mapping' covers a small portion of the disturbance footprint, and the species is assumed present. Parts of the important habitat mapping occurs on cropping land and/or non-native vegetation and is not considered suitable habitat for this species. As a result, a species polygon was not generated at these locations. Additionally, the important habitat mapping intersects the disturbance footprint along existing farm tracks that have been incorporated into vegetation zones. It's unlikely that construction of access tracks along existing farm tracks will have a direct impact on the Plains-wanderer. However due to the

varying condition of access tracks and uncertainty of suitable habitat across the Project area, a species polygon was created for these locations and includes the area of habitat on the disturbance footprint that intersects the important habitat map. This corresponds with the native vegetation mapped as Zone 5 (PCT17), Zone 6 (PCT26), Zone 11 (PCT44), Zone 14 (PCT45) and Zones 15, 16, 18 (PCT46). The remaining parts of the disturbance footprint that are not within the important area mapping will be offset by ecosystem credits (e.g. foraging habitat, unmapped locations used by a species).

As described in **Section 9**, considerable effort was made to avoid areas of Plains-wanderer important area mapping. This required the re-location of wind turbines, proposed tracks, cabling and other design components outside of the important mapping areas. The proposed impact of 1.78 ha in important area mapping is fully restricted to existing farm tracks to minimise impacts Plains-wanderer important habitat. It is important to note that the habitat loss is associated with a series of very small fragments along existing farm tracks over a large area, and the species is considered to persist in the Project area given the low impact activity associated with an operational wind farm and the extent of habitat that will remain.

The population size is susceptible to fluctuations associated with environmental conditions as no breeding may occur in years of drought and breeding success can also be very low in years of heavy rainfall (DoE, 2016). Additionally, as the estimated generation length is three years (S Garnett & Crowley, 2000), the construction duration may disturb breeding activities for two seasons, for low number of birds. Considering the spatial and temporal extent of construction activities within an area supporting a portion of the regional population. It is considered possible that the Project may lead to change in the site population numbers, especially if environmental conditions are unfavourable during construction or in the years following.

Table 10-2. Summary of direct impacts on threatened flora species-credit species habitat associated with the loss of native vegetation

Threatened flora	Area in disturbance footprint (ha)																			Total (ha)
	PCT 7		PCT 9		PCT 13		PCT 17		PCT 26		PCT 28		PCT 44		PCT 45		PCT 46		PCT 160	
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11	Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18	Zone 19	
<i>Swainsona murrayana*</i>	-	-	-	-	-	2.10 (0.14)	-	0.19	-	1.49	9.54 (0.44)	0.34	0.53	-	3.71 (0.33)	5.06	0.99 (0.68)	6.48 (0.10)	-	32.12
<i>Austrostipa wakoolica</i>	-	-	-	-	0.95	12.18	0.01	0.6	0.03	5.80	-	-	-	-	-	-	-	-	-	19.57
<i>Brachyscome muelleroides</i>	-	-	-	-	-	-	-	-	-	-	9.39	0.34	-	-	2.63	3.96	0.94	6.31	-	23.57
<i>Brachyscome papillosa</i>	-	-	-	-	-	-	-	-	-	-	9.39	0.34	-	-	2.63	3.96	0.94	6.31	0.03	23.60
<i>Caladenia arenaria</i>	-	-	-	-	-	-	-	-	-	1.49	-	-	-	-	-	-	-	-	-	1.49
<i>Convolvulus tedmoorei</i>	-	-	-	-	-	2.10	-	0.19	-	-	9.54	0.34	-	-	0.07	-	-	-	0.03	12.27
<i>Cullen parvum</i>	0.17	0.20	-	-	-	-	-	-	-	-	31.79	3.13	-	-	-	-	-	-	-	35.29
<i>Lepidium monoplocoides</i>	-	-	-	-	-	12.18	0.01	0.60	0.03	-	-	-	-	-	0.07	-	-	-	0.03	12.92
<i>Leptorhynchus orientalis</i>	-	-	-	-	-	1.98	-	0.13	-	-	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	25.75
<i>Maireana cheelii</i>	-	-	-	-	-	1.98	-	0.13	-	-	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	25.75
<i>Pitularia novae-hollandiae</i>	-	0.16	0.56	0.11	-	12.18	0.01	0.60	0.03	-	-	-	0.49	0.29	-	-	-	-	-	14.43
<i>Sclerolaena napiformis</i>	-	-	-	-	-	1.98	-	0.13	-	-	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	25.75
<i>Swainsona plagiotropis</i>	-	-	-	-	-	2.10	-	0.19	-	-	9.54	0.34	0.53	-	3.71	5.06	0.99	6.48	-	28.94
<i>Swainsona sericea</i>	-	-	-	-	-	1.98	-	0.13	-	1.49	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	27.24

*area includes combined impact for confirmed populations and habitat with assumed presence. Area of confirmed populations in brackets.

Table 10-3. Summary of direct impacts on threatened fauna species-credit species habitat associated with the loss of native vegetation

Zone	Plant community type name	Broad condition class	Area in disturbance footprint (ha)	
			Plains-wanderer (SAIL entity)	Southern Myotis
1	River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)	Low to Moderate	-	0.88
2	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)	Low to Moderate	-	0.02
5	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)	Moderate to Good	0.03	-
6	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26)	Moderate to Good_grassy	0.48	-
11	Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT44)	Moderate to Good	0.12	-
14	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)	Low to Moderate	0.05	-
15	Curly Windmill Grass – speargrass – wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46)	Moderate to Good	0.44	-
16		Low to Moderate	0.338	-
18		Low to Moderate_Cottonbush	0.28	-
Total			1.78	0.9

10.2 Indirect impacts on native vegetation and habitat

Section 1.2 of the BAM Stage 2 Manual (DPIE 2019b) defines indirect impacts as development related activities not associated with clearing for the development footprint. Paragraph 8.2 of the BAM lists potential indirect impacts that may result from construction and/or operation of a new development. The potential indirect impacts that are applicable to this Project are discussed below. Though indirect impacts cannot be quantified, the potential for indirect impacts can be minimised through the application of stringent mitigation measures and monitoring the performance of these. The types of potential indirect impacts on native vegetation, threatened ecological communities and threatened species (and their habitat) beyond the disturbance footprint are summarised in **Table 10-4** and described in more detail in the following sections. The discussion includes an assessment of the extent, duration and consequence of the impact.

Table 10-4. Summary of potential indirect impacts on native vegetation and habitat for threatened species

Indirect impact (refers text following sections)	Impacted entities	Extent	Duration	Consequence
Inadvertent impacts on adjacent vegetation and threatened species habitat: edges effects (Section 10.2.1)	Native vegetation associated with 10 PCTs, four TECs and habitat for threatened species adjoining the cleared areas	The extent of the indirect disturbance buffer adjacent to the Project is uncertain and subject to monitoring and assessment	Long-term	Negative changes to the structure and function of the adjoining vegetation
Changed hydrology and sedimentation (Section 10.2.2)	Riparian zones and aquatic habitat for Murray Cod and Silver Perch	Yanco Creek, Delta Creek and Turn back Jimmy Creek, as well as isolated depressions and minor drainage lines	Potential short-term	Transport of sediment into waterways
Weed invasion and risk of pathogens (Section 10.2.4)	Native vegetation associated with seven PCTs and habitat for threatened species adjoining the cleared areas. Indirect impacts of relocating spoil.	The extent of the indirect disturbance buffer adjacent to the Project is uncertain and subject to monitoring and assessment	Potential long-term during construction and operation	Negative changes to the structure and function of the adjoining vegetation
Increase in predator and pest animal populations (Section 10.2.5)	Threatened fauna, and common fauna, particularly small mammal groups and ground dwelling birds such as Plains-wanderer	Throughout the Project area	Potential short and long-term during construction and operation	Decline of threatened fauna populations such as Plains-wanderer
Collisions and electrocution of fauna with transmission lines (Section 10.2.6)	High risk species of birds and bats	Along the length of transmission line	Potential long-term during operation	Loss of resident pairs, particularly raptors and disturbance to breeding activity
Changed fire regimes during operation (Section 10.2.7)	Native vegetation and threatened species	Surrounding landscape including biodiversity stewardship sites	Long-term during operation	Negative changes to the structure and function of the adjoining vegetation Direct mortality of fauna
Noise, vibration, and light pollution (Section 10.2.8)	Threatened fauna	The extent of the indirect disturbance buffer from the easement is uncertain	Short-term during construction	Disturbance to breeding activity
Dust pollution (Section 10.2.9)	Native vegetation and threatened species	The extent of the indirect disturbance buffer from the easement is uncertain	Short-term during construction	Negative changes to the structure and function of the adjoining vegetation
Contaminant pollution (Section 10.2.10)	Aquatic habitat	Yanco Creek, Delta Creek and Turn back Jimmy Creek	Short-term during construction	Decline on habitat condition for aquatic species

10.2.1 Inadvertent impacts on adjacent vegetation and threatened species habitat

The direct impact of clearing vegetation from the disturbance footprint is described previously, and will remove portions of 10 PCTs with low to moderate and moderate to good vegetation integrity scores, and remove known habitat for threatened flora and fauna species. Areas of comparable vegetation and habitat also occur adjacent to and outside of the disturbance footprint that may be indirectly impacted. Indirect impacts reportedly result in a reduced viability of the vegetation, and gradual decline in vegetation integrity and habitat value for threatened ecological communities and species. The indirect impact may displace resident threatened fauna through increased risk of exposure, and loss of shade or shelter, in turn interrupting movements and availability of breeding habitat. Species at greatest risk for this Project are likely to include Plains-wanderer and threatened flora species. In-situ populations of *Swainsona murrayana* and *Swainsona sericea* have been identified adjacent to the disturbance footprint. These range from 5-600 m from the edge of the disturbance footprint and there is potential for some of these in-situ plants to be inadvertently impacted by changed abiotic conditions.

These indirect impacts could be reasonably expected to occur in vegetation and habitat retained adjacent to the cleared land. This indirect impact specifically refers to negative changes to the structure and function of retained vegetation as a result of changed abiotic factors such as increased light intensity and duration, increased runoff, increased exposure to wind, and weed invasion in edge habitats, or displacement of soil into adjoining vegetation from areas of modified landforms. These changes can have a negative impact on plant and animal species by changing habitat quality. The assessment of indirect impacts has been guided by Section 2.4.1 of the BAM Stage 2 manual. The case study (Box 2) in Section 2.4.1 describes the use of a 50 m buffer to capture the edge effects caused by a major road infrastructure Project. Most indirect impacts are likely to affect open grassland or open woodland which are already susceptible to abiotic factors. Direct impacts to Eucalyptus woodland are small and generally restricted to narrow widths comprising access tracks, cabling and transmission lines. As a result, a 10 m buffer has been applied to capture impacts of edge effects.

Post-construction of the vegetation within the cabling alignments and underneath transmission line poles will regenerate and be maintained during operation as low shrubs and intact ground layer. Bare surfaces will be limited to access tracks used for maintenance and around structures. The level of traffic following completion of construction will be minor and associated with maintenance and management of vegetation during operation. As such, it is expected that weed spread will be typically limited, however the extent of weed spread and reduced vegetation integrity from the edge of the disturbance footprint is unknown and will require monitoring.

Other edge effects associated with a change in abiotic conditions will vary in distance from the edge, and the extent of the indirect impact has not been quantified for the purposes of generating offsets for indirect impacts. To assess this potential indirect impact, monitoring is proposed during and post-construction and the details of this monitoring program will be described in the Biodiversity Management Plan (BMP) to be developed post-approval. Further assessment may be required where Plains-wanderer or in-situ threatened flora populations are known or expected to occur. Any impacts determined post-construction will be reported as part of the BMP adaptive management strategy.

A suite of mitigation measures are proposed to avoid and minimise the disturbance to retained vegetation adjacent to the Project during the construction phase. These are documented in **Section 12** and include but are not limited to placing exclusion zones around clearing limits, applying standard sediment and erosion control measures, and applying methods to prevent the transportation of weeds and pathogens.

It is difficult to quantify any loss in vegetation integrity in edge retained areas or the extent of this loss, and offset credits have not been generated for indirect impacts. Monitoring of vegetation integrity in adjacent areas will be conducted to identify any decline in condition relative to set performance criteria. Where measurable declines are identified, the area will be quantified, and offsets applied.

The indirect impacts from decommissioning activities undertaken would be similar to the construction phase. This would include delivery of construction equipment to the Project area and use of construction equipment, transport of materials and disposal of waste. Therefore, decommissioning would present a similar risk to water quality and groundwater. Parts of the disturbance footprint will also regenerate with native vegetation such as hard stands which may require additional vegetation clearing during decommissioning.

10.2.2 Changed hydrology and sedimentation

The Project area is situated in a flat landscape on poorly drained clay soils with discrete drainage lines or depressions which are seasonally inundated and are subsequently dry. The nature and location of the proposed construction works is unlikely to substantially modify the hydrological regime or cause serious erosion to impact on biodiversity. Large areas of clearing are mostly restricted to proposed locations of wind turbines, substations and BESS and these are situated away from important waterways and drainage lines. Flood events and seasonal inundation can occur on the plains landscape which can inundate open grassland and woodland. Earthworks and building embankments for infrastructure, including installation of footings for wind turbine locations has potential to change the level and movement of water in a flat landscape. There is the potential for soils to be dispersed or transported to other locations within the Project area and offsite via erosion i.e. by water and/or wind. Erodibility potential may also be increased in sodic, dispersive or reactive soils by construction activities such as excavation, vehicle and machinery traffic movements, particularly during wet periods. If high intensity rainfall or flooding events occur during construction, the likelihood of adverse water erosion effects would also increase. Based on the soils and contamination assessment prepared for the Project, soils present throughout the southern half of the Project area have a high potential for erosion via wind and/or water (refer to the EIS). Potential soil erosion hazards can be managed with the implementation of appropriate management measures during construction

The greatest risk is displaced sediment entering Yanco Creek via the associated floodplain during construction of transmission line along Wilson Road. The transmission line will directly cross over this creek and while vegetation clearing will be largely avoided on banks and near the creek, there is a potential for increased deposition of sediment into the Yanco Creek during the installation of poles. This could result in impacts to the aquatic habitat for Murray Cod and Silver Perch and Flathead Galaxias. However, the placement of poles is small scale and ground cover vegetation will eventually recover during the construction phase and early operational phase, any areas of exposed soil on these slopes presents the risk of sedimentation until this vegetation cover returns. There will be no use of heavy machinery in the riparian zones. Further discussion of impact assessment on aquatic habitats is provided below

Mitigation measures will be implemented according to standard construction controls and guidelines.

10.2.3 Assessment of impacts on aquatic habitat

10.2.3.1 Risk Assessment – Construction

A risk assessment of the potential impacts has been carried out to consider the consequence and likelihood of impacts:

- Without the implementation of environmental management and mitigation measures (risk)
- With the implementation of proposed measures (residual risk).

The risk assessment is provided in **Table 10-5**.

Table 10-5. Risk assessment for construction works for the Project

Activity	Potential impact pathway and effect	Consequence	Likelihood	Risk	Proposed measures	Consequence	Likelihood	Residual risk
Earthworks	Reduced water quality from sedimentation potentially leading to proliferation of pest species and subsequent further degradation of water quality and habitat	Moderate	Possible	Medium	<ul style="list-style-type: none"> Site erosion and sediment controls and other management measures would be established as the first step in commencement of construction activities to avoid and/or manage erosion and sedimentation impacts 	Minor	Rare	Low
	Mobilisation of construction runoff which may result in downstream sedimentation, leading to increased turbidity and nutrients which may reduce visibility for fish, clog fish gills, smother aquatic vegetation, smother benthic invertebrates, infill habitat features and increase algal productivity.	Moderate	Likely	Medium	<ul style="list-style-type: none"> Site erosion and sediment controls and other management measures would be established as the first step in commencement of construction activities to avoid and/or manage erosion and sedimentation impacts 	Minor	Rare	Low

Biodiversity Development Assessment Report

Activity	Potential impact pathway and effect	Consequence	Likelihood	Risk	Proposed measures	Consequence	Likelihood	Residual risk
Transportation of excavated material and the movement of heavy vehicles across exposed earth	Reduced water quality from transportation of pollutants from accidental spills or leaks of fuels and/or oils, which may lead to direct harm or mortality of aquatic species that cannot tolerate poor water quality	Moderate	Possible	Medium	<ul style="list-style-type: none"> Fuels and oils for construction equipment, machinery and vehicles will be stored in a bunded area, as far as practicable from the waterway. All refuelling and maintenance will be undertaken within bunded areas. 	Minor	Rare	Very low
	Potential for rubbish, debris and sediment being transported via proposed haulage routes during transport of spoil and excavated material	Moderate	Possible	Medium	<ul style="list-style-type: none"> Truck loads to be adequately covered when transporting loose material (ie. spoil) Dust suppression activities will be implemented to ensure minimal dust is generated from using the access tracks. 	Minor	Rare	Very low
	Proliferation of pest species that can tolerate poor water quality and subsequently result in further degradation of water quality and habitat	Moderate	Possible	Medium	<ul style="list-style-type: none"> Runoff captured in water quality controls will be treated and discharged in accordance with relevant water quality guidelines (MDBA, 2012; ANZG, 2018). 	Minor	Rare	Very low

Biodiversity Development Assessment Report

Activity	Potential impact pathway and effect	Consequence	Likelihood	Risk	Proposed measures	Consequence	Likelihood	Residual risk
Accidental spills and litter	Reduced water quality from transportation of pollutants from accidental spills or leaks of fuels and/or oils, which may lead to direct harm or mortality of aquatic species that cannot tolerate poor water quality	Moderate	Possible	Medium	<ul style="list-style-type: none"> An emergency spill response procedure would be prepared to minimise the impact of accidental spillages of fuels, chemicals and fluids during construction and Spill response kits will be kept at all sites in the event of a spill All fuels, chemicals and liquids would be stored on level ground away from waterways and would be stored in sealed bunded area within the construction compound Refuelling and minor maintenance activities would be limited to designated areas with established spill capture and management controls Regular visual water quality checks (for hydrocarbon spills/slicks, turbid plumes and other water quality issues) will be carried out at waterways in proximity to works 	Minor	Rare	Very low
	Proliferation of pest species that can tolerate poor water quality and subsequently result in further degradation of water quality and habitat	Moderate	Possible	Medium	<ul style="list-style-type: none"> Runoff captured in water quality controls will be treated and discharged in accordance with relevant water quality guidelines (MDBA, 2012; ANZG, 2018). Installing and maintaining control measures such as silt fencing and gross pollutant traps etc. 	Minor	Rare	Very low

Biodiversity Development Assessment Report

Activity	Potential impact pathway and effect	Consequence	Likelihood	Risk	Proposed measures	Consequence	Likelihood	Residual risk
Trenching	Reduced water quality from sedimentation potentially leading to proliferation of pest species and subsequent further degradation of water quality and habitat	Moderate	Possible	Medium	<ul style="list-style-type: none"> Aim to carry out works when the flow path is dry or mostly dry at the site Runoff captured in water quality controls will be treated and discharged in accordance with relevant water quality guidelines (MDBA, 2012; ANZG, 2018). Installing and maintaining control measures such as silt fencing and gross pollutant traps etc. 	Minor	Rare	Low
	Proliferation of pest species that can tolerate poor water quality and subsequently result in further degradation of water quality and habitat	Moderate	Possible	Medium	<ul style="list-style-type: none"> Runoff captured in water quality controls will be treated and discharged in accordance with relevant water quality guidelines (MDBA, 2012; ANZG, 2018). Installing and maintaining control measures such as silt fencing and gross pollutant traps etc 	Minor	Rare	Low
	Disturbance of the channel bed which may result in downstream sedimentation, leading to increased turbidity and nutrients which may reduce visibility for fish, clog fish gills, smother aquatic vegetation, smother benthic invertebrates, infill habitat features and increase algal productivity.	Moderate	Likely	Medium	<ul style="list-style-type: none"> Aim to carry out works when the flow path is dry or mostly dry at the site. If water is present, works would be carried out under baseflow conditions and floating silt curtain will be placed around the instream work area If water is present at the time of works monitoring of dissolved oxygen to ensure suitable saturation levels. 	Minor	Rare	Low

Biodiversity Development Assessment Report

Activity	Potential impact pathway and effect	Consequence	Likelihood	Risk	Proposed measures	Consequence	Likelihood	Residual risk
	Disturbance / excavation of the channel bed leading to direct harm or mortality of native fauna burrowed into the sediment	Major	Possible	Medium	<ul style="list-style-type: none"> Measures to ensure that all waterway crossings will be constructed in accordance with the Guidelines for Controlled Activities on Waterfront Land – riparian corridors (Natural Resources Access Regulator, 2018), Guidelines for watercourse crossings on waterfront land (DPI, 2012), Guidelines for riparian corridors on waterfront land (DPI, 2012) and Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (DPI, 2003) 	Minor	Rare	Low

10.2.3.2 Potential impacts – Operation

During the operational phase of the project, all project elements would be complete. Cleared areas would be stabilised through revegetation or landscaping. Risk to aquatic ecology would be associated with changes in water quality associated with the establishment of new permanent impervious surfaces, the use of internal access tracks to, from and between WTGs and decommissioning activities. The key pollutants of concern during operation that has the potential to impact on aquatic ecosystems would be sediments (and possibly nutrients if bound to sediment) and contaminants such as hydrocarbons.

During operation, the project would result in a minor increase in impervious surfaces due to the presence of roads, WTG foundations and operational facilities. Whilst hardstand areas are located near Delta Creek and Turn Back Jimmy Creek, the relatively flat topography would not result in an increased risk of erosion or subsequent downstream sedimentation.

Temporary tracks established during the construction of the Project would be retained and converted to permanent access tracks where required. Tracks would be cleared of vegetation and stabilised where required but are not proposed to be paved or asphalted. The risk to water quality from driving on gravel tracks can include the creation and transport of dust due to vehicle movements and erosion of roads if not appropriately maintained. This could potentially lead to transport of sediment to downstream waterways, including Delta Creek and Turn Back Jimmy Creek and subsequently impact on aquatic ecosystems.

10.2.3.3 Risk Assessment – Operation

A risk assessment of the potential impacts outlined in **Section 10.2.3.2** has been carried out to consider the consequence and likelihood of impacts:

1. Without the implementation of environmental management and mitigation measures (risk)
2. With the implementation of proposed measures (residual risk).

The risk assessment is provided in **Table 10-6**.

Table 10-6. Risk assessment of identified impact from operation of the Project

Activity	Potential impact pathway and effect	Consequence	Likelihood	Risk	Proposed measures	Consequence	Likelihood	Residual risk
Sedimentation from dust deposition	Reduced water quality from sedimentation downstream receivers, particularly turbidity	Minor	Possible	Low	<ul style="list-style-type: none"> Manage access tracks and unsealed roads adjacent to waterways to reduce sedimentation impacts and avoid unnecessary disturbance of track surfaces 	Minor	Possible	Low
Accidental spills and leaks from maintenance vehicles	Direct mortality or harm to native aquatic species from substances which may be toxic to aquatic species.	Minor	Possible	Low	<ul style="list-style-type: none"> An emergency spill response procedure would be prepared to minimise the impact of accidental spillages of fuels, chemicals and fluids during construction and Spill response kits will be kept at all sites in the event of a spill 	Minor	Possible	Low

10.2.3.4 Impact assessment – Sensitive receptors

Key Threatening Processes

Schedule 6 of the FM Act outlines the key threatening process related to aquatic species and ecological communities. The Project is expected to involve the key threatening processes outlined in **Table 10-7**.

Table 10-7. Key threatening processes related to the Project

Key threatening process	Project impact
Degradation of native riparian vegetation along New South Wales water courses	<p>The construction and operation may result in disturbance of a limited amount of riparian vegetation in areas within the disturbance footprint.</p> <p>Removal of riparian vegetation can indirectly impact on aquatic species and habitats as it can potentially result in sedimentation of waterways if runoff is allowed to mobilise exposed soils, which can subsequently affect water quality and sediment deposition in aquatic habitats.</p> <p>Increased sedimentation may cause increased turbidity which can clog fish gills or limit growth of aquatic flora due to blocking sunlight. Mobilised sediments may contain elevated concentrations of nutrients which can cause algal blooms. Algal blooms can result in a decrease in dissolved oxygen concentrations and create dead zones where aquatic life cannot survive. Sediments may also settle into refuge pools that are used by species during times of low flow.</p> <p>Removal of riparian vegetation can result in destabilisation of the banks and subsequent erosion. Sedimentation and bank erosion can subsequently cause changes to geomorphology which may impact flow velocities or changes to aquatic habitat features.</p> <p>Clearance of riparian vegetation would be avoided as much as practicable and following completion of construction at the site, riparian vegetation would be re-established. Any other vegetation clearing that is required would be set back from the riverbank (in temporary work areas) and sediment fences would be erected around site areas prior to clearance.</p> <p>Following completion of construction, it is expected that riparian vegetation would be re-established and rehabilitated in areas not used during operation and on the banks of the waterway.</p>
Removal of large woody debris from NSW rivers and streams	<p>Removal of instream aquatic vegetation and habitat features including large woody debris and instream aquatic vegetation, have the potential to impact aquatic species that depend on these habitat features for food supply, shelter and spawning. Removal of habitat features has the potential to result in habitat loss, reduced reproductivity or direct mortality.</p> <p>Habitat features would be relocated upstream or downstream in consultation with an appropriately qualified ecologist. Further, it is anticipated that aquatic habitat features would then be reinstated, to the extent possible, once construction is completed.</p>

10.2.3.1 Threatened species and ecological communities

Aquatic species and ecological communities including those that are listed as threatened under the FM Act and EPBC Act have potential to be directly or indirectly impacted by the Project because of the following activities:

- Riparian vegetation removal
- Instream construction
- Accidental spills and pollution
- Erosion and sedimentation due to construction activities.

Significance tests in accordance with Commonwealth and state legislation have been carried out for all threatened species and TECs which have been deemed possible to occur. **Table 10-8** provides a summary of key considerations and the outcome of the significance tests. Silver Perch, Trout Cod, and Flathead Galaxias are all EPBC and FM listed species, therefore have been assessed against the EPBC significance impact criteria (DoE, 2013), as well as the '7-part test' of impact significance in accordance with the FM Act. Murray Cod is an EPBC listed species only and assessed against the EPBC significance impact criteria. **Appendix K** presents the significance tests in further detail.

Table 10-8. Summary of significance tests for likely threatened species in the study area

Scientific name	Common name	FM Act	EPBC Act	Key impact considerations	Determination of impact of significance
Lower Murray River Endangered Ecological Community	-	EEC	-	<p>The Project would require localised disturbance for widening of access tracks, underground cabling and installation of overhead wiring. This may involve some clearance of adjoining riparian vegetation and instream disturbance. Disturbance would be limited to the footprint area.</p> <p>The extent of riparian and instream aquatic habitat that is likely to be cleared during construction is limited. Areas that are proposed to be cleared within the disturbance footprint will be rehabilitated as far as practicable following construction.</p> <p>As the Project area is predicted to support several threatened fish and the Lower Murray River EEC, the Project has been designed to minimise waterways crossings, disturbance of waterways and riparian vegetation removal. The Project is not expected to fragment, isolate or impact on the long-term survival of the Lower Murray EEC in the locality.</p>	Project is not expected to significantly impact on Lower Murray River EEC.
<i>Bidyanus bidyanus</i>	Silver Perch	V	CE	<p>The Project would require localised disturbance at or near Delta Creek, Turn Back Jimmy Creek and Yanco Creek for widening of access tracks, underground cabling and installation of overhead wiring. This may involve some clearance of adjoining riparian vegetation and instream disturbance. Disturbance would be limited to the footprint area.</p> <p>The operation of the Project does not present any risk to the Silver Perch as there will be no changes to flow and no barrier to fish movement. The only potential risk is a deterioration in water quality due to accidental spills and leaks which would be managed during operation. Given the minimal disturbance to waterways, the risk of introduction of pest species is low.</p> <p>Little is known of the impact of diseases on the Silver Perch. While there is potential for contact with non-native fish species, no change in the potential for interaction would result from operation of the Project.</p>	Project is not expected to significantly impact on Silver Perch.
<i>Maccullochella peelii</i>	Murray Cod	-	V	<p>The Project would require localised disturbance at or near Yanco Creek for widening of access tracks, underground cabling and installation of overhead wiring. This may involve some clearance of adjoining riparian vegetation and instream disturbance. Disturbance would be limited to the footprint area.</p> <p>The operation of the Project does not present any risk to the Murray Cod as there will be no changes to flow and no barrier to fish movement. The only potential risk is a deterioration in water quality due to accidental spills and leaks although this would be managed during operation. Given the minimal disturbance to waterways, the risk of introduction of pest species is low.</p> <p>Little is known of the impact of diseases on Murray Cod, however naturally occurring pathogens may be a problem for injured fish. Another risk for Murray Cod is Epizootic Haematopoietic Necrosis Virus (EHNV) virus, which the species can contract from contact with Redfin Perch. While there is potential for contact with Redfin Perch as both</p>	Project is not expected to significantly impact on Murray Cod.

Biodiversity Development Assessment Report

Scientific name	Common name	FM Act	EPBC Act	Key impact considerations	Determination of impact of significance
				species have may occur in the study area, no change in the potential for interaction would result from operation of the Project.	
<i>Maccullochella macquariensis</i>	Trout Cod	E	E	<p>The Project would require localised disturbance at or near Yanco Creek for widening of access tracks, underground cabling and installation of overhead wiring. This may involve some clearance of adjoining riparian vegetation and instream disturbance. Disturbance would be limited to the footprint area.</p> <p>The operation of the Project does not present any risk to Trout Cod as there will be no changes to flow and no barrier to fish movement. The only potential risk is a deterioration in water quality due to accidental spills and leaks which would be managed during operation. Given the minimal disturbance to waterways, the risk of introduction of pest species is low.</p> <p>Little is known of the impact of diseases on the Trout Cod. While there is potential for contact with non-native fish species, no change in the potential for interaction would result from operation of the Project.</p>	Project is not expected to significantly impact on Trout Cod.
<i>Galaxias rostratus</i>	Flathead galaxias	CE	CE	<p>The Project would require localised disturbance at or near Delta Creek, Turn Back Jimmy Creek and Yanco Creek for widening of access tracks, underground cabling and installation of overhead wiring. This may involve some clearance of adjoining riparian vegetation and instream disturbance. Disturbance would be limited to the footprint area.</p> <p>The operation of the Project does not present any risk to the Flathead Galaxias as there will be no changes to flow and no barrier to fish movement. The only potential risk is a deterioration in water quality due to accidental spills and leaks which would be managed during operation. Given the minimal disturbance to waterways, the risk of introduction of pest species is low.</p> <p>Little is known of the impact of diseases on the Flathead Galaxias. While there is potential for contact with non-native fish species, no change in the potential for interaction would result from operation of the Project.</p>	Project is not expected to significantly impact on Flathead Galaxias.

10.2.4 Weed invasion and risk of pathogens

The Project area generally lacks large outbreaks of perennial exotic species. Exotic vegetation is mostly restricted to irrigated land with crops and/or ploughed paddocks. Annual exotic grasses such as Rye Grass (*Lolium* spp.), Wild Oats (*Avena* spp.) and Barley Grass (*Hordeum* spp.) dominate the landscape in spring, but dieback in early summer. The most common weed species in the Project area are Bathurst burr (*Xanthium spinosum*) and African Boxthorn (*Lycium ferocissimum*). Many infestations are controlled by local farmers. African Boxthorn is a Weed of National Significance (WoNS) and was commonly recorded in the northern sections of the Project area.

There is potential for new weed species to be introduced and spread into native vegetation and habitat not directly impacted by the Project given the nature of permanent and partial impacts across a very large Project area. Weeds can indirectly decrease the value of native vegetation, including TECs and threatened species habitat. Weed and pest management would be adequately implemented in a detailed BMP required prior to construction.

Further advice on mitigation measures for controlling weed species are discussed in **Section 12** and focus on control of the high threat weeds prior to clearing, and ongoing monitoring of weed invasion in adjoining habitat during construction and decommissioning as a part of an adaptive management plan. The exact distance from the disturbance footprint that weeds may become established in adjoining vegetation is uncertain, but is predicted to potentially up to 50 metres. Monitoring of priority weeds in adjacent vegetation is therefore important as part of the adaptive management strategy (refer **Section 12**).

10.2.5 Increase in predator and pest animal populations

Predator and pest species refer to foxes, dogs, cats, feral horses, pigs, and rabbits, some of these species have been reported in the Project area during the ecological surveys. There are a number of factors that suggest the Project could lead to a short-term increase in predator and pest species activity at least during the construction phase. As the Project will involve increased human activity in a remote location that currently experiences low levels of human activity, this presence may mean more opportunity for food waste and waste disposal, encouraging scavenging. Secondly, the removal of vegetation and habitat will lead to the temporary displacement of native fauna from occupied habitat and present greater opportunity for predation by feral predators exploiting this situation and may lead to increased activity and abundance of predators over the construction phase of the Project.

Refer to **Section 12** for mitigation measures to minimise the potential for increase predator and pest species activity during construction. This includes appropriate removal and storage of waste products generated at construction sites and by construction personnel. Monitoring is proposed to assess any significant change in predator and pest species in proximity to the Project and inform the need for control measures.

10.2.6 Collisions and electrocutions of fauna with transmission lines

Collisions and electrocutions of birds and bats with transmission lines is an uncertain operational impact that must be considered. Transmission lines carry the unique risk of electrocution. The most commonly reported impacts of transmission lines in the literature is the death and injury of birds due to electrocutions and collisions with wires (see Richardson et al., 2017). The reported impacts of transmission lines associated with electrocution and collision include abandonment of territories where the risk of electrocution is high and increase in scavenger activity, and perhaps the population size of scavengers, near transmission lines because of the availability of bird carcasses (see Richardson et al., 2017). While there was no obvious evidence of electrocuted birds or bats noted opportunistically during surveys (although no targeted surveys were undertaken as part of this assessment) under the existing transmission lines in the landscape, there is an increased risk of bird and bat electrocution, particularly to raptors, from the Project.

Transmission lines can be used as a resource by fauna, being used for perching, nesting, roosting, and scavenging of electrocuted birds (Biasotto, & Kindel, 2018). Black Kite, Nankeen Kestrel and Brown Falcon were regularly observed perched on existing transmission lines. The proposed transmission line structures are unlikely to be used as a significant resource for nesting as no evidence of structures being used as a nest site was observed during the survey.

10.2.7 Changed fire regimes during operation

A bush fire risk technical report has been completed as part of the EIS (Jacobs, 2022). Wind farms are not expected to worsen fire behaviour in the landscape, nor create a major ignition risk (AFAC, 2018). As such, the consequences of a given fire in the landscape to receptors outside of the Project area are not changed by the construction and operation and decommissioning of the Project. WTGs may attract lightning strike (one of the major causes of fire in the region). With the WTGs' inbuilt lightning protection, likelihood of fires in the landscape due to lightning strike may decrease.

The construction of the Project will increase the risk of fire ignition, potentially causing fires that have the potential to spread far from the disturbance footprint, particularly grass fires. There is also biodiversity stewardship sites known to occur near the Project area adjacent to Wilson Road where biomass is managed differently compared to surrounding farm land. An altered fire frequency could have a detrimental long-term impact on flora and fauna populations, grassland or woodland structure and weeds. Bird electrocution is a frequent cause of fires in hot climates (Manville, 2005), as are faulty transmission lines.

The fire risk from proposed transmission lines will be managed in accordance with appropriate standard and procedures to minimise the chance of a fire starting.

Current land management practices (grazing sheep on native grassland) is planned to continue throughout the Project area throughout its operational phase. Grazing will contribute to the ongoing mitigation of bush fire risk to the Project through reduction of bush fire fuel across the whole Project area. Prior to and during the bush fire season, these practices should ensure (at least) a mosaic of fuel-reduced areas throughout the Project area, such that there are no large contiguous stretches of high fuel hazard (as per Hines et al., 2010).

Bush fire mitigation measures are provided in the bush fire risk technical report (Jacobs, 2022).

10.2.8 Noise, vibration, and light impacts

Anthropogenic noise can alter the behaviour of animals or interfere with their normal functioning (Bowles, 1997). During all phases of the Project there will be increased noise and vibration levels in the study area and immediate surrounds due to vegetation clearing, ground disturbance, machinery and vehicle movements, and general human presence. The predicted noise and vibration created by the Project is outlined in the EIS. Noise impacts during operation are expected to be minimal and localised to wind turbines, substation, and BESS. The construction of the Project will generally occur from 7am to 6pm and is expected to last 3 years (36 months).

Key sources of noise expected during construction, operation and decommissioning will include:

- Construction and decommissioning traffic – predicted impacts include an increase in noise along access routes. It is concluded that additional traffic movements from Project construction activities are not expected to result in unacceptable changes in traffic noise levels at sensitive receivers along the intended access routes, however this will result in increased impacts in the immediate surroundings of the Project
- Construction vibration – vibratory rollers and truck movement
- Operational wind turbine - predicted to produce different sound power levels with wind speed. Other factors, including the size of the turbines will also influence noise. These factors, including the sound power levels and noise spectra associated with the turbines.

Based on the information provided above, construction and decommissioning activities will likely result in an increase in ambient noise levels (mainly an increase from current night noise levels) as well as potentially loud noise and vibration for short periods associated with earth works. The noise and vibration from activities associated with the Project will occur periodically over the construction period and will potentially disturb resident fauna and may disrupt foraging, reproductive, or movement behaviours of the short construction life-cycle. During breeding season of hollow-dependent fauna species, some individuals may be disturbed. The impacts from noise emissions are likely to be temporarily localised to the construction areas and immediate surrounds and moving as the construction progresses. These emissions are not considered likely to have a significant, long-term, impact on wildlife populations outside the area of impact. Within the area of impact (including habitats immediately adjacent to the disturbance footprint), some sensitive species (e.g.

woodland birds and hollow-breeding mammals) may avoid the noise and some more tolerant species, including small mammals and birds, will habituate over the longer-term.

Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting (including lights from passing vehicles), that can have potentially adverse effects on wildlife (Longcore and Rich, 2004).

There is potential for night works that will be associated with the construction of the Project. The construction hours will be conducted between 7am to 6pm. During winter, lighting may potentially be required in the early mornings and late afternoons.

During operation, the substations, WTGs and BESS will require security lighting at all hours of the night, including interior and exterior lighting. The external low-level lighting will be installed in a manner that aims to minimise light spill to areas beyond the substation boundary fence, however there is likely to be some small amount of light pollution projected into the surrounding vegetation. The ecological light pollution may potentially affect nocturnal fauna by interrupting their life cycle, such as the Plains-wanderer, microbats and Barn Owl. However, the amount of light spill is expected to be very low and the area around the substations and BESS are already exposed to some level of disturbance from the road and existing easement. It is likely that any nocturnal animals present will habituate over the long-term. Some species such as light tolerant microchiropteran bats may benefit from the lighting due to increased food availability (e.g. insects attracted to lights) around these areas. However, this may also cause a risk of collision with barbed wire security fences.

Given that lighting will be designed and installed to limit light spill, the impact of the residual light spill is unlikely to significantly affect any nocturnal species in the area.

A number of measures are proposed and these are described in **Section 12**. This includes minimising noise from equipment through measures such as keeping both stationary and mobile plant and equipment in good working condition (including mufflers, enclosures etc), and avoid leaving engines running on standby for extended periods of time and selecting equipment with the lowest noise rating that meets task requirements and minimise operating loud machinery conjunctively.

10.2.9 Dust impacts

Elevated levels of dust may become deposited onto the foliage of retained vegetation adjacent to the Project during construction and decommissioning activities, particularly during hot and dry conditions. This has the potential to temporarily reduce the process of photosynthesis and transpiration and cause abrasion and radioactive heating resulting in reduced growth rates and decreases in overall health of the vegetation. Consequently, changes in the structure and composition of plant communities and consequently the grazing patterns of fauna may occur.

Some level of dust is likely to be generated throughout the lifecycle of the Project due to the clearing of vegetation, although dust pollution is likely to be greatest during construction, during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and decommissioning activities and during adverse weather conditions (i.e. high wind). However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary (particularly during the wetter seasons) and is therefore not considered likely to be a major impact of the Project. The likelihood of dust pollution occurring over the long term operational phase is considered very low and negligible.

Adaptive dust management and monitoring programs using industry best practices and standards to control air quality will be implemented as part of the air quality environment mitigation measure in the EIS. No dust generating works will be conducted during high winds and stockpiles will be kept covered with material to prevent the generation of dust in addition to applying water dust suppression techniques during dust generating activities.

10.2.10 Contaminant pollution

During the construction phase, localised release of contaminants (i.e. hydraulic fluids, oils, drilling fluids, etc.) into the surrounding environment (including drainage lines) may accidentally occur. The most likely result of contaminant discharge will be the localised contamination of soil, waterways, and potential direct physical trauma to flora and fauna that come into contact with contaminants. Accidental release of contaminants is likely to be localised.

Control measures will include ensuring that accidental spills are immediately reported and remediated, contaminated water will be separated from stormwater and will be managed in a process water system and on-site signage will be provided to identify contaminated topsoils if relevant.

10.3 Prescribed impacts

This section describes the nature, extent, duration and consequences where relevant for prescribed impact entities identified in **Section 6** in accordance with Section 8.3 of the BAM. Prescribed impacts are assessed on both category 2 and category 1 exempt land. Description of prescribed impact entities relevant to the Project are provided in **Table 10-9**.

Table 10-9. Assessment of impacts on prescribed biodiversity impacts

Prescribed impact entity	Description of impact (nature, extent and frequency)	Consequences	Justification
<p>Human made structures as habitat of threatened species or ecological communities</p>	<p>There is potential for impact of three farm dams at locations with proposed access tracks. Proposed tracks will be established adjacent to farm dams along existing farm tracks. One farm dam will be impacted by underground cabling works. These will likely upgrade existing farm tracks to a width of 5 m and are unlikely to impact farm dam water sources.</p> <p>Nature: There will be a direct loss of non-native vegetation (sometimes native shrubs) on category 1 exempt land.</p> <p>Extent: Track upgrades to a width of 5 m.</p> <p>Frequency: Short term disturbance during construction of track and maintenance during operation</p>	<p>Removal of non-native vegetation around the edge of farm dams that may indirectly affect foraging behaviour of microbats.</p>	<p>Proposed tracks have been placed along existing farm tracks where possible to access wind farm infrastructure. Some of the existing tracks traverse along and adjacent to farm dams. This was designed to avoid native vegetation and higher quality threatened species habitat.</p>
<p>Non-native vegetation as habitat of threatened species or ecological communities</p>	<p>A total 60.29 ha of the disturbance footprint comprises non-native vegetation that is established on cultivated land as exotic grassland and is dominated by annual exotic species (54.71 ha and 5.58 ha in category 1 exempt land and category 2 land, respectively).</p> <p>These areas are not considered suitable habitat for TECs, namely Natural Grasslands of the Murray Valley Plains listed critically endangered under the EPBC Act, which may have once existed in these areas.</p> <p>There is potential for prescribed impacts associated with wind turbine bird and bat strike in non-native vegetation.</p> <p>Nature: There will be a direct loss of non-native vegetation (sometimes native shrubs) on category 1 exempt land and category 2 land.</p> <p>Extent: A total 60.29 ha within the disturbance footprint (all project components)</p>	<p>As a result of the Project, there will be a total loss 60.29 ha of non-native vegetation that provides suitable foraging habitat for some threatened species such as Little Eagle and microbats at locations near water.</p>	<p>Throughout the assessment of the Project opportunities to identify areas of non-native vegetation/cultivated land and lower condition vegetation were prioritised to further avoid and minimise impacts to native vegetation and higher quality threatened species habitat.</p>

Prescribed impact entity	Description of impact (nature, extent and frequency)	Consequences	Justification
Habitat connectivity	<p>Frequency: Short term construction disturbance and long term impacts on foraging during operation of wind turbines.</p> <p>Loss of native vegetation and habitat has potential to affect landscape connectivity permanently or temporarily during operation. While the Project would increase levels of fragmentation within the region, it would not occur to the extent where species or communities are significantly impacted.</p> <p>Nature: Disruption of connectivity due to linear cleared strips of vegetation on the ground and loss of airspace in a very large landscape</p> <p>Extent: Construction of linear infrastructure would contribute to a slight increase in fragmentation of habitats and interrupt connectivity across the landscape to a width of five metres for access tracks and potentially 10 metres for transmission lines.</p> <p>Frequency: Short term construction disturbance and long term impacts on foraging during operation of wind turbines.</p>	<p>Grassland fragmentation and creation of new edges has the potential to interrupt wildlife movement passages for grassland specialists such as the Plains-wanderer. This would be most notable during construction, when species would be discouraged from moving through the Project area.</p> <p>During Project operation, it is expected that native vegetation would recover to the edge of the permanent surface infrastructure naturally, particularly for cable trenches. This impact would be of low magnitude, but mitigation measures to restore habitat connectivity.</p> <p>The operation of wind turbines would reduce the availability of air space for birds and bats flying above 50 m. As discussed in Section 6.1, blade strike collision has potential to substantially disrupt air space movement of birds and bats in the landscape, particularly for animals moving across open grassland between different habitat patches, including migratory species arriving to the location from different directions.</p> <p>It's reasonable to expect that movements of larger water birds, pelicans, egrets, cormorants and other large birds may fly in an east-west direction along major waterways such as Delta Creek and Yanco Creek and then dispersal movements across the landscape from one creek to the next (within direct path of turbines). Wedge-tailed eagles will largely stick to the elevated sandhills where the prey species occur such</p>	<p>The predicted level of isolation from the Project is not likely to be enough to prevent the breeding and dispersal of plant pollinators. The dispersal of plant propagules (seed or other vegetative reproductive material) between habitat patches would continue with little impact for those species with seeds dispersed by wind, larger animal and specialised seed dispersal such as ants. Functional connectivity for many species would remain in the Project area.</p> <p>The use of barbed wire on fencing around the substations and BESS is to be minimised and mitigation will focus on installing highly visible wire and attachments such as metal tags, tapping or cloth material on the existing barbed wire to increase visibility and act as a deterrence technique for in flight fauna.</p>

Biodiversity Development Assessment Report

Prescribed impact entity	Description of impact (nature, extent and frequency)	Consequences	Justification
		<p>as rabbits are, except when dispersing from parents territory, and could travel in any direction. Other raptors recorded have large home range territories with no specific flight paths. However, all species will move from woodland patches (shelter, nesting and perching locations) into the open grassland for hunting daily. Parrots, galahs and cockatoos are locally nomadic and move large distance across the landscape in any direction. White-throated Needle-tail fly ahead of storm fronts, which may also come from any direction.</p>	
<p>Water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities</p>	<p>Changes in soil and hydrologic quality are abiotic impacts that may occur due to the Project. Unmitigated, erosion and contamination of watercourses and ephemeral drainage lines may result from earth movement during construction needed for creation of access tracks and vegetation clearing which will influence water runoff dynamics.</p> <p>Nature: Impacts may occur in the following ways:</p> <ul style="list-style-type: none"> ▪ There is potential for release of poor-quality sediment laden water into watercourses within and adjacent to the disturbance footprint when there are rainfall events during construction, particularly near creek banks and depressions ▪ There is potential for a reduction in stream bank stability following vegetation removal/trimming for construction of transmission lines, resulting in bank erosion and sedimentation of watercourses near Yanco Creek ▪ There is potential for increased water flow into the waterways resulting from vegetation removal and access track construction (channelling of water) and increased erosion. 	<p>The Project may have impacts on water quality, water bodies and hydrological processes that sustain threatened species, in particular the Murray Cod and Silver Perch (which have potential to inhabit the Yanco Creek) and Flathead Galaxias which is to occur in Delta Creek, Yanco Creek and Turn Back Jimmy Creek.</p> <p>The discharge of fine sediments and contaminants are likely to be short 'pulse' events and the fine sediments would be rapidly flushed out of the system. This would most likely result in negligible impact to threatened species such as the Murray Cod and Silver Perch and Flathead Galaxias.</p>	<p>The direct removal, lopping or trimming of woodland trees is minimal and is been minimised to reduce impacts on waterways.</p> <p>A Construction Soil and Water Management Plan (CSWMP) will be prepared and implemented in consultation with BCS. This forms part of the environment management measures in the EIS. The plan will include stringent controls to mitigate impacts of runoff and sediment transfer from the Project area during construction and operation.</p>

Prescribed impact entity	Description of impact (nature, extent and frequency)	Consequences	Justification
	<p>This impact may also occur during operation if access tracks are not correctly designed with erosion protection measures</p> <ul style="list-style-type: none"> There is potential for accidental release of contaminants during construction and maintenance (i.e. chemicals, fuel, oil, hydraulic fluid) that could result in the release of hydrocarbons and metal contaminants into watercourses. <p>Extent: Limited direct impacts on woodland. Potential indirect impacts to waterways if not mitigated appropriately.</p> <p>Frequency: Short term reductions in water quality and mobilisation of fine sediments into watercourses within and adjacent to the disturbance footprint during construction and operation is unlikely to result in any long-term detrimental impacts to the aquatic environments.</p>		
<p>Wind turbine strikes on protected animals</p>	<p>Nature: The wind turbines and associated infrastructure would have various impacts on protected fauna species. Impacts to aerial species include direct strike, loss of air space, disruption to movement and potentially barotrauma.</p> <p>Extent: Impacts are likely to occur across the entire study area where wind turbines occur</p> <p>Frequency: long term impacts during the operation of the project</p>	<p>Moderate ongoing direct and indirect impacts parrots, raptors, waterbirds, migratory species. The collision risk assessment identified the following species with a moderate to high risk rating:</p> <ul style="list-style-type: none"> Black Kite Black-shouldered Kite Brown Falcon Brown Goshawk Galah Little Eagle Little Raven Nankeen Kestrel Painted Honeyeater Tree Martin Wedge-tailed Eagle White-bellied Sea Eagle Whistling Kite 	<p>Avoidance and minimisation measures were implemented to minimise the risk of blade strike on fauna. This included a reduction of WTGs from 245 to 208.</p> <p>During the development of the Project, considerable attention and flexibility was given to the avoidance of the important local habitats. The outcomes of the constraints assessment, ongoing field surveys and advice from BCS of DPE identified the following key biodiversity values that have been avoided and impacts minimised to the greatest extent possible. The Project has been designed to position wind turbines at locations at least 100 metres away from biodiversity habitat features that attract interactions with protected fauna and threatened fauna. This included:</p> <ul style="list-style-type: none"> Stick nests and hollow bearing trees where possible, particularly large stick nests used by Wedge-tailed Eagle Riparian corridors

Prescribed impact entity	Description of impact (nature, extent and frequency)	Consequences	Justification
		<ul style="list-style-type: none"> ▪ White-browed Woodswallow ▪ White-faced Heron ▪ Black Falcon ▪ Spotted Harrier ▪ Square-tailed Kite ▪ Superb Parrot ▪ White-throated Needletail 	<ul style="list-style-type: none"> ▪ Eucalypt woodland edges, where possible ▪ Permanent waterbodies or lying depressions/Lignum swamps. <p>A detailed bird and bat collision risk assessment was completed as part of this BDAR to identify those fauna species at greatest risk of blade strike impacts. Blake strike collision may impact numerous bird and bat with a moderate to high risk rating and affect their home range, their dispersal and genetic exchange in the landscape. A Bird and Bat Adaptive Management Plan will be developed for the Project and will aim to address the prescribed impact associated with fauna mortality from blade strike and uncertainty of consequences on regional aerial fauna populations. The strategy will continue to be developed during detailed design and form part of the Biodiversity Management Plan.</p>
<p>Vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community</p>	<p>Vehicular activity within the study area and on external roads accessing the site will increase during construction in associated TECs:</p> <ul style="list-style-type: none"> ▪ Natural Grasslands of the Murray Valley Plains listed as critically endangered under the EPBC Act ▪ Weeping Myall Woodlands listed as endangered under the EPBC Act ▪ Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed as endangered under the BC Act ▪ Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered under the BC Act. <p>Nature: All protected mammals, reptiles, amphibians, and birds are all at risk of vehicle strike, particularly those common species (e.g. macropods) that are tolerant of disturbance</p>	<p>Vehicle collision is a direct impact that reduces local population numbers and is a common occurrence in Australia. There are a range of known and potential threatened fauna (mainly birds) that are part of TECs in the study area with possible risk of vehicle strike and include:</p> <ul style="list-style-type: none"> ▪ Plains-wanderer ▪ Painted Honeyeater ▪ White-fronted Chat ▪ Dusky Woodswallow ▪ Grey-crowned Babbler ▪ Brown Treecreeper ▪ Diamond Firetail ▪ Flame Robin. <p>It is likely that some sedentary animal species that live in these habitats will not be accustomed to roads or vehicles. It is also likely that the newly created access tracks through the habitats will provide an</p>	<p>Vehicles will be introduced into relatively remote areas of the study area, however vehicle presence and speeds may vary depending on the type of access road and its location in native vegetation and habitat. The mitigation measure BIO27 imposes a 40 km speed limit on proposed access tracks.</p>

Prescribed impact entity	Description of impact (nature, extent and frequency)	Consequences	Justification
	<p>and/or those species that can utilise roadways for movement pathways or as foraging habitat. Rare species and low-density populations of species will have a low risk of a serious impact with the management of potential vehicle strike.</p> <p>Extent: Construction of linear infrastructure would contribute to a greater risk in vehicle collisions in adjacent habitats across the landscape, including on proposed 5m wide access tracks and existing roads.</p> <p>Frequency: There is a chance of fauna injury and mortality during the construction, operation and decommissioning of the Project through vehicle collision (i.e. roadkill). Once the Project has been constructed, vehicle movements will be considerably reduced. However, it is not considered likely that this would result in a significant number of vehicle strikes on threatened species or parts of a TEC.</p>	<p>attraction point to some species increasing the potential for vehicle strike.</p>	

10.4 Summary of uncertain impacts

The above description and analysis of impacts from the Project has identified direct, indirect, and prescribed impacts. In some instances the extent, duration and consequence of the impact is uncertain and the management and monitoring of these is important and is a focus of the mitigation and monitoring strategy outlined in the following section of the BDAR. These uncertain impacts may include:

- It is expected that the clearing of vegetation along long linear edges and broad parts of the disturbance footprint may lead indirectly to weed invasion within adjoining intact vegetation where weeds currently don't exist. Similarly, the current vegetation integrity may experience decline in edge effected areas for the PCTs represented. In both instances the distance of this edge effect is predicted to extend between 20-50 m, however this is largely unknown and the degree to which vegetation integrity declines is unknown. These data will be used to inform a decline in vegetation integrity beyond a set performance threshold, whereby further offsets may be required
- The clearing of habitat along the long linear edges and broad parts of the disturbance footprint may lead to indirect impacts (e.g. edge effects and weed invasion) to certain populations of threatened species that are present or using habitat adjoining the disturbance footprint, such as the Plains-wanderer, *Swainsona murrayana* and *Swainsona sericea*. While measures are proposed to mitigate the impact, the effectiveness of these should be monitored and tested relative to undisturbed habitats not impacted by the (control areas). Corrective actions will apply where mitigation measures are found to be in-effective and impacts are identified beyond set performance thresholds
- The installation of WTGS and powerline infrastructure may lead to an indirect impact on bird and bat populations through collision and electrocution of animals identified in the BDAR as being at risk. A Bird and Bat Adaptive Management Plan (BBAMP) will be prepared to measure any impacts on bird and bats species to address the prescribed impacts associated with blade strike and powerline collisions and will develop trigger levels designed to manage impacts during the operation of the Project (See **Section 12**).

The management of these uncertain impacts requires the development of an adaptive management plan with the aim of adjusting actions based on results to achieve specified outcomes. Details of the proposed monitoring and adaptive management framework for all potential impacts is provided in **Section 12**.

10.5 Cumulative impacts

There are 11 energy-related Projects within 130 kilometres of the Project. Most of the projects are also part of the South-West REZ , and are considered relevant to the cumulative impact assessment due to their proximity, and potential adverse effects on the local and regional biodiversity.

The potential biodiversity impacts of the Project must be considered as a consequence during construction and operation within the existing environment. The Project will not act alone in causing direct and indirect impacts to biodiversity, including prescribed impacts of wind farm bird and bat blade strikes. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the Project within a strategic context.

The level of vegetation and habitat clearing for other Projects is unknown as many are still in planning approval stage. The regional area is known to contain high biodiversity conservation values, including TECs and threatened species habitat recorded for this Project. Therefore it's likely that cumulative impacts will increase the loss of similar native vegetation and threatened species habitat in the region.

The cumulative impacts to biodiversity in the region were further assessed by identifying the expected loss of vegetation and TECs associated with the EnergyConnect (Eastern) project (refer to **Table 10-10**). The project is located within a regional landscape that is dominated by native vegetation and is this trend of vegetation and habitat removal is likely to continue in the short and long term at this location with current and future project. The removal of vegetation for this project would contribute to the cumulative loss of vegetation in the surrounding landscape. The Project would involve removal of around 173.39 hectares of native vegetation, of which 129.70 hectares are TECs. In addition to this there is an estimated 1,554.88 hectares of native vegetation of which 133.20 hectares are TECs that are similar to the Project and are also proposed for removal associated with the EnergyConnect (Eastern) project. This is a conservative estimate only based on publicly available information.

The Project would have one or more construction access routes overlap with nearby Projects. Increased traffic of planners, construction workers and operators of other Projects would likely increase the risk of vehicle strike on native fauna in the region.

Table 10-10. Potential cumulative biodiversity impacts

Project	Brief project description	Location	Potential cumulative biodiversity impacts
Approved projects			
Project EnergyConnect (Eastern) Approved	Construction and operation of a high voltage interconnector between NSW and SA. The transmission project's eastern section includes new transmission lines between Wagga Wagga and Buronga, with a new Dinawan Terminal Station to be located next to Kidman Way about 55 km south of Darlington Point.	11 km east of the Project area and would connect to Dinawan Terminal Station (the same connection point as the Project) <u>Located partially within the South-West REZ</u>	<p>Direct impacts on 1,554.88 hectares of native vegetation. Impacts on threatened biodiversity for this project are shown below.</p> <p>TECs:</p> <ul style="list-style-type: none"> 101.21 hectares of Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions listed as endangered under the BC Act 31.99 hectares of Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered under the BC Act. <p>Threatened flora:</p> <ul style="list-style-type: none"> 71.17 hectares of habitat for <i>Brachyscome papillosa</i> (Mossgiel Daisy) – listed as vulnerable under the BC Act and EPBC Act (18.69 hectares of area of occupancy and 52.48 hectares of assumed habitat) 50.31 hectares of assumed habitat for <i>Cullen parvum</i> (Small Scurf-pea) – listed as endangered under the BC Act. (50.31 hectares of assumed habitat) 7 hectares of habitat for <i>Lepidium monoplocoides</i> (Winged Peppercress) – listed as endangered under the BC and EPBC Act (0.20 hectares of area of occupancy and 6.8 hectares of assumed habitat) 15.32 hectares of habitat for <i>Leptorhynchos orientalis</i> (Lanky Buttons) – listed as endangered under the BC Act (0.63 hectares of area of occupancy and 14.69 of assumed habitat) — 109.68 hectares of habitat for <i>Maireana cheelii</i> (Chariot Wheels) – listed as vulnerable under the BC Act and EPBC Act (7.01 hectares of area of occupancy and 102.67 of assumed habitat) 8.62 hectares of habitat for <i>Pilularia novae-hollandiae</i> (Austral Pillwort) – listed as endangered under the BC Act (0.32 hectares of area of occupancy and 8.62 hectares of assumed habitat) 232.35 hectares of habitat for <i>Swainsona murrayana</i> (Slender Darling Pea) – listed as vulnerable under the BC Act and EPBC Act (80.67 hectares of area of occupancy and 80.67 hectares of assumed habitat) 109.17 hectares of habitat for <i>Swainsona sericea</i> (Silky Swainson-pea) – Vulnerable (10.32 hectares of area of occupancy and 98.85 hectares of assumed habitat). <p>Threatened fauna:</p> <ul style="list-style-type: none"> 0.41 hectares of habitat for <i>Pedionomus torquatus</i> (Plains-wanderer) – listed as endangered under the BC Act and EPBC Act 4.77 hectares of habitat for <i>Myotis macropus</i> (Southern Myotis) – listed as vulnerable under the BC Act.

Biodiversity Development Assessment Report

Project	Brief project description	Location	Potential cumulative biodiversity impacts
Micro Solar Farm Approved	Construction and operation of a 5 MW micro solar farm and associated infrastructure, located within the Coleambally Irrigation Area.	54 km north-east of Project area	No impacts on biodiversity
Riverina and Darlington Point BESS Approved	Construction and operation of a combined 150 MW/300 MWh three independent but co-located BESS projects.	55 km north-east of Project area	Direct impact to Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45) moderate to good moderate Direct impact to Black Box grassy open woodland wetland of rarely flooded depressions in south western NSW (PCT 16) moderate to good - moderate
In planning – Scoping report available			
Baldon Wind Farm In planning – SEARs issued	Construction, operation and maintenance of a wind farm with up to 162 WTGs, BESS and associated infrastructure.	117 km west of Project area <u>Located within the South-West REZ</u>	TECs considered to likely or potentially occur: <ul style="list-style-type: none"> Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions Threatened species considered to likely or potentially occur: <ul style="list-style-type: none"> Brachyscome papillosa Maireana cheelii Southern Bell Frog Spotted Harrier White-fronted Chat White-bellied Sea-Eagle Major Mitchell's Cockatoo Plains-wanderer Painted Honeyeater.
Keri Keri Wind Farm In planning – SEARs issued	Construction, operation and maintenance of a wind farm with up to 176 WTGs, BESS (up to 200 MW/800 MWh) and associated infrastructure.	128 km west of Project area <u>Located within the South-West REZ</u>	Threatened biodiversity considered to likely or potentially occur: <ul style="list-style-type: none"> <i>Brachyscome papillosa</i> <i>Maireana cheelii</i> <i>Lepidium monoplocoides</i> Plains-wanderer Southern Bell Frog Natural Grasslands of the Murray Valley Plains TEC.
Coleambally BESS	Construction and operation of a 100 MW/200-400 MWh BESS including ancillary infrastructure in Coleambally,	42 km north-east of the Project area	Biodiversity considered to likely or potentially occur: <ul style="list-style-type: none"> Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (BC Act)

Biodiversity Development Assessment Report

Project	Brief project description	Location	Potential cumulative biodiversity impacts
In planning – SEARs issued	NSW. The BESS footprint would be about four hectares and is located near Kidman Way with proposed transmission connection to the Transgrid Coleambally substation.		<ul style="list-style-type: none"> Weeping Myall Woodland (EPBC Act) Plains Grassland on Alluvial mainly clay soils in the Riverina Bioregion of NSW South Western Slopes (PCT 45).
Woodland BESS In planning – SEARs issued	Construction and operation of a 200 MW/800 MWh BESS located about 10 km south of Darlington Point. This project is located next to the Darlington Point Solar Farm.	55 km north-east of Project area	Threatened biodiversity considered to likely or potentially occur: <ul style="list-style-type: none"> 5 TECs 17 Threatened species and 9 migratory species.
Keri Keri Solar Farm In planning – SEARs issued	Solar farm with a maximum installed capacity of 500 MW _p (MW-peak) and an alternating current capacity of up to 400 MW _n (MW-nominal). The project will also include ancillary infrastructure.	128 km west of Project area <u>Located within the South-West REZ</u>	Threatened biodiversity considered to likely or potentially occur: <ul style="list-style-type: none"> <i>Brachyscome papillosa</i> <i>Maireana cheelii</i> <i>Lepidium monoplocoides</i> Plains-wanderer Southern Bell Frog Natural Grasslands of the Murray Valley Plains TEC.
Announced			
Victoria to NSW Interconnector West (VNI West) Announced, pre-scoping phase	A new interconnector between Victoria and NSW including a series of high voltage transmission lines and terminal stations that links the regions of Murray River, Western Victoria, South-West NSW. The VNI West transmission route is indicated to link the Dinawan substation to Kerang, Bendigo and Ballarat, where the Western Victoria Transmission Network Project would be constructed. The transmission route is not yet finalised.	Transmission route may intersect the Project area near Mabins Well Road, Moonbria Road and Wilson Road <u>Located within the South-West REZ</u>	Not yet assessed.
Bullawah Wind Farm Announced, pre-scoping phase	Construction, operation and maintenance of a wind farm with up to 170 WTGs (up to 300 metres tip height), BESS and associated infrastructure. The project will have a capacity of 1000 MW.	16 km north-west of Project area <u>Located within the South-West REZ</u>	Not yet assessed.

Biodiversity Development Assessment Report

Project	Brief project description	Location	Potential cumulative biodiversity impacts
Dinawan Energy Hub Announced, pre-scoping phase	Construction and operation of a hybrid wind, solar and battery storage project, with capacity up to 2.5 GW, to be located between Coleambally and Jerilderie, west of the Kidman Way. The energy hub would connect to Project EnergyConnect.	Adjacent to the Project area northern boundary <u>Located within the South-West REZ</u>	Not yet assessed.

11. Serious and irreversible impacts

The concept of serious and irreversible impacts (SAIL) is fundamentally about protecting threatened entities that are most at risk of extinction from potential development. The BOS recognises that there are some types of serious and irreversible impacts that the community expects would not occur except where the consent authority considers that this type of impact is outweighed by the social and economic benefits that a development will deliver to the State.

The four principles for determining SAIL are outlined in clause 6.7 of the Biodiversity Conservation Regulation 2017 (BC Regulation). The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community. The principles include:

- Principle 1- species or ecological community currently in a rapid rate of decline
- Principle 2 – species or ecological community with a very small population size
- Principle 3 – species or area of ecological community with very limited geographical distribution
- Principle 4 – species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

The BC Act permits the Minister for Planning to give consent to or approve State Significant Development which is likely to have serious or irreversible impacts. The Minister must take those impacts into consideration and determine whether there are any additional and appropriate measures that will minimise those impacts if consent or approval is to be granted.

Entities at risk of an SAIL relevant to the Project and as identified by the BAM-C are provided in **Table 11-1** below. All threatened entities have been evaluated against the principles and criteria set out in subsection 9.1.2 of the BAM for each species. The reason for inclusion in SAIL assessments are summarised below, and the full assessments are provided in **Appendix I**. No important area mapping occurs within the Project area for the Swift Parrot and Regent Honeyeater, both SAIL entities. These species are only classed as ecosystem credit species for this assessment and are excluded from the SAIL assessment.

Table 11-1. Entities at risk of an SAIL

Species name	Common name	Reason for inclusion in the assessment
<i>Brachyscome muelleroides</i>	Claypan Daisy	<ul style="list-style-type: none"> ▪ Only a single significant known population exists at Morundah Station in NSW (about 20,000) about 65 kilometres east of the Project area ▪ A total of 23.57 hectares of suitable habitat (habitat area not surveyed with suitable habitat) occurs within the disturbance footprint and would be impacted directly, which equates to about 13.1% of the area of occupancy for the species (1,000 hectares) within NSW. The species was not able to be confirmed by survey, and this impact represents assumed presence in suitable habitat. If present, a population would occupy a small portion of this area.
<i>Caladenia arenaria</i>	Sand-hill Spider orchid	<ul style="list-style-type: none"> ▪ The species is currently only known from two locations in NSW and has a with a total population of about 25 individuals in 2021 ▪ The species has limited capacity to regenerate after a decline ▪ A total of 1.49 hectares of suitable habitat (habitat area not surveyed with suitable habitat) occurs within the disturbance footprint and would be impacted directly, which equates to about 1.028% of the area of occupancy for the species (1000 hectares) within NSW. The species was not able to be confirmed by survey and this impact represents assumed presence in suitable habitat. If present, a population would occupy a small portion of this area
<i>Convolvulus tedmoorei</i>	Bindweed	<ul style="list-style-type: none"> ▪ Populations sizes in NSW are estimated to be between <50 individuals to <250 individuals where threats are known ▪ It is difficult to estimate the decline in the species population size in NSW due to a lack of ecological and distributional information

Biodiversity Development Assessment Report

Species name	Common name	Reason for inclusion in the assessment
		<ul style="list-style-type: none"> ▪ A total of 12.27 hectares of suitable habitat (habitat area not surveyed with suitable habitat) occurs within the disturbance footprint and would be impacted directly. The species was not able to be confirmed by survey and this impact represents assumed presence in suitable habitat. If present, a population would occupy a small portion of this area.
<i>Pedionomus torquatus</i>	Plains-wanderer	<ul style="list-style-type: none"> ▪ The vast majority (>99%) of records of Plains-wanderers in NSW now come from an area of the western Riverina ▪ There is estimated to be only 300 birds remaining in NSW ▪ The Project would directly impact on around 1.78 hectares of mapped habitat for the species, which equates to 0.0054 % of the area of occupancy (33 000 hectares) in NSW for the species.

12. Mitigation and managing impacts

While direct impacts are easily quantified and controlled by managing the extent of clearing within the Disturbance footprint, the indirect impacts are subject to the efficacy of implemented environmental controls. As such, direct impacts are defined during Project design, whereas indirect impacts are mitigated through effective environmental management during construction and associated with an adaptive management strategy. The following section outlines measures to minimise, mitigate and monitor the predicted impacts to biodiversity that are described in **Section 10.1** of the BDAR.

These measures form the basis and framework for development of a Project specific Biodiversity Management Plan (BMP) that will include a biodiversity monitoring program to be developed post-approval. The measures outlined in this section provide a framework for developing the BMP. The BMP will expand on, and provide more specific detail on the biodiversity mitigation measures described herein which have been devised for the protection and monitoring of biodiversity, individual threatened species, and their habitat.

The BMP will be based on SMART principals (Specific, Measurable, Achievable, Realistic, and Timebound) and will include details of a biodiversity monitoring and reporting program designed to monitor the performance of the mitigation measures proposed. The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. The BMP will include a program to evaluate and publicly report on the outcomes of such monitoring.

12.1 Mitigation measures

Proposed mitigation measures are documented in **Table 12-1** which includes details of the proposed action or technique, timing, frequency, and responsibility for implementing each measure.

Table 12-1. Proposed biodiversity mitigation measures

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
Biodiversity							
Detailed design to avoid and minimise clearing of vegetation and habitat for threatened species (Section 9.1)	BIO1	Detailed design of the Project will avoid and minimise the loss of vegetation and habitat and movements of fauna across the landscape and to minimise the impact of predation on displaced fauna. Final design for access roads across waterway crossing (including creeks and drainage lines) will implement a design option to ensure stream flow is unaffected. Design and micro-siting of access tracks and cabling will avoid and minimise impacts to breeding habitat for fauna, including threatened species, and avoid mapped habitat trees. Threatened species habitat buffers and nest tree buffers show locations of known or potential threatened species habitat that will be avoided and minimised during detailed design. These maps will inform the induction of construction teams as required for future construction and operational management plans. Access track and cabling corridors will be established with consideration to terrain (e.g. utilisation of the existing tracks and flat areas on slightly higher elevations) to minimise newly created tracks, tracks through depressions and additional vegetation clearing.	Avoid and minimise clearing of vegetation and habitat during Project planning	Detailed design, Project survey and pre-construction	The Proponent	Known and proven effective	All zones
	BIO2	Habitat buffer maps (refer to Section 6.4 of the BDAR) will inform the induction of construction and maintenance teams as required for the Construction Environment Plan (CEMP) and Operational Environmental Management Plan (OEMP)					
	BIO3	Final design for access tracks across waterway crossings (including creeks and drainage lines) will implement a design option to ensure stream flow is unaffected.		Detailed design			

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
Removal of native vegetation, TECs and habitat (Section 10.1.1 and 10.1.2)	BIO4	<p>A Biodiversity Management Plan (BMP) will be prepared and approved prior to construction. The BMP will be prepared by a qualified ecologist in consultation with BCS and include a plan for implementing, evaluating and reporting on the effectiveness of all mitigation measures but not be limited to these measures. The BMP will be implemented for all stages of the Project (pre-construction, construction and operation. The overarching framework of the BMP will be based on SMART principals (Specific, Measurable, Achievable, Realistic, Timebound) and will focus on monitoring the performance of proposed measures and informing an adaptive management approach based on performance triggers for remedial action or additional offsets where further impacts are identified. The BMP will detail required mitigation actions for the Project for all biodiversity, including indirect, prescribed and uncertain impacts. The actions are to be prepared in consultation with BCS and endorsed by BCS.</p> <p>The BMP will include a program to monitor, evaluate and publicly report on the outcomes of a biodiversity monitoring program (refer Section 12.2). The BMP will stipulate objectives for monitoring, and how baseline data will be captured and represented.</p> <p>The operational management component of the BMP will be prepared in consultation with BCS and approved prior to clearing.</p> <p>The CEMP will replicate the requirements detailed in the BMP for all safeguards /mitigation measures particularly pre- clearing and clearing during construction.</p>	Avoid, minimise, and mitigate impacts to biodiversity through planning and active management	Pre-clearing, construction and operation	The Proponent and contractors	Known and proven effective measure	All zones
	BIO5	<p>A Rehabilitation Plan (RP) will be prepared and approved prior to clearing in consultation with BCS. The Rehabilitation Plan will inform the implementation of rehabilitation within the disturbance footprint. Areas requiring rehabilitation will be identified in the final detailed design and include areas disturbed during construction that are not required to be maintained or cleared for the operation of the Project, such as backfilled trenches for cabling, and transmission lines.</p>	Avoid soil erosion and invasion of weeds in disturbed areas and their spread in adjoining edges of	Developed pre-construction and implemented pre-clearing, during and post construction	The Proponent and contractors	Known and effective measures	All zones

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<p>The plan will comprise:</p> <ul style="list-style-type: none"> ▪ Implementation of soil erosion prevention, re-establishment of local expression of the original/adjacent plant community type, use local native plant species and habitat and outline the details of rehabilitation objectives and how their outcomes for success will be measured, locations, target landforms and plant community types ▪ Restoration of riparian vegetation (i.e. weed control) will be implemented to protect and improve key habitat areas, where relevant ▪ A program for adaptive monitoring of specific success measures and reporting and include a Trigger Action Response Plan (TARP); including notification to BCS that remedial actions have been triggered and agreement about the response ▪ Landscaping of pervious surfaces using native indigenous species only ▪ Soil loss will be prevented by immediate stabilisation of exposed surfaces (e.g. use of Jute mesh and/or soil binder) ▪ Ongoing maintenance of the rehabilitation work will be required, including management of weeds and pathogens ▪ Topsoil and subsoil generated during construction will be stockpiled separately on-site to be used for rehabilitation. Stockpiles will be managed according to best management practices (Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom, 2004). 	native vegetation				
	BIO6	<p>Pre-clearing Process: the BMP will provide detail of necessary mitigation measures for harm to live animals and threatened hollow dependent fauna during/all pre-clearing survey and translocation activities. This includes, but is not limited to:</p>	Avoid, minimise, and mitigate impacts to biodiversity	Pre-clearing	The Proponent and contractors	Known and proven effective measure	All zones

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<ul style="list-style-type: none"> ▪ Pre-clearing surveys to be conducted with a suitably qualified and licenced wildlife handler to rescue and re-locate fauna ▪ Protocol for the removal of hollow bearing trees or stick nests - hollow inspection /lowering limbs to the ground using cherry picker ▪ Protocol to mitigate harm to hollow or stick nest dependant threatened fauna or known or with potential to be utilising breeding habitat in the Project area and disturbance footprint, e.g. Superb Parrot and Little Eagle. <p>The pre-clearing process will include two stages:</p> <ul style="list-style-type: none"> ▪ Stage 1 will include survey and translocation of any fauna from the disturbance footprint into areas of retained vegetation prior to construction. This may include detailed markup of threatened species locations and their translocation such as <i>Swainsona murrayana</i>. All work must be carried out by qualified ecologists. ▪ Stage 2 will include final inspections of the disturbance footprint immediately before the construction activity commences to check and physically mark any important habitat features that need to be considered when identifying exclusion zones and conducting the staged habitat removal process within the full and partial clearing zones. Document, mark and record the location of: <ul style="list-style-type: none"> - Large stick nests - Habitat/hollow-bearing trees - Threatened flora. <p>The outcomes of the pre-clearing inspections will be reported to BCS prior to the commencement of vegetation clearing. The report will include any fauna relocated or euthanised, including name of qualified/licensed handler, species, location notes, and release location and method.</p>					
	BIO7	<p>Exclusion Zones: The boundary of the clearing limits for the disturbance footprint will be clearly marked on site by a surveyor before vegetation clearing commences. Specific exclusion zones (habitat buffers) will</p>	Avoid, minimise, and mitigate	Pre-clearing, construction and early operation	The Proponent and contractors	Known and proven	All zones

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		include known areas of threatened flora populations (<i>Swainsona murrayana</i> and <i>Swainsona sericea</i>) Plains-wander important area mapping, Southern Myotis and the edge of the clearing boundary will be marked with high visibility fencing and signage.	impacts to biodiversity			effective measure	
	BIO8	<p>Staged Habitat Removal: the staged habitat removal process is required for removal of habitat (hollow-bearing trees, habitat trees, stick nests). Staged habitat removal minimises direct impacts on fauna by providing them with an opportunity to vacate hollows and relocate naturally. The process includes:</p> <ul style="list-style-type: none"> ▪ Avoiding clearing during times when hollow-dependent fauna are breeding ▪ Contact vets and wildlife carers before works commence ▪ Ensure that licensed wildlife carers and/or ecologists are on site during habitat removal ▪ Adopt two staged removal clearing non-habitat first (e.g. shrubs, regrowth, ground cover and non-habitat trees) and allowing at least 24 hours for fauna to vacate habitat before removing habitat trees ▪ Ensure wildlife carers and/or ecologists are present during removal of habitat trees, and that habitat trees are felled carefully, using equipment that allows habitat trees to be lowered to the ground with minimal impact ▪ A procedure for the ethical handling of injured or displaced fauna is to be documented in the BMP ▪ Record the effort and outcomes of the habitat removal process ▪ Save and reuse cleared material for rehabilitation and habitat ▪ Preparation of an 'Unexpected threatened species finds procedure' to be implemented during construction and operation that will apply to all activities that have potential to impact upon threatened flora and fauna species which have not already been assessed and 	Avoid, minimise impacts to fauna during clearing and construction	Construction	The Proponent and contractors	Known and proven effective measure	All zones

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<p>approved. Any threatened entities found in a location previously unknown during construction or operation must be immediately notified to BCS</p> <ul style="list-style-type: none"> Preparation of a Fauna handling and rescue procedure to be implemented during construction and operation. 					
	BIO9	<p>Clearance of native vegetation and habitat prior to start of daily construction to ensure there is no wildlife present. This will involve:</p> <ul style="list-style-type: none"> An on-foot pre-clearing survey by a suitably qualified ecologist A regular drive through sweep of areas planned for construction by the contractors environmental representatives. <p>If an animal is located within the construction area during work, the Delivery Manager and Project Management Site Representative are to be notified immediately. All work must immediately cease within the immediate area of the find and a local wildlife rescue or an ecologist will be required for assistance where necessary.</p>	Avoid, minimise impacts to fauna during clearing and construction	Construction	The Proponent and contractors	Known and proven effective measure	All zones
Increase in weeds and disease pathogens in adjacent vegetation (Section 10.2.4)	BIO10	<p>Weed monitoring and control programs are to be documented in the BMP and Trigger Action Response Plan as part of the CSWMP and in consultation with BCS and any deviation from measures approved by DPE are to be raised and approved. Additional monitoring and control measures for introduced plant introduction and spread should be implemented at and around locations used for sediment control structures. Monitoring of exotic plants with waterborne propagules and a Trigger Action Response Plan for control must be undertaken along drainage lines outside the Project area in locations where runoff drains from the construction site, and from locations where sediment control has failed. The program will include adaptive management strategies for priority weed species during construction, and early operational phase. The details of the monitoring program will be determined during the preparation of the BMP and follow the principles outlined in Section 12.2.</p>	Control spread of weed from the Project	Pre-construction, construction, operation	The Proponent and contractors	Known effectiveness	All zones

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
	BIO11	Identify, map, and remove all weeds before clearing for construction, and record location of weed and sprayed area for use in ongoing weed monitoring and management programs, particularly for <i>Lycium ferocissimum</i> .					
	BIO12	A vehicle and machinery hygiene strategy will be prepared and implemented during construction and operation. The strategy will include specific locations, timing and methods for removing soil and plant matter from vehicles and machinery. Ensure vehicle and machinery hygiene measures in the strategy are applied during construction and operation.					
	BIO13	During the clearing works, weeds will be disposed and managed appropriately to stop the spread of weed species.					
	BIO14	Wash down stations will be constructed at suitable locations to wash down vehicles and employee shoes to stop the spread of weeds, pathogens (including agricultural weeds, amphibian chytrid fungus, <i>Phytophthora cinnamomi</i> and exotic rust fungi) and the introduction of new species.					
Increase in predatory and pest species (Section 10.2.5)	BIO15	Personal waste / refuse generated during construction or operation will be stored appropriately in inaccessible bins and disposed in an appropriate waste facility.	Control attraction of introduced predators and pests to the construction area	During construction and operation	The Proponent and contractors	Known effectiveness	All zones
	BIO16	A feral animal monitoring program will be developed and implemented based on performance triggers for adaptive management. It will be important to share data with landholders. Increased predator activity will trigger the need for predator control based on performance measures to be outlined in the BMP. Control will be done in consultation with Host Landowners.					

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
<p>Impacts of wind farm strikes on protected animals (Section 10.3)</p> <p>Increase in risk of electrocution and EMF exposure (Section 10.2.6)</p>	<p>BIO17</p>	<p>A Bird and Bat Adaptive Management Plan (BBAMP) will be prepared as part of the BMP to measure any impacts on bird and bats species. The plan is a key mitigation measure to address the prescribed impacts associated with blade strike impacts and will develop trigger levels designed to manage impacts during Project operation . The plan will provide guidance for developing a framework for monitoring impacts, including baseline and ongoing monitoring.</p> <p>The BBAMP will utilise the bird survey data for this Project to identify specific bird and bat species that are at risk of collision with overhead cabling and power lines or the transmission line and electrocution. For higher risk species, a strategy will be developed in consultation with BCS focused on identifying key sections of overhead cabling and power lines or the transmission line where mitigation is required and will include deploying bird divertors, with day/night reflectors within approved buffer distance. This will be appropriate for diurnal and nocturnal birds</p> <p>The plan will include the following in consultation with BCS:</p> <ul style="list-style-type: none"> ▪ Regular monitoring in overhead cabling and power lines or the transmission line easements for evidence of bird / bat collision (intervals to be determined in consultation with BCS) ▪ Monitoring of taller structures for evidence of raptor nest building ▪ Developing target trigger for number of high risk species incidents ▪ Deploying species specific bird / bat divertors / flappers / reflectors in areas where a defined number of incidents have occurred. ▪ Identifying locations for specific measures and the monitoring method for testing effectiveness 	<p>Monitoring</p> <p>Minimise fauna blade strike collision</p>	<p>During construction and operation</p>	<p>The Proponent</p>	<p>Likely effectiveness with management and adaptive response approach</p>	<p>All zones</p>

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
Fragmentation resulting in reduced connectivity (Section 10.3)	BIO18	The barbed wire/razor wire fencing installed around the substation switchyard will have improved visibility measures installed, such as adding visible objects to the fence, for example metal tags, tapping or cloth material on the existing barbed wire to increase visibility and act as a deterrence technique for in flight fauna.	Avoid, minimise impacts from loss of connectivity, and movements of fauna Monitoring	Construction	Contractor	Known and proven effective measure	All zones
Wildlife impacts from vehicle strike (Section 10.3)	BIO19	Vehicle movements on newly formed access tracks will be limited to 40 km/h speed limit to reduce the risk of vehicle strike to fauna.	Minimise fauna strike during construction and operation	Construction and Operation	The Proponent and Contractor	Known and proven effective measure	All zones
Water and Soil (full measures can be found in the EIS, those relevant to biodiversity are listed below)							
Changes to surface runoff regimes resulting in sedimentation due to the removal of habitat (Section 10.2.3) Impacts on water quality and hydrological processes and	SW1	A Construction Soil and Water Management Plan (CSWMP) will be prepared as part of the CEMP. The CSWMP will include but not be limited to: <ul style="list-style-type: none"> Measures to minimise/manage erosion and sediment transport both within the Project area and offsite (including work on erodible soil types), including the requirements for the preparation of Erosion and Sediment Control Plan (ESCP) for construction Measures to manage accidental spills, including the requirement to maintain materials such as spill kits Measures to manage any potential acid sulfate soils (ASS) if found in excavated fill material in accordance with the NSW Acid Sulfate Soil Guidelines (Acid Sulfate Soils Management Advisory Committee, 1998) Measures to manage potential tannin leachate Measures to manage stockpiles 	Avoid, minimise impacts to aquatic habitat and particularly habitat for potential threatened fish species	Prior to construction, construction, decommissioning	The Proponent and contractor	Known effectiveness	All zones

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
that sustain threatened species (Section 10.2.2) Contaminant pollution (Section 10.2.10)		<ul style="list-style-type: none"> ▪ Details of surface water quality monitoring to be undertaken prior to, throughout and following construction (refer to SW4 for further information). 					
	SW2	<p>A construction ESCP will be prepared as part of the CSWMP and will detail the specific erosion and sediment control measures to be implemented within the Project area, in accordance with the principles and requirements of Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom, 2004).</p> <p>Scour protection and control measures will be identified in the CSWMP to reduce erosion and water quality impacts from increased sediment loads from ancillary sites and access tracks.</p>		Prior to construction, construction			
	SW3	<p>To avoid any impacts on water quality and threatened species, the following measures will be implemented:</p> <ul style="list-style-type: none"> ▪ Minimise the total area of bare earth exposed at any time ▪ Employ interim rehabilitation strategies to minimise dust generation, soil erosion and weed incursion on parts of the Project area that cannot yet be permanently rehabilitated ▪ Where required, rehabilitate all areas of the Project area that are not proposed for future disturbance as soon as is practicable following construction and decommissioning. 		Construction, decommissioning			
	SW4	<p>A surface water monitoring program will be implemented as part of the CSWMP prior to, during and following construction and decommissioning. The monitoring program will include but not be limited to:</p> <ul style="list-style-type: none"> ▪ Visual assessment and routine monitoring of physico-chemical parameters and contaminants of concern at downstream SREs to ensure compliance with applicable guidelines during construction and decommissioning ▪ Visual assessment of surface water quality control structures at least once a week and also following any heavy rain during construction and decommissioning, to ensure controls are operating effectively for their designed purpose. 		Prior to construction, construction, decommissioning			

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
	SW5	<p>Project specific controls and procedures will be developed and implemented as part of the CSWMP to reduce the risk of litter, spills and leaks entering downstream waterways and/or leaching into the soil and groundwater table. The CSWMP will include, but not be limited to, the following measures:</p> <ul style="list-style-type: none"> ▪ All fuels, chemicals and liquids will be stored on level ground away from waterways and will be stored in sealed bunded area within the construction compound ▪ Refuelling and minor maintenance activities will be limited to designated areas with established spill capture and management controls ▪ An emergency spill response procedure will be prepared as part of the CSWMP ▪ Regular visual water quality checks (for hydrocarbon spills/slicks, turbid plumes and other water quality issues) will be carried out at waterways in proximity to work ▪ Installing and maintaining control measures such as silt fencing and gross pollutant traps. 		Construction, decommissioning			
	SW6	<p>Stockpiles will be managed to minimise the potential for mobilisation and transport of dust, sediment and leachate in runoff. This will include:</p> <ul style="list-style-type: none"> ▪ Minimising the number of stockpiles, area used for stockpiles, and time that they are left exposed ▪ Locating stockpiles away from drainage lines, waterways and area where they may be susceptible to wind erosion ▪ Stabilising stockpiles, establishing appropriate sediment controls and suppressing dust as required. 		Construction			
	SW7	<p>Batch plants will be located on a concrete slab adjacent to the construction compound. To avoid ingress of concrete waste material into downstream waterways, the CEMP will outline procedures to capture, contain and appropriately dispose of any concrete waste from concrete work, including designated lined, bunded and controlled concrete washout areas.</p>		Prior to construction, construction			

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
	SW8	<p>Increased stormwater runoff during Project operation will be managed through:</p> <ul style="list-style-type: none"> The design of permanent drainage and water management, demonstrating the ability to meet Project performance outcomes of no pollution of water Scour protection, control measures and maintenance of access tracks to reduce erosion and water quality impacts Monitoring of receiving drainage channels and waterways downstream of discharge location to identify any evidence of channel erosion and scour. 		Operation			
	SW9	<p>Project specific controls and procedures will be developed to reduce the risk of the release of potentially harmful chemicals from spills entering downstream watercourses such as:</p> <ul style="list-style-type: none"> Appropriate storage of equipment and hazardous substances during operation Operational procedures for emergency response to spills and leaks from equipment or maintenance activities. 		Operation			
	SW11	If, during detailed design, Project excavation is designed to exceed the current proposed maximum depth of 3 mbgl, potential impacts to GDEs will be re-assessed by a suitably qualified hydrogeologist.	Avoidance of impacts on GDE's	Detailed design, construction			
Bush fire risk (full measures can be found in the EIS, those relevant to biodiversity are listed below)							
Fire risk during operation (Section 10.2.7)	BU01	<p>The Project will implement the following permanent bush fire protections:</p> <ul style="list-style-type: none"> Asset Protection Zones (APZs) around each WTG (accomplished by hardstand, no additional vegetation management needed) APZs around the substations and BESS An APZ around the operation and maintenance facility, which is to be constructed to a BAL-12.5 standard as the Project refuge of last resort Perimeter firebreak 	Mitigation for risk to biodiversity	During construction and operation	The Proponent	Known and proven effective measure	All zones

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<ul style="list-style-type: none"> ▪ Ongoing vegetation management (grazing, clearance around poles and overhead power lines) ▪ Access for emergency response vehicles ▪ A permanent, dedicated firefighting water source ▪ Controls on Project actions to prevent bush fire ignition ▪ Fire suppression systems in WTGs, substations, BESS ▪ Project fire fighting vehicle. 					
	BU02	<p>Construction and Operation Bush fire Emergency Management Plans will be developed for the Project in accordance with Planning for Bush Fire Protection (PBP) (NSW Rural Fire Service [RFS], 2019) and in consultation with the NSW RFS (including any requirements in relation to aerial firefighting). These plans will identify all relevant bush fire risks and mitigation measures associated with the construction and operation of the Project, including those listed in BU01 and:</p> <ul style="list-style-type: none"> ▪ Specific measures to prevent bush fire ignition or spread from Project activities ▪ Work types that will not be conducted during total fire bans ▪ Storage location and safety arrangements for any fuels or other hazardous or flammable materials ▪ Notification protocols to the NSW RFS of any work with the potential to cause a fire in the surrounding vegetation ▪ Instructions and triggers to shut down WTGs with an approaching fire ▪ Any other measures required by the NSW RFS or other authorities to manage risk to aerial firefighting in the region ▪ Notification protocols and contact details for the local NSW RFS Fire Control Centre, local fire brigades, CASA, Air Services Australia, Transgrid, and any other people or organisations who will be notified of an emergency at the Project area ▪ Location of firefighting water, any alternative water supplies that may be available during an emergency, and any other fire suppression equipment held on site 					

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<ul style="list-style-type: none"> Bush fire emergency planning, including evacuation triggers, evacuation routes and when and where to take refuge. 					
Noise and vibration (full measures can be found in the EIS, those relevant to biodiversity are listed below)							
Light and noise and vibration impacts during night works (Section 10.2.8)	NV1	A Construction Noise Management Plan will be developed as part of the CEMP to address noise where it is likely to be greater than the applicable NMLs.	Avoid, minimise, and mitigate impacts to biodiversity	During construction and operation	The Proponent and Contractor	Known and proven effective	All zones
	NV3	<p>Where reasonable and feasible, standard noise mitigation measures from the Construction Noise and Vibration Guidelines (RMS, 2016) will be adopted, including:</p> <ul style="list-style-type: none"> Wherever possible and safe, limit work to standard hours of construction Select low-noise plant and equipment Ensure equipment mufflers operate in a proper and efficient manner Where possible, use quieter and less vibration emitting construction methods Only have necessary equipment on-site and turn off when not in use Where possible, concentrate noisy activities at one location and move to another as quickly as possible Vehicle movements, including deliveries outside standard hours, would be minimised and avoided where possible All plant and equipment is to be well maintained and, where possible, fitted with silencing devices Use only the necessary size and powered equipment for tasks Implement training to induct staff on noise sensitivities Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms Consider the installation of temporary construction noise barriers or earth mounds for concentrated, noise-intensive activities Where practicable, install enclosures around noisy mobile and stationary equipment as necessary 					

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<ul style="list-style-type: none"> ▪ Where possible, avoid simultaneous operation of two or more noisy plant close to receivers ▪ The offset distance between noisy plant and sensitive receivers would be maximised ▪ Plan traffic flow, parking and loading/unloading areas to minimise reversing movements ▪ Complete routine monitoring to evaluate construction noise levels and evaluate whether the mitigation measures in place are adequate or require revision 					
	NV4	<p>Where reasonable and feasible, standard vibration mitigation measures will be adopted from the <i>Assessing Vibration: a technical guideline</i>, (DECC, 2006), including:</p> <ul style="list-style-type: none"> ▪ Choosing alternative, lower-impact equipment or methods wherever possible ▪ Scheduling the use of vibration-causing equipment at the least sensitive times of the day (wherever possible) ▪ Locating high vibration sources as far away from sensitive receiver areas as possible ▪ Sequencing operations so that vibration-causing activities do not occur simultaneously ▪ Keeping equipment well maintained ▪ Do not conduct vibration intensive work within the recommended safe setback distances ▪ Informing nearby receivers about the nature of construction phases and the vibration-generating activities. 					
Air Quality (full measures can be found in the EIS, those relevant to biodiversity are listed below)							
Dust pollution (Section 10.2.9)	AQ01	<p>Air quality management measures will be included in the CEMP for the Project, and would include but not be limited to:</p> <ul style="list-style-type: none"> ▪ Clearly marking haul routes ▪ Watering and maintenance of haul routes 	Avoid, minimise, and mitigate impacts from	During construction	Proponent and Contractor	Known and proven effective measure	All zones

Biodiversity Development Assessment Report

Direct and Indirect Impact (refer Chapter 10)	Action ID	Biodiversity mitigation action	Outcome	Timing and frequency	Responsibility	Effectiveness of action	Relevant vegetation zone
		<ul style="list-style-type: none"> ▪ Vehicle speed restrictions ▪ Prompt clean-up of any material spillage. 	dust pollution				
	AQ02	Weather will be monitored to minimise activities during adverse dust conditions e.g., during hot and windy conditions					

12.2 Monitoring program and adaptive management

A biodiversity monitoring program will be developed post-approval and approved prior to construction as part of the BMP and implemented before, during and after construction to monitor the effectiveness of the mitigation measures, and provide adaptive management where performance measures are not met. Monitoring will be conducted until such time as the mitigation measures have been proven to be effective after an agreed monitoring period. The monitoring data will provide robust information to draw sound conclusions around the effectiveness of mitigation measures for the target species and groups, and inform adaptive management actions. The BMP will include a program to evaluate and publicly report on the outcomes of a biodiversity monitoring program.

As explained in the BAM Operational Manual Stage 2, some impacts are difficult to predict or assess prior to commencement of the development. The management of uncertain impacts requires the development of an adaptive management plan with the aim of adjusting actions based on results of monitoring to achieve a specified outcome. The plan is to be reviewed and approved by BCS and any proposed deviation from the plan must be approved by DPE. An example is the edge effects predicted for vegetation adjoining the development. Monitoring is performance based and requires a trigger for necessary remedial action to be taken, such as adjusting the activity causing the impact or adjusting the mitigation measure. Monitoring is required to determine if measures are being implemented as planned and provide an early warning of measures that are ineffective and/or the uncertain impact is being realised.

A comprehensive biodiversity monitoring program will be developed post-approval as an integral part of the BMP. The information provided in **Table 12-2** shows a suggested framework for the key monitoring activities required, example of appropriate methods to be used and performance criteria are also identified.

Results will be reported to BCS at least annually. Some programs may require more frequent reporting. All data collected for survey and monitoring programs will be provided in digital format (including spatial) to BCS.

12.2.1 Bird and Bat Adaptive Management Plan

The BDAR has identified a potential risk of bird and bat collision with turbine blades associated with the operation of the wind farm. Blade strike collision may impact numerous bird and bat with a moderate to high risk rating and affect their home range, their dispersal and genetic exchange in the landscape. A Bird and Bat Adaptive Management Plan will be developed for the Project and will aim to address the prescribed impact associated with fauna mortality from blade strike and uncertainty of consequences on regional aerial fauna populations. The strategy will continue to be developed during detailed design and form part of the Biodiversity Management Plan.

The goal of the strategy is to reduce fauna mortality from blade strike, maintain connectivity and movement of individuals in the landscape and maintain long-term persistence of populations where the Project will result in a loss of airspace. Additionally, the bird and bat adaptive management plan will present opportunities to develop a framework for undertaking baseline and operational monitoring to measure the impact of blade strike in the Project area.

The BMP will identify specific goals for bird and bat blade strike management, implementation of management actions, followed with a monitoring program with an adaptive management approach (refer to **Section 12.2**). This will allow for performance thresholds to be evaluated to measure the effectiveness of management goals and implement corrective actions to improve mitigation if required.

Table 12-2. Recommended framework for biodiversity monitoring program

Impact being mitigated	Action ID	Monitoring schedule	Example methods and triggers applied	Example performance criteria
Removal of native vegetation and habitat	BIO1 BIO2 BIO3 BIO4	During construction	Targeted threatened species monitoring program to focus on all species. Methods will focus on applying a Before, After, Control, Impact approach (BACI), designed to monitor population (based on occupancy) and distribution and comparing with baseline data collection at impact and control sites before construction commences.	Negative change in site occupation comparing impact and control sites, and setting appropriate confidence limits
	BIO5 BIO6 BIO7 BIO8	Operation at years 5, 10 and 15 years post-construction	Monitoring the actual impacts from edge effects on TECs and key threatened species populations (<i>Swainsona murrayana</i> and <i>Swainsona sericea</i>) beyond the disturbance footprint. The monitoring plan will identify the specific locations proposed for conducting monitoring and the methods, variables, and timing of the proposed monitoring, to include impact and control sites. It is expected that monitoring will focus on vegetation integrity for the relevant PCTs, as per the BAM and will be collected to detect change and set a reasonable and feasible distance from the disturbance footprint for monitoring activity as approved by BCS.	Vegetation integrity scores monitoring along the edges of the disturbance footprint
		Operational period over the life of Project set at 5 yearly intervals for 25 years	Trigger for compliance action and revision of vegetation maintenance procedures if vegetation integrity scores show any reduction. Review must be undertaken by a qualified ecologist in consultation with BCS and NPWS.	Vegetation integrity scores are consistent with the prediction in the BAM to demonstrate that VI scores can be maintained in the long-term
Changes to surface runoff regimes resulting in sedimentation due to the removal of habitat Impacts on water quality and hydrological processes and that sustain threatened species	BIO9	During construction	<ul style="list-style-type: none"> ▪ Monitoring of sediment fencing performance, after rainfall events of >50 mm in a 24 hour period ▪ Testing of water quality indicators including turbidity, pH and dissolved oxygen within aquatic habitats occurring downstream of the construction area. Testing sites to focus on sites specific to the Project, impacts may affect downstream into Yanco Creek ▪ If a decline in water quality is detected, all work will be stopped or scaled back until additional control measures are implemented and confirmed to be successful ▪ Testing of bunds and controlled water releases through landform for acidity. 	The monitoring plan will identify appropriate triggers and adaptive management measures
Increase in weeds and disease pathogens in adjacent vegetation	BIO10 BIO11 BIO12 BIO13 BIO14	Construction and operation – controls will be determined to be effective if no corrective actions are triggered after a period of three	Weed / pathogen monitoring program, using a before, after, control and impact method (BACI) and comparing with baseline data collected before construction. Floristic plot based assessment focused on weeds identified in consultation with NPWS.	Set acceptable limits of weed cover and performance criteria Measures will be considered effective after meeting performance for three (3)

Biodiversity Development Assessment Report

Impact being mitigated	Action ID	Monitoring schedule	Example methods and triggers applied	Example performance criteria
		consecutive monitoring periods post-construction	Weed and pathogen spread and invasion particularly in areas subject to potential indirect impacts beyond the 20 m edge effect buffer, by sampling out 20-50 m from the disturbance footprint. Weed control and monitoring will be implemented as per the BMP requirements and/or conditions of consent.	consecutive years post-construction
Increase in predator and pest species	BIO15 BIO16	Construction and operation – controls will be determined to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	Monitoring pest and predator species using remote cameras. Focus on construction compound areas and transmission substation where there is potential for increased pest activity, compare with baseline data.	Triggers based on increased pest activity, and will trigger the implementation of controls. Appropriate triggers will be decided in consultation with BCS and landholders.
Increase in risk of electrocution and EMF exposure	BIO17	Operational phase for 25 year life of Project	The Biodiversity Management Plan (BMP) to include adaptive management for high risk bird and bat species: <ul style="list-style-type: none"> Monitoring in transmission line easement for evidence of bird / bat collision with transmission lines Regular monitoring of taller structures for evidence of raptor nest building Develop target trigger for number of high risk species incidents Deploy species specific bird / bat divertors / reflectors in areas where a defined number of incidents have occurred. 	Impact triggers, decision making framework and mitigation
Increase in risk of farm strike on protected animals	BIO8	Operational phase for 25 year life of Project	The BMP to include adaptive management for high risk bird and bat species: <ul style="list-style-type: none"> Monitoring in the Project area at wind turbine locations for evidence of bird / bat collision /carcass search / mortality with blades Regular monitoring of turbine structures or near turbines for evidence of raptor nest building Develop target trigger for number of high risk species incidents Implement measures to reduce risk of blade collision i.e. removal of carcasses and lighting on turbines. 	Impact triggers, decision making framework and mitigation
Fragmentation resulting in reduced connectivity	BIO27	Pre-construction, construction and operation – controls	The BMP will identify specific goals for bird and bat blade strike management, implementation of management actions and a monitoring program with an adaptive management approach (refer to Section 12.2.1) This will allow for performance	The monitoring plan will identify appropriate triggers and adaptive management measures

Biodiversity Development Assessment Report

Impact being mitigated	Action ID	Monitoring schedule	Example methods and triggers applied	Example performance criteria
		will be determined to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	thresholds to be evaluated to measure the effectiveness of management goals and implement corrective actions to improve mitigation if required.	
Post-construction rehabilitation	BIO3	Operational phase. Mitigation will be determined to be effective if no corrective actions are triggered after a period of three consecutive monitoring periods post-construction	The plan will include a program for adaptive monitoring of specific success measures and reporting and include a Trigger Action Response Plan (TARP).	N/A

13. Impact summary

This section of the BDAR identifies the impact thresholds that the assessor must apply, including impacts:

- On a potential entity that are serious and irreversible impacts
- For which the assessor is required to determine an offset requirement
- That do not require further assessment by the assessor.

13.1 Impacts for which the assessor is required to determine an offset requirement

The determination of impacts calculated within the disturbance footprint (see **Section 10**) which require an offset was undertaken in accordance with section 10.3 of the BAM. Impacts requiring offsets are shown in **Figure 13-1**.

13.1.1 Impacts on native vegetation (ecosystem credits)

An offset is required for direct impacts to PCTs, as outlined in **Table 13-1**.

Table 13-1 Direct impacts to PCTs which require an offset

Vegetation zone	Plant community type name	TEC status		Area in disturbance footprint (ha)	Total VI loss
		BC Act	EPBC Act		
1	River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT 7)	None	None	1.10	37.7
2	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT 9)	None	None	0.22	33.1
3	Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 13)	None	None	0.58	61.1
4		None	None	0.11	48.9
5	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT 17)	None	None	1.86	94
6	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26)	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions EEC	Weeping Myall Woodlands EEC	27.00	50.1
7			Not listed	1.40	30.9
8			Weeping Myall Woodlands EEC	2.10	82.2
9			Weeping Myall Woodlands EEC	0.59	34.9

Vegetation zone	Plant community type name	TEC status		Area in disturbance footprint (ha)	Total VI loss
		BC Act	EPBC Act		
10	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28)	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions EEC	None	10.28	28.2
11	Forb-rich Speargrass – Windmill Grass - White Top grassland of the Riverina Bioregion (PCT44)	None	Natural Grasslands of the Murray Valley Plains CEEC	32.99	99.4
12		None	Not listed	3.15	84.5
13	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)	None	Natural Grasslands of the Murray Valley Plains CEEC	1.42	90.9
14		None	Not listed	0.81	68.7
15	Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46)	None	Natural Grasslands of the Murray Valley Plains CEEC	31.29	92.1
16		None	Not listed	13.32	67.3
17		None	Natural Grasslands of the Murray Valley Plains CEEC	23.49	97.7
18		None	Not listed	22.51	83.3
19	Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160)	None	None	0.03	80.3
Total				173.39	

13.1.2 Impacts on threatened species (species credits)

An offset is required for impacts to threatened species as outlined in **Table 13-2**.

Table 13-2 Impacts to threatened species populations and suitable habitat (assumed presence) which require an offset

Threatened species	Area in disturbance footprint (ha)																			Total (ha)
	PCT 7	PCT 9	PCT 13		PCT 17	PCT 26				PCT 28	PCT 44		PCT 45		PCT 46			PCT 160		
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11	Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18	Zone 19	
Threatened flora																				
<i>Swainsona murrayana*</i>	-	-	-	-	-	2.10 (0.14)	-	0.19	-	1.49	9.54 (0.44)	0.34	0.53	-	3.71 (0.33)	5.06	0.99 (0.68)	6.48 (0.10)	-	32.12
<i>Austrostipa wakoolica</i>	-	-	-	-	0.95	12.18	0.01	0.6	0.03	5.80	-	-	-	-	-	-	-	-	-	19.57
<i>Brachyscome muelleroides</i>	-	-	-	-	-	-	-	-	-	-	9.39	0.34	-	-	2.63	3.96	0.94	6.31	-	23.57
<i>Brachyscome papillosa</i>	-	-	-	-	-	-	-	-	-	-	9.39	0.34	-	-	2.63	3.96	0.94	6.31	0.03	23.60
<i>Caladenia arenaria</i>	-	-	-	-	-	-	-	-	-	1.49	-	-	-	-	-	-	-	-	-	1.49
<i>Convolvulus tedmoorei</i>	-	-	-	-	-	2.10	-	0.19	-	-	9.54	0.34	-	-	0.07	-	-	-	0.03	12.27
<i>Cullen parvum</i>	0.17	0.20	-	-	-	-	-	-	-	-	31.79	3.13	-	-	-	-	-	-	-	35.29
<i>Lepidium monoplacoides</i>	-	-	-	-	-	12.18	0.01	0.60	0.03	-	-	-	-	-	0.07	-	-	-	0.03	12.92
<i>Leptorhynchus orientalis</i>	-	-	-	-	-	1.98	-	0.13	-	-	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	25.75
<i>Maireana cheelii</i>	-	-	-	-	-	1.98	-	0.13	-	-	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	25.75
<i>Pilularia novae-hollandiae</i>	-	0.16	0.56	0.11	-	12.18	0.01	0.60	0.03	-	-	-	0.49	0.29	-	-	-	-	-	14.43
<i>Sclerolaena napiformis</i>	-	-	-	-	-	1.98	-	0.13	-	-	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	25.75
<i>Swainsona plagiotropis</i>	-	-	-	-	-	2.10	-	0.19	-	-	9.54	0.34	0.53	-	3.71	5.06	0.99	6.48	-	28.94

Biodiversity Development Assessment Report

Threatened species	Area in disturbance footprint (ha)																			Total (ha)
	PCT 7	PCT 9	PCT 13		PCT 17	PCT 26		PCT 28	PCT 44		PCT 45		PCT 46				PCT 160			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	Zone 11	Zone 12	Zone 13	Zone 14	Zone 15	Zone 16	Zone 17	Zone 18	Zone 19	
<i>Swainsona sericea</i>	-	-	-	-	-	1.98	-	0.13	-	1.49	9.39	0.34	-	-	2.70	3.96	0.94	6.31	-	27.24
Threatened fauna																				
Plains-wanderer	-	-	-	-	0.03	0.48	-	-	-	-	0.12	-	-	0.05	0.44	0.38	-	0.28	-	1.78
Southern Myotis	0.88	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.9

*areas in brackets represent a species polygon comprising a total of 1.69 ha for known *Swainsona murrayana* populations in addition to areas with suitable habitat and species assumed present.

13.2 Impacts for which the assessor is not required to determine an offset requirement

An offset is not required for impacts where the vegetation integrity score is below those set out in paragraph 10.3.1.1 of the BAM for impacts on native vegetation, and paragraph 10.3.2.1 of the BAM for impacts on threatened species. All impacts on native vegetation and threatened population and their habitat in the disturbance footprint require offsets.

13.3 Impacts that do not need further assessment

An assessor is not required to assess areas of land on the disturbance footprint for ecosystem credits without native vegetation under Chapter 4 or Chapter 5 of the BAM.

A total 60.29 ha of the disturbance footprint comprises non-native vegetation as open exotic grassland (or large ploughed bare ground) that is established on the cropping land that is regularly ploughed and cultivated and is dominated by annual exotic species. No native plant species were observed at these locations. This includes, ploughed paddocks, active and derelict cotton farms and associated constructed channels. Impacts on ecosystem credits for these areas are not assessed in the BDAR.

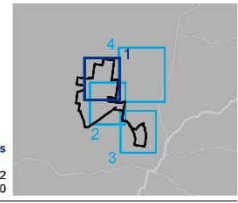
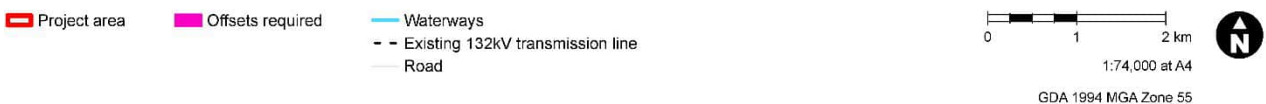
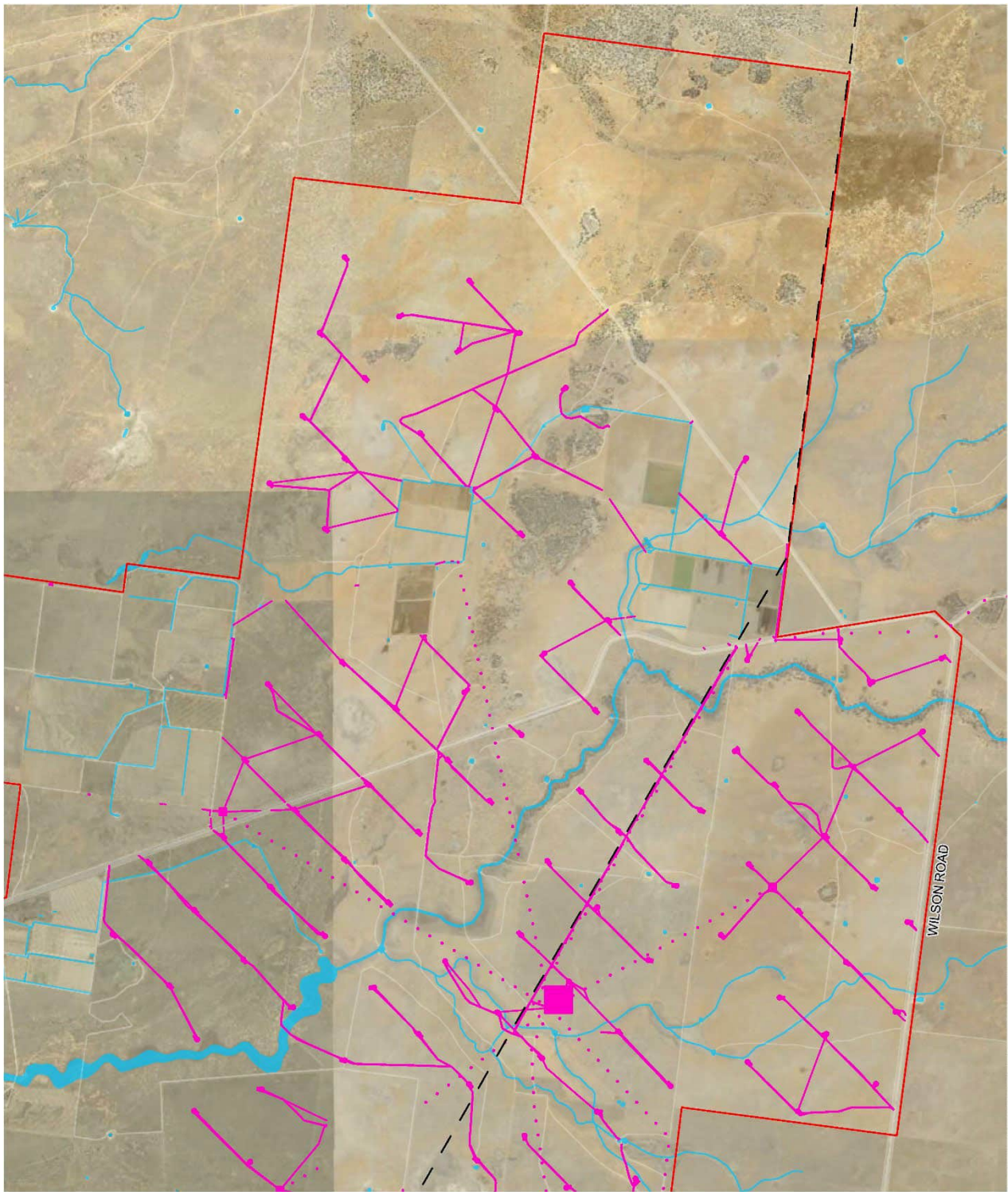


Figure 13-1. Impacts to PCTs requiring offsets (Page 1 of 4)

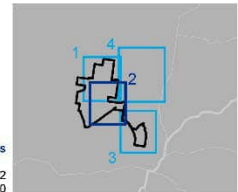
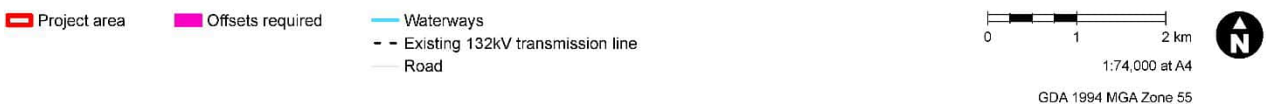
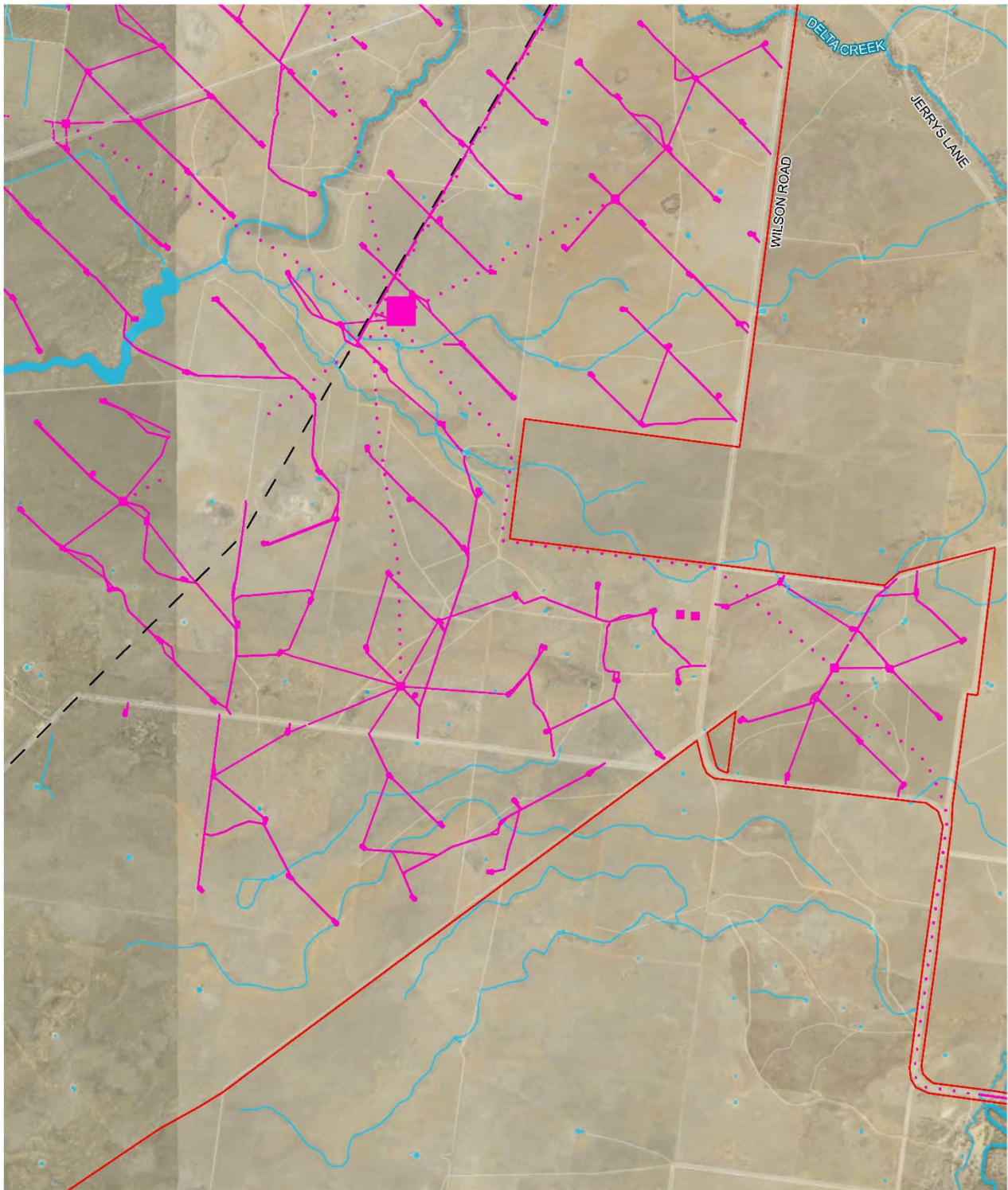
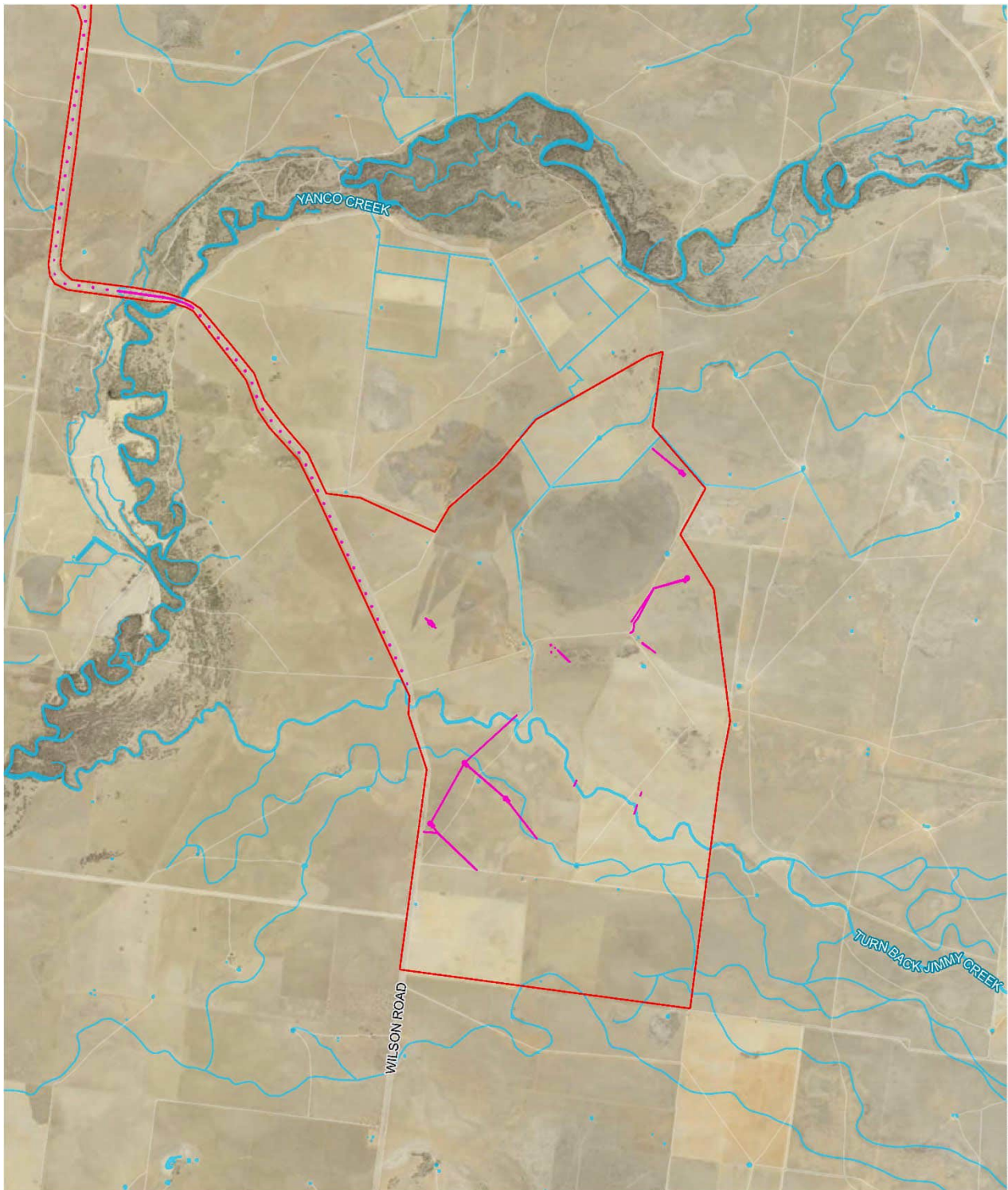


Figure 13-1. Impacts to PCTs requiring offsets (Page 2 of 4)

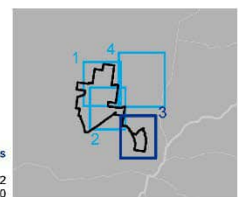


▬ Project area ▬ Offsets required ▬ Waterways
▬ Road

0 1 2 km

1:74,000 at A4

GDA 1994 MGA Zone 55



Data sources

Jacobs 2022
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Figure 13-1. Impacts to PCTs requiring offsets (Page 3 of 4)



— Offsets required — Waterways
— Road

0 1 2 km
 1:90,000 at A4
 GDA 1994 MGA Zone 55

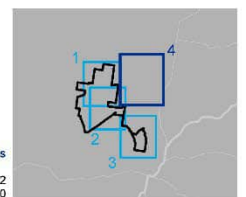


Figure 13-1. Impacts to PCTs requiring offsets (Page 4 of 4)

14. Biodiversity credit requirements

A summary of the biodiversity credit requirements for the Project are provided below in **Table 14-1** and **Table 14-2**. The credit report is provided in **Appendix F**. Credits have been calculated and displayed for direct impacts of the Project.

The Project will have direct impacts on 173.39 hectares of native vegetation within the disturbance footprint. Project impacts and offset obligations will be revised throughout the life of the Project through the monitoring program. Where there is opportunity to modify the clearing extent and the potential biodiversity impact post-approval, this will be done as part of the detailed design and analysis of operational management requirements.

Indirect impacts are subject to the efficacy of implemented environmental controls. These are mitigated through effective environmental management during construction and associated with adaptive management. The monitoring program will be designed to verify the extent of indirect impacts, identify where additional mitigation of indirect impacts is required. Any substantial loss in future VI that cannot be mitigated will need to be reflected in the future offset obligation.

In summary, a credit requirement has been generated by the BAM-C for the project and comprise the following totals:

- 5,854 ecosystem credits
- 13,675 species credits.

A strategy to meet the offset obligation will be developed post-approval and consider a range of options, including direct payment into the Biodiversity Conservation Trust Fund and seeking like-for like credits from the offset market.

Table 14-1 provides a summary of the ecosystem credits required to offset direct impacts to native vegetation that will occur within the disturbance footprint.

Table 14-2 provide a summary of the species credits required to offset direct impacts on threatened species credit species that will occur within the disturbance footprint.

Table 14-1. Ecosystem credits required by vegetation zone

Ecosystem credit	PCT name	PCT vegetation class	PCT vegetation formation	Associated TEC or EC	Offset trading group (BAM Section 10.2, Tables 4 & 5)	Hollow bearing trees present?	IBRA subregion (in which Project is located)
16	River Red Gum - Warrego Grass - herbaceous riparian tall open forest wetland mainly in the Riverina Bioregion (PCT7)	Inland Riverine Forests	Forested Wetlands	No associated TECs	Inland Riverine Forests <50%	Yes	Murrumbidgee
3	River Red Gum - wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (PCT9)	Inland Riverine Forests	Forested Wetlands	No associated TECs	Inland Riverine Forests >=50% and <70%	Yes	Murrumbidgee
15	Black Box - Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT13)	Inland Floodplain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	No associated TECs	Inland Riverine Forests >=50% and <70%	Yes	Murrumbidgee
76	Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (PCT17)	Inland Floodplain Shrublands	Freshwater Wetlands	No associated TECs	Inland Riverine Forests >=50% and <70%	No	Murrumbidgee
794	Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT26)	Riverine Plain Woodlands	Semi-arid Woodlands (Grassy sub-formation)	Weeping Myall Woodland (listed endangered under the EPBC Act) and Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (listed endangered under the BC Act)	Weeping Myall Woodlands	No	Murrumbidgee

Biodiversity Development Assessment Report

Ecosystem credit	PCT name	PCT vegetation class	PCT vegetation formation	Associated TEC or EC	Offset trading group (BAM Section 10.2, Tables 4 & 5)	Hollow bearing trees present?	IBRA subregion (in which Project is located)
145	White Cypress Pine open woodland of sand plains, prior streams and dunes mainly of the semi-arid (warm) climate zone (PCT28)	Riverine Sandhill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	No	Murrumbidgee
1773	Forb-rich Speargrass - Windmill Grass - White Top grassland of the Riverina Bioregion (PCT44)	Riverine Plain Grasslands	Grasslands	Some patches meet Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act)	Riverine Plain Grasslands $\geq 70\%$ and $< 90\%$	No	Murrumbidgee
80	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion (PCT45)	Riverine Plain Grasslands	Grasslands	Some patches meet Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act)	Riverine Plain Grasslands $\geq 50\%$ and $< 70\%$	No	Murrumbidgee
2949	Curly Windmill Grass - speargrass - wallaby grass grassland on alluvial clay and loam on the Hay Plain, Riverina Bioregion (PCT46)	Riverine Plain Grasslands	Grasslands	Some patches meet Natural Grasslands of the Murray Valley Plains (listed critically endangered under the EPBC Act)	Riverine Plain Grasslands $< 50\%$	No	Murrumbidgee
1	Nitre Goosefoot shrubland wetland on clays of the inland floodplains (PCT160)	Inland Floodplain Shrublands	Freshwater Wetlands	No associated TECs	Inland Floodplain Shrublands $< 50\%$	No	Murrumbidgee

Table 14-2. Species credits required by vegetation zone

Species Credit	Name of threatened species	Kingdom	BC Act status*	EPBC Act status	IBRA region
459	<i>Austrostipa wakoolica</i> (A spear-grass)	Plantae	E	E	Riverina
1567	<i>Brachyscome muelleroides</i> (Claypan Daisy)	Plantae	V	V	Riverina
1045	<i>Brachyscome papillosa</i> (Mossgiel Daisy)	Plantae	V	V	Riverina
31	<i>Caladenia arenaria</i> (Sand-hill Spider Orchid)	Plantae	E	E	Riverina
831	<i>Convolvulus tedmoorei</i> (Bindweed)	Plantae	E	-	Riverina
1718	<i>Cullen parvum</i> (Small Scurf-pea)	Plantae	E	-	Riverina
336	<i>Lepidium monoplacoides</i> (Winged Peppergrass)	Plantae	E	E	Riverina
1102	<i>Leptorhynchos orientalis</i> (Lanky Buttons)	Plantae	E	-	Riverina
1102	<i>Maieana cheelii</i> (Chariot Wheels)	Plantae	V	V	Riverina
18	<i>Myotis Macropus</i> (Southern Myotis)	Animalia	V	-	Riverina
99	<i>Pedionomus torquatus</i> (Plains-wanderer)	Animalia	E	CE	Riverina
579	<i>Pilularia novae-hollandiae</i> (Austral Pillwort)	Plantae	E	-	Riverina
1102	<i>Sclerolaena napiformis</i> (Turnip Copperburr)	Plantae	E	E	Riverina
1331	<i>Swainsona murrayana</i> (Slender Darling Pea)	Plantae	V	V	Riverina
1232	<i>Swainsona plagiotropos</i> (Red Darling Pea)	Plantae	V	V	Riverina
1123	<i>Swainsona sericea</i> (Silky Swainson-pea)	Plantae	V	-	Riverina

*E=endangered, V=vulnerable

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