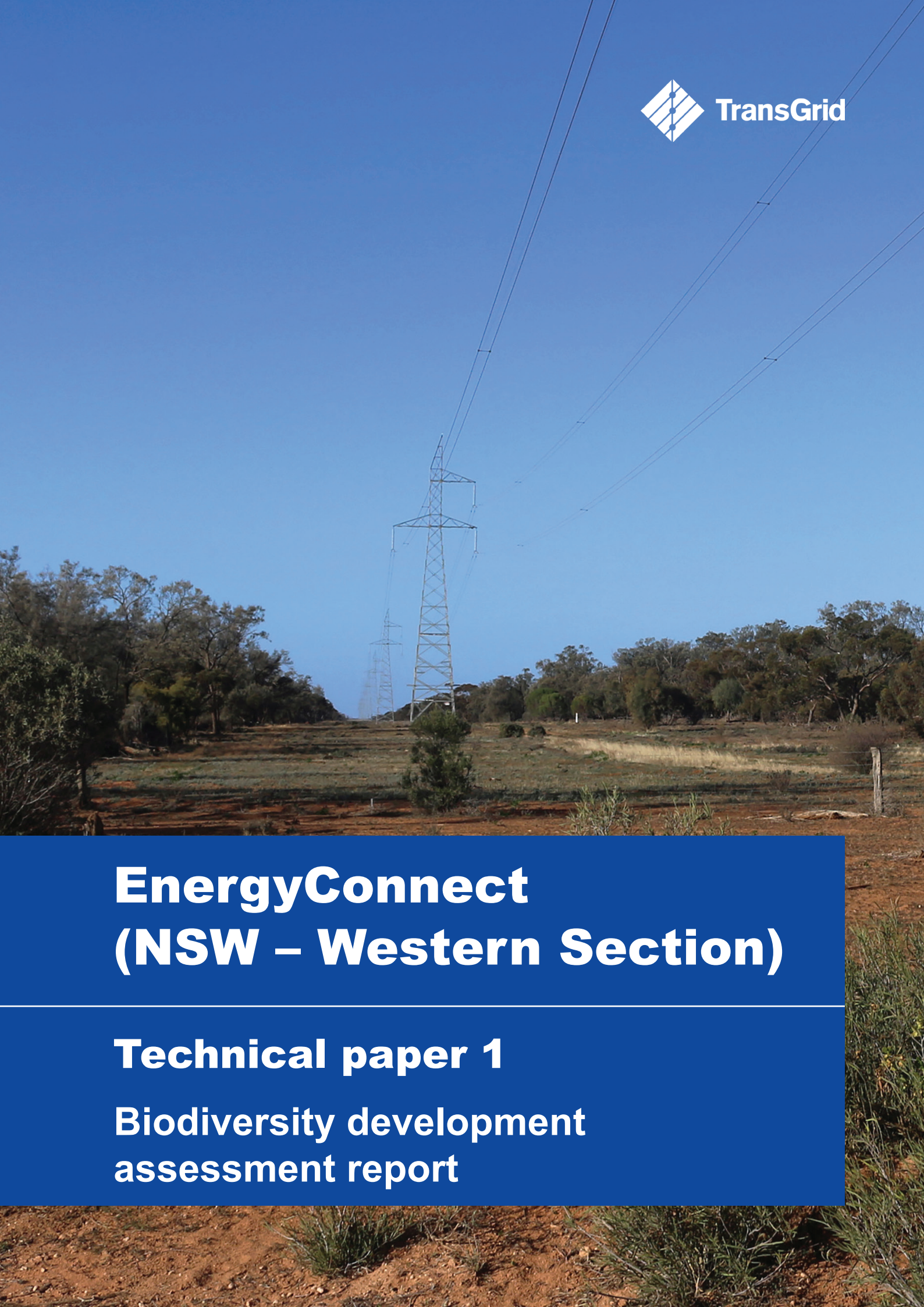

TransGrid

EnergyConnect (NSW – Western Section)

Technical paper 1

Biodiversity development assessment report

Question today
Imagine tomorrow
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EnergyConnect (NSW – Western Section)
Technical paper 1 – Biodiversity development assessment report

TransGrid

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REV	DATE	DETAILS
Final	21/10/2020	Final

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GLOSSARY

Avoid	Measures taken by a proponent such as careful site selection or actions taken through the design, planning, construction and operational phases of the development to completely avoid impacts on biodiversity values, or certain areas of biodiversity.
Biodiversity credits	Ecosystem credits or species credits
Biodiversity Credit Report	The report produced by the Biodiversity Credit Calculator 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 (OEH, 2017).
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 value	Are the following values: — vegetation integrity--being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state — habitat suitability--being the degree to which the habitat needs of threatened species are present at a particular site — biodiversity values, or biodiversity-related values, prescribed by the regulations.
Disturbance area	Refers to the area that would be directly impacted by both construction and operation (including the areas that would be impacted by maintenance activities) of the proposal including all proposal infrastructure elements (including the proposed transmission line alignment, substation site works and other ancillary works i.e. the operational footprint) as well as locations for currently proposed construction elements such as construction compounds, access tracks and site access points, laydown and staging areas, concrete batching plants, brake/winch sites, site offices and accommodation camps. The disturbance area would have varying degrees of physical disturbance along the transmission line alignment to reflect construction and operational requirements – specifically: – disturbance area A, in which ground disturbance would be required – disturbance area B, in which ground disturbance is not required except in limited circumstances. For this biodiversity assessment, an *indicative* disturbance area has been applied. Disturbance area has the same meaning as 'Development site' as defined in the BAM.
Disturbance area A	Refers to an area around transmission towers and between transmission towers in which vegetation would be removed during construction and subject to ongoing maintenance during operation (i.e. removal to ground level) for operational and safety requirements (including bushfire). This zone is a subset to the disturbance area.

Disturbance area B	Refers to an area between transmission towers in which trimming would only be required to meet the vegetation clearance heights, which would not require disturbance at ground level. However, where trees within this area would or have the potential to exceed vegetation clearance heights, these trees would be removed and may result in temporary ground disturbance. Vegetation clearance heights are set by TransGrid for operational and safety requirements, including bushfire risk management. This zone is a subset to the disturbance area.
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
Ecosystem credit species	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT (OEH, 2017).
EnergyConnect	EnergyConnect is a proposed new electricity interconnector between Wagga Wagga in New South Wales and Robertstown in South Australia, with an added connection into north-west Victoria. EnergyConnect is a joint project between TransGrid and ElectraNet, who operate the transmission networks in New South Wales (NSW) and South Australia (SA), respectively.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Hollow bearing tree	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1m above the ground. Trees must be examined from all angles.
IBRA region	A bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system3, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes.
IBRA subregion	A subregion of a bioregion identified under the IBRA system.
Indirect impact	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. Compared to direct impacts, indirect impacts often: — 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 (OEH, 2017).
Linear shaped development	Defined in the BAM as development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length.
Locality	The area within 10 kilometres of the proposal study area

Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately (OEH, 2017).
Minimise	A process applied throughout the development planning and design life cycle which seeks to reduce the residual impacts of the proposal on biodiversity values.
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.
Native vegetation	Means 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) — plants occurring in a wetland.
Patch size	an area of intact native vegetation that: — occurs on the development site or biodiversity stewardship site — includes native vegetation that has a gap of less than 100 m from the next area of moderate to good condition native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or biodiversity stewardship site.
PCT classification system	The system of classifying native vegetation approved by the NSW Plant Community Type Control Panel and described in the BioNet Vegetation Classification.
Plant community type	A NSW plant community type identified using the PCT classification system.
Population	A group of organisms, all of the same species, occupying a particular area.
(the) Proposal	The proposal is known as 'EnergyConnect (NSW – Western Section)' The proposal would involve the following key features: — construction of new high voltage transmission lines and associated infrastructure between the SA/NSW border near Chowilla and the existing Buronga substation — an upgrade to the existing transmission line between the Buronga substation and the NSW/Victoria border at Monak, near Red Cliffs — an expansion and upgrade of the existing Buronga substation from an operating capacity of 220kV to 330kV — establishment and upgrade of access tracks and roads, as required — other ancillary works required to facilitate the construction of the proposal e.g. laydown and staging areas, concrete batching plants, brake/winch sites, site offices and accommodation camps.
Proposal study area	The study area for this EIS, which comprises a one km wide corridor between the SA/NSW border near Chowilla and Buronga and a 200 m wide corridor between Buronga and the NSW/Victoria border at Monak, near Red Cliffs.

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 in accordance with section 6.4 of the BAM.
Stage 1: Biodiversity Assessment	Stage 1 of the Biodiversity Assessment Method. It establishes a single consistent approach to assessing the biodiversity values on land subject to the proposal.
Stage 2: Impact Assessment	Stage 2 of the Biodiversity Assessment Method. It provides for an impact assessment on biodiversity values on land subject to the proposal.
Species credit	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	Are threatened species or components of species habitat that are identified in the Threatened Species Data Collection as requiring assessment for species credits.
Subject land	This is the same area as the proposal study area and used in the Stage 1 of the BAM.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by EES and accessible from the BioNet website at www.bionet.nsw.gov.au
Threatened ecological community	Means a critically endangered ecological community, an endangered ecological community or a vulnerable ecological community listed in Schedule 2 of the BC Act.
Threatened species	Critically endangered, endangered or vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as critically endangered, endangered or vulnerable.
Vegetation class	A level of classification of vegetation communities defined in Keith (2004). There are 99 vegetation classes in NSW.
Vegetation formation	A broad level of vegetation classification as defined in Keith (2004). There are 16 vegetation formations and sub-formations in NSW.
Vegetation integrity	The condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT.
Vegetation integrity score	The quantitative measure of vegetation condition.
Vegetation type	A NSW plant community type
Vegetation zone	A relatively homogenous area of native vegetation that is the same PCT and broad condition state.

ABBREVIATIONS

AER	Australian Energy Regulator
BAM	Biodiversity Assessment method 2017
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOM	Bureau of Meteorology
BOS	NSW Biodiversity Offset Scheme
CEMP	Construction and Environment Management Plan
CSSI	Critical State Significant Infrastructure
EEC	Endangered Ecological Community
EES	Environment, Energy and Science Group – a division of the Department of Planning Industry and Environment (DPIE) (formerly NSW Office of Environment and Heritage)
EIS	Environmental impact statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
LGA	Local Government Area
MNES	Matters of national environment and significance
NSW	New South Wales
PCT	Plant Community Type
SA	South Australia
SEARs	Secretary's Environmental Assessment Requirements
TEC	Threatened Ecological Community
VIC	Victoria
VIS	Vegetation information system (BioNet Vegetation Classification)

EXECUTIVE SUMMARY

THE PROPOSAL

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are currently seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an added connection to north-west Victoria. Collectively the proposed interconnector is known as EnergyConnect.

The proposal, focusing on the western section of EnergyConnect in NSW, would involve the construction and operation of new 330 kilovolt (kV) transmission lines between the SA/NSW border and Buronga, an expansion and upgrade of the existing Buronga substation from an operating capacity of 220kV to a combined operating voltage 220kV/330kV and an upgrade of the existing 24 kilometre long 220kV single circuit transmission line between the Buronga substation and the NSW/Victoria border at Monak (near Red Cliffs, Victoria) to a 220kV double circuit transmission line.

TransGrid is seeking approval under Division 5.2, Part 5 of the *Environmental Planning and Assessment Act 1979* (the EP&A Act) to construct and operate the proposal. The proposal has been declared as Critical State Significant Infrastructure (CSSI) under Section 5.13 of the EP&A Act.

The proposal was also declared a controlled action on 26 June 2020 and requires a separate approval under the (Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). The proposal is subject to the bilateral assessment process that has been established between the Australian and NSW governments.

The purpose of this Biodiversity Development Assessment Report (BDAR) is to identify and assess the potential impacts of the proposal in relation to biodiversity. It responds directly to the NSW Biodiversity Assessment Method 2017 (BAM) and Secretary's environmental assessment requirements (SEARs).

LANDSCAPE FEATURES OVERVIEW

The indicative disturbance area occurs with three IBRA regions that comprise of four IBRA subregions, being:

- Murray Darling Depression region
  - South Olary Plain subregion
- Darling Riverine Plains region
  - Great Darling Anabranch subregion
  - Pooncarie – Darling subregion
- Riverine region
  - Robinvale Plain subregion.

The main important landscape features identified within the proposal study area are;

- Great Darling Anabranch
- Darling River
- Murray River.

In accordance with the BAM, calculations have been undertaken for each IBRA subregion. Given the large linear distance of the proposal alignment (~160 kilometres) and the extent of native vegetation, patch size analysis for BAM calculation has been estimated to greater than 100 hectares for all vegetation zones. Native vegetation cover for BAM landscape calculation purpose has been estimated as greater than 70 per cent.

NATIVE VEGETATION OVERVIEW

Native vegetation recorded within the indicative disturbance area has been assigned to seven vegetation formations that occur within four IBRA subregions. The recorded vegetation formations are:

- Arid Shrublands (Acacia sub-formation)
- Arid Shrublands (Chenopod sub-formation)
- Forested Wetlands
- Freshwater Wetlands
- Saline Wetlands
- Semi-arid Woodlands (Grassy sub-formation)
- Semi-arid Woodlands (Shrubby sub-formation).

Of the seven recorded native vegetation formations, these have been assigned to nine vegetation classes, 20 Plant Community Types (PCTs) and 27 vegetation zones.

One threatened ecological community has been recorded within the indicative disturbance area, being:

- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions listed as endangered under the BC Act.

No threatened ecological communities listed under the EPBC Act were recorded.

THREATENED SPECIES OVERVIEW

In accordance with the BAM threatened species have been assessed as predicted or ecosystem credit species and species credit species.

PREDICTED SPECIES (ECOSYSTEM CREDIT SPECIES)

A total of 55 threatened fauna species have been identified as predicted or ecosystem credit species within the indicative disturbance area.

THREATENED FLORA (SPECIES CREDIT SPECIES)

A total of 20 candidate threatened flora species were considered to have potential associated habitat within the indicative disturbance area and were the subject of targeted surveys. Of these, five threatened flora species have been recorded. These are:

- *Acacia acanthoclada* (Harrow Wattle) listed as endangered under the BC Act
- *Atriplex infrequens* (A saltbush) listed as vulnerable under the BC Act and EPBC Act
- *Austrostipa nullanulla* (A spear-grass) listed as endangered under the BC Act
- *Dodonaea stenozyga* (Desert Hopbush) listed as critically endangered under the BC Act
- *Santalum murrayanum* (Bitter Quandong) listed as endangered under the BC Act.

THREATENED FAUNA (SPECIES CREDIT SPECIES)

A total of 18 candidate threatened fauna species were considered to have potential associated habitat within the indicative disturbance area and were the subject of targeted surveys. Of these, one species is considered affected by the proposal based on observation, being:

- *Polytelis anthopeplus monarchoides* (Regent Parrot (eastern subspecies)). Endangered under the BC Act and vulnerable under the EPBC Act.

AVOIDANCE AND DESIGN REFINEMENTS

The proposal has been refined to avoid and minimise potential impacts on biodiversity values including:

- positioning of preferred corridor to co-locate where possible with existing infrastructure (i.e. Renmark Road and existing Broken Hill to Buronga 220kV electrical infrastructure)
- relocation of preferred corridor from southern side of Renmark Road to the northern side to avoid impacts on the critically endangered threatened flora species *Dodonaea stenozyga* and the endangered flora species *Acacia acanthoclada*
- relocation of preferred corridor south at Nulla Station to avoid high biodiversity value areas that contain a population of the endangered flora species *Austrostipa nullanulla.*

Ongoing commitment to avoid and minimise impacts on biodiversity values would be further achieved through micro siting new transmission line structures, brake/winch sites and access tracks during the detailed design phase.

IMPACT SUMMARY

Impacts unable to be avoided by the proposal have been assessed in accordance with Stage 2 of the BAM, Item 16 of Appendix A of the SEARs and Matters of National Environmental Significance – Significant impact guidelines 1.1 (2013) EPBC Act.

Impacts on biodiversity values resulting from the proposal are:

- the proposal would directly impact on 20 native vegetation PCTs and one threatened ecological community based on the indicative disturbance area. Direct impacts on native vegetation because of the proposal would include:
  - direct impacts on up to 606.76 hectares of native vegetation (full disturbance in indictive disturbance area A is 313.99 hectares, partial disturbance in indicative disturbance area B is 292.77 hectares)
  - direct impacts on up to 14.02 hectares of threatened ecological community in the form of Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions which is listed as endangered under the BC Act
- indirect impacts on native vegetation are considered unlikely due to the retention of shrub and ground stratum native vegetation retention to a height of two meters in areas buffering direct permanent loss. Mitigation measure would further minimise any residual indirect impact to native vegetation is managed during both the construction and operational phases of the proposal
- the proposal would not impact on groundwater and is considered unlikely to lead to any adverse impact on the groundwater availability or status for groundwater dependent ecosystems, including the Darling River, Murray River or PCT's 11, 13, 15, 170, 171 and 172
- impacts on threatened species have been considered in accordance with the BAM based on ecosystem credit species and species credit species. Impacts resulting from the proposal on threatened species includes:
  - loss of habitat for 55 threatened fauna species identified and/or predicted as ecosystem credit species
  - a total of four threatened flora species credit species affected by the proposal. These include impacts to:
    - 0.01 hectares of habitat for *Acacia acanthoclada* (Harrow Wattle)
    - 0.26 hectares of habitat for *Atriplex infrequens* (A saltbush)
    - 2.18 hectares of habitat for *Austrostipa nullanulla* (A spear-grass)
    - 18 individuals of *Santalum murrayanum* (Bitter Quandong)
  - a total of one threatened fauna species credit species affected by the proposal. This include impacts to:
    - 6.91 hectares of habitat for *Polytelis anthopeplus monarchoides* (Regent Parrot (eastern subspecies))
- the proposal is considered unlikely to lead to a significant impact on any threatened aquatic species, ecological communities or their habitats.

In terms of impacts on Matters of National Environmental Significance the proposal would:

- not impact on any listed threatened ecological communities
- impact on known or assumed habitat for one threatened flora species listed under the EPBC Act
- impact on known or assumed habitat for 17 threatened fauna species comprising of one amphibian, 12 birds, three fish and one mammal listed under the EPBC Act
- impact on potential habitat for 24 migratory species listed under the EPBC Act.

The impact assessment outcomes for Matters of National Environmental Significance conclude that:

- the proposal is unlikely to lead to a significant impact on any threatened species and/or their habitat listed under the EPBC Act
- the proposal is considered unlikely to substantially modify, destroy or isolate an area of important habitat for any EPBC Act listed migratory species and is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds
- the proposal would not impact on any wetlands of national or international importance.

MANAGEMENT AND MITIGATION

The specific performance outcomes for the proposal regarding biodiversity include:

- minimising or where possible avoiding impacts to threatened flora and fauna species, and ecological communities listed under the BC Act and EPBC Act through the detailed design and construction methodology refinement processes
- offsetting impacts to threatened ecological communities and species.

A Construction Environmental Management Plan (CEMP) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor including sub-plans, and other supporting documentation for each specific environmental aspect.

A specific sub-plan from the CEMP that would be developed to address biodiversity values would include a Biodiversity Management Sub-Plan.

OFFSETTING BIODIVERSITY IMPACTS

Residual impacts that are not able to be managed through mitigation would be offset in accordance with BAM calculations for both ecosystem and species credits. The proposal offset obligation based on the indicative disturbance area has been calculated to require the following biodiversity credits:

- 8,845 ecosystem credits
- 254 species credits.

The proposal offset obligations would be met through implementing offset delivery options which may include a combination of:

- the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register
- establishing biodiversity stewardship site(s) on lands with like for like biodiversity values to those impacted by the proposal
- making a payment into the Biodiversity Conservation Fund
- alternative strategic offset outcomes.

STAGE 1 – BIODIVERSITY ASSESSMENT

1 INTRODUCTION

1.1 CERTIFICATION

As required under *Section 6.15 Currency of biodiversity assessment report* of the *NSW Biodiversity Conservation Act 2016* (BC Act), the accredited person certifies that the report has been prepared on the basis of the requirements of (and information provided under) the biodiversity assessment method as at 12 October 2020. This date is within 14 days of the date the report being submitted.

1.2 OVERVIEW OF ENERGYCONNECT

TransGrid (electricity transmission operator in New South Wales (NSW)) and ElectraNet (electricity transmission operator in South Australia (SA)) are seeking regulatory and environmental planning approval for the construction and operation of a new High Voltage (HV) interconnector between NSW and SA, with an added connection to north-west Victoria. Collectively, the proposed interconnector is known as EnergyConnect.

EnergyConnect comprises several components or 'sections' (shown on Figure 1.1). The Western Section (referred to as 'the proposal') is the subject of this technical paper.

EnergyConnect aims to secure increased electricity transmission between SA, NSW and Victoria, while facilitating the longer-term transition of the energy sector across the National Electricity Market (NEM) to low emission energy sources.

EnergyConnect has been identified as a priority transmission project in the NSW Transmission Infrastructure Strategy (Department of Planning and Environment, 2018), linking the SA and NSW energy markets and would assist in transporting energy from the South-West Renewable Energy Zone to major demand centres.

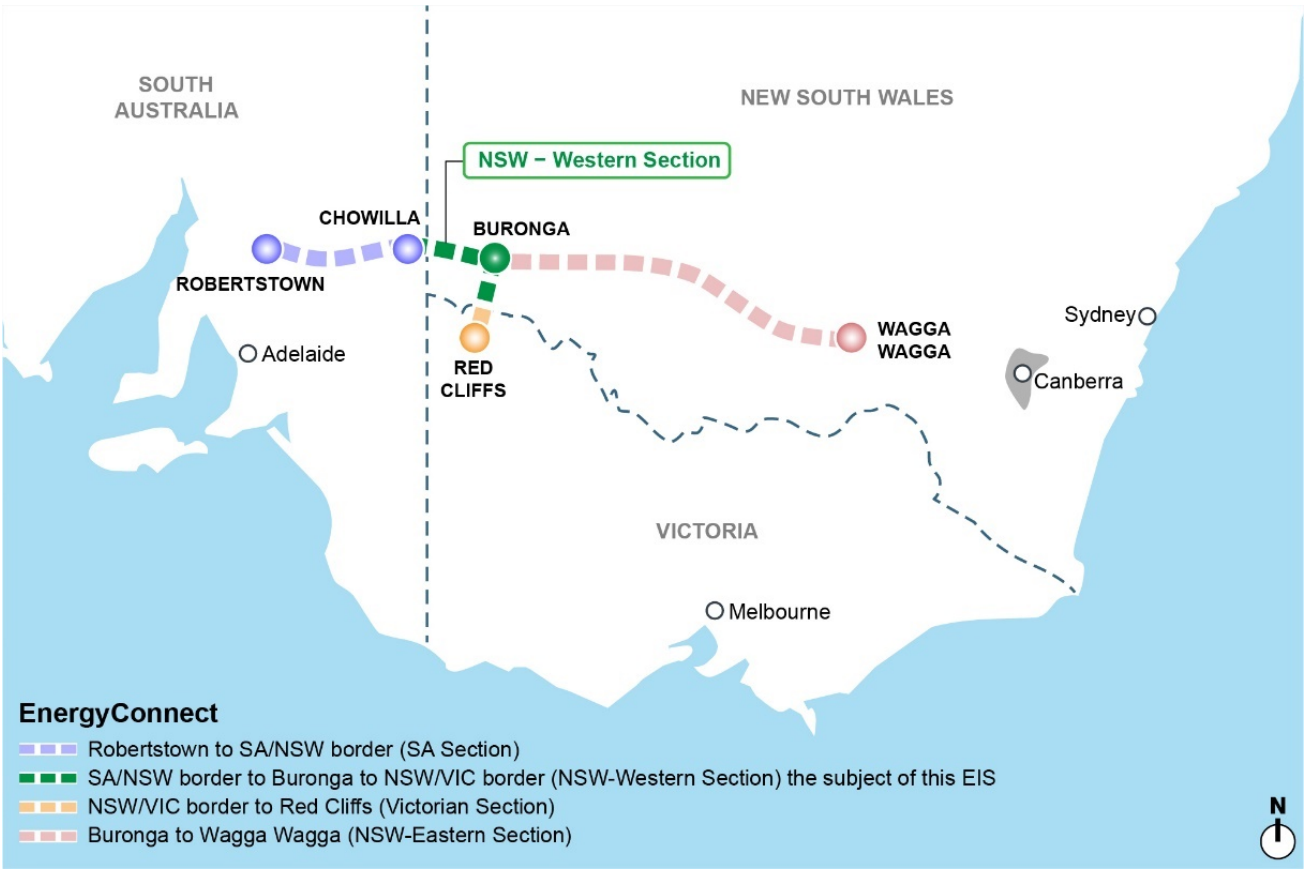

Figure 1.1 Overview of EnergyConnect

1.3 THE PROPOSAL

TransGrid is seeking approval under Division 5.2, Part 5 of the Environmental Planning and Assessment Act 1979 (the EP&A Act) to construct and operate the proposal. The proposal has been declared as Critical State significant infrastructure under Section 5.13 of the EP&A Act.

The proposal was also declared a controlled action on 26 June 2020 and requires a separate approval under the (Commonwealth) Environment Protection and Biodiversity Conservation Act 1999. The proposal is subject to the bilateral assessment process that has been established between the Australian and NSW governments.

The proposal is located in western NSW within the Wentworth Local Government Area (LGA), approximately 800 kilometres west of Sydney at its nearest extent. The proposal spans between the SA/NSW border near Chowilla and Buronga and the NSW/Victoria border at Monak, near Red Cliffs. It traverses around 160 kilometres in total.

1.3.1 KEY PROPOSAL FEATURES

The key components of the proposal include:

- about 135 kilometres of new 330 kilovolt (kV) double circuit transmission line and associated infrastructure between the SA/NSW border near Chowilla and the existing Buronga substation
- an upgrade of the existing 22 kilometre 220kV single circuit transmission line between the existing Buronga substation and the NSW/Victoria border at Monak, near Red Cliffs in Victoria to a 220kV double circuit transmission line, and the decommissioning of the 220kV single circuit transmission line (known as Line 0X1)
- a significant upgrade and expansion of the existing Buronga substation to a combined operating voltage 220kV/330kV
- a minor realignment of the existing 0X2 220kV transmission line, in proximity to the Darling River
- new and/or upgrade of access tracks as required
- ancillary works required to facilitate the construction of the proposal (e.g. laydown and staging areas, concrete batching plants, brake/winch sites, site offices and accommodation camps).

An overview of the proposal is provided in Figure 1.2. The final alignment and easement of the transmission line would be confirmed during detailed design and would be located within the transmission line corridor as shown in Figure 1.2.

Construction of the proposal would commence in mid-2021. The construction of the transmission lines would take approximately 18 months. The Buronga substation upgrade and expansion would be delivered in two components and would be initially operational by the end of 2022, with site decommissioning and rehabilitation to be completed by mid-2024.

Construction timeframes for the proposal are subject to approvals, and the final program would be confirmed during detailed design.

In assessing construction impacts an “indicative disturbance area” has been utilised, as detailed design has not yet been completed. For this report, the indicative disturbance area has the same meaning as ‘development site’ as defined in the BAM. The indicative disturbance area includes areas in which complete disturbance would occur (disturbance area A) and areas in which partial disturbance would occur (disturbance area B), generally associated with partial clearing within the transmission line corridor. These are more fully described in Sections 1.6 and 9 of this BDAR.

The proposal is also further described in Chapter 5 and Chapter 6 of the Environmental Impact Statement (EIS).

1.3.2 PROPOSAL NEED

The proposal is required to complete the missing transmission link between SA, and NSW transmission networks. The upgrade to the existing transmission line between Buronga and Red Cliffs would also enhance the capacity of the network to provide electricity between NSW and Victoria.

This connection would relieve system constraints and allow for NSW, SA and Victorian consumers to benefit from significant amounts of low-cost, large-scale solar generation in south-west NSW. The proposal is an essential component of EnergyConnect.

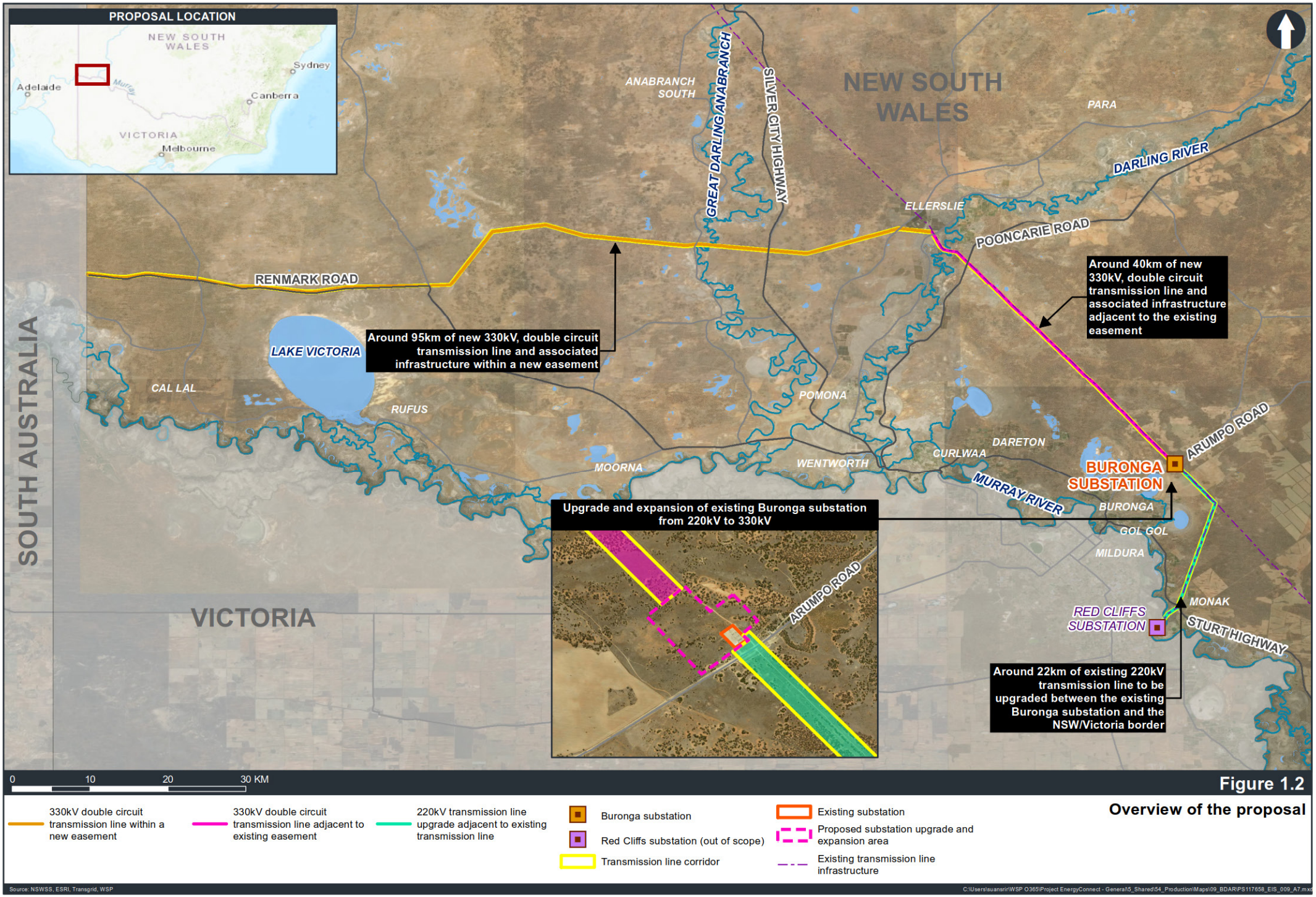

Figure 1.2

Overview of the proposal

1.4 PURPOSE OF THIS TECHNICAL REPORT

This technical paper is one of a number of technical papers that form part of the EIS for the proposal.

The purpose of this technical paper is to identify and assess the potential impacts of the proposal in relation to biodiversity. It responds directly to the Secretary's environmental assessment requirements (SEARs) (refer to Section 1.4.1) and has been prepared with consideration of:

- NSW *Biodiversity Conservation Act 2016* (BC Act)
- NSW Biodiversity Regulation 2017 (BC Reg)
- NSW Biodiversity Assessment Method 2017 (BAM)
- NSW *Fisheries Management Act 1994* (FM Act)
- Commonwealth *Environment Protection* and *Biodiversity Conservation Act 1999* (EPBC Act).

This report has the following objectives:

- to provide an assessment of biodiversity values within the proposal study area and the indicative disturbance area
- demonstrate the proposals effort to avoid and minimise impacts on biodiversity values
- mitigate and manage impacts on biodiversity values
- calculate the offset requirement for impacts on biodiversity values that are unable to be avoided
- provide an assessment of significance on threatened species, ecological communities or their habitats listed under the FM Act and EPBC Act.

Further detail on the methodology applied in this assessment are detailed in Chapter 3 of this technical paper

1.4.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The NSW Department of Planning, Industry and Environment (DPIE) has provided the SEARs for the EIS. The requirements specific to this assessment and where these aspects are addressed in this technical report are outlined in Table 1.1.

Table 1.1 Secretary's environmental assessment requirements – Biodiversity

REFERENCE	SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS	WHERE ADDRESSED
Biodiversity Key issues	The EIS an assessment of the biodiversity impacts of the project in accordance with the NSW *Biodiversity Conservation Act 2016*, the Biodiversity Assessment Method (BAM) and documented in a Biodiversity Development Assessment Report (BDAR).	This report is a BDAR that has been prepared in accordance with the BC Act and BAM
	The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM.	Refer to Chapters 8, 9 and 12
	An assessment of the impacts of the project on aquatic ecology including impacts on key fish habitat and threatened species of fish.	Refer to Section 6.3 and 9.8

In addition, Appendix A of the SEARs outlines biodiversity Matters of National Environmental Significance (MNES) including protected matters listed under the EPBC Act that require consideration within the BDAR. Appendix A of the SEARs states the list of protected matters are based on the information in the referral documentation, the location of the action, species records and likely habitat present in the area, that there are likely to be significant impacts to:

- Black-eared Miner (*Manorina melanotis*) – endangered.

Additionally, Appendix A of the SEARs states there is a possibility that the proposed action will have or is likely to have significant impacts on the following species and ecological communities and levels of impact should be further investigated:

- Australasian Bittern (*Botaurus poiciloptilus*) – endangered
- *Austrostipa metatoris* – vulnerable
- *Atriplex infrequens* – vulnerable
- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (*Allocasuarina luehmannii*) – endangered
- Coolibah Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions –endangered
- Corben's Long-eared Bat (*Nyctophilus corbeni*) – vulnerable, recorded in traps in the study area
- Curlew Sandpiper (*Calidris ferruginea*) – critically endangered
- Malleefowl (*Leipoa ocellata*) – vulnerable
- Mallee Emu-wren (*Stipiturus mallee*) – endangered
- Menindee Nightshade (*Solanum karsense*) – vulnerable
- Mossgiel Daisy (*Brachyscome papillosa*) – vulnerable
- Northern Siberian Bar-tailed Godwit (*Limosa lapponica menzbieri*) – critically endangered
- Plains Wanderer (*Pedionomus torquatus*) – critically endangered
- Red-lored Whistler (*Pachycephala rufogularis*) – vulnerable
- Regent Parrot (Eastern) (*Polytelis anthopeplus monarchoides*) – vulnerable
- Southern Bell Frog *(Litoria raniformis*) – vulnerable
- Swift Parrot (*Lathamus discolor*) – critically endangered
- Winged Pepper-cress (*Lepidium monoplocoides*) – endangered; and
- Yellow Swainson-pea (*Swainsona pyrophila*) – vulnerable.

MNES are addressed in Chapter 7, Section 9.9 and Appendix E of this BDAR.

1.5 STRUCTURE OF THIS REPORT

The structure and content of this report is as follows:

Stage 1 – Biodiversity assessment

- *Chapter 1 – Introduction:* Outlines the background and need for the proposal, and the purpose of this report.
- *Chapter 2 – Legislative and policy context:* Provides an outline of the key legislative requirements and policy guidelines relating to the proposal.
- *Chapter 3 – Methods:* Provides an outline of the methodology used for the preparation of this BDAR.
- *Chapter 4 – Landscape context:* Provides information on a range of landscape features in accordance with section 4 of the BAM that occur on the proposal study area and broader locality.
- *Chapter 5 – Native vegetation:* Provides information on native vegetation in accordance with section 5 of the BAM and matters relating to the BC Act.
- *Chapter 6 – Threatened species:* Provides information on threatened species in accordance with section 6 of the BAM and matters relating to the BC Act.
- *Chapter 7 – Matters on national environmental significance:* Describes biodiversity matters relating to Commonwealth legislation under the EPBC Act.

Stage 2 – Impact assessment

- *Chapter 8 – Avoid and minimise:* Provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the proposal in accordance with section 8 of the BAM.
- *Chapter 9 – Assessment of construction impacts:* Describes the potential construction impacts associated with the proposal. This chapter also includes potential construction cumulative impacts with respect to other known developments within the vicinity of the proposal.
- *Chapter 10 – Assessment of operational impacts:* Describes the potential operational impacts associated with the proposal. This chapter also includes potential operational cumulative impacts with respect to other known developments within the vicinity of the proposal.
- *Chapter 11 – Mitigation and management measures:* Outlines the proposed mitigation measures for the proposal on biodiversity matters.
- *Chapter 12 – Biodiversity credit report:* Provides an overview of the BAC calculator biodiversity credit report output.
- *Chapter 13 – Conclusion:* Provides a conclusion of the potential impacts of the proposal on biodiversity.
- *Chapter 14 – References:* Identifies the key reports and documents used to generate this report.

Appendices to this report includes:

- **Appendix A** – Methods
- **Appendix B** – Landscape features
- **Appendix C** – Native vegetation
- **Appendix D** – Threatened species
- **Appendix E** – Matters of national environmental significance
- **Appendix F** – Impact assessment
- **Appendix G** – Biodiversity credit report.

1.6 REPORT TERMINOLOGY

The following terms are discussed throughout this report and are defined as:

- **Proposal study area** – the study area for the environmental assessments to provide a broader understanding of the constraints and conditions of the locality. It comprises of a one kilometre wide corridor between the SA/NSW border near Chowilla and Buronga and a 200 metre wide corridor between Buronga and the NSW/Victoria border at Monak, near Red Cliffs. The transmission line corridor, Buronga substation upgrade and expansion, access tracks, and the main construction compounds and accommodation camps at Buronga and Anabranch South would be contained in this area.

- **Disturbance area** – the area that would be directly impacted by both construction and operation (including the areas that would be impacted by maintenance activities) of the proposal including all proposal infrastructure elements (including the proposed transmission line alignment, substation site works and other ancillary works i.e. the operational footprint) as well as locations for currently proposed construction elements such as construction compounds, access tracks and site access points, laydown and staging areas, concrete batching plants, brake/winch sites, site offices and accommodation camps.

  The disturbance area would have varying degrees of physical disturbance along the transmission line alignment to reflect construction and operational requirements – specifically:

  - disturbance area A, in which ground disturbance would be required
  - disturbance area B, in which ground disturbance is not required except in limited circumstances.

  For this biodiversity assessment, an *indicative* disturbance area has been applied.

  Disturbance area has the same meaning as ‘Development site’ as defined in the BAM.

- **Disturbance area A** – refers to an area around transmission towers and between transmission towers in which vegetation would be removed during construction and subject to ongoing maintenance during operation (i.e. removal to ground level) for operational and safety requirements (including bushfire).
- **Disturbance area B** – refers to an area between transmission towers in which trimming would only be required to meet the vegetation clearance heights, which would not require disturbance at ground level. However, where trees within this area would or have the potential to exceed vegetation clearance heights, these trees would be removed and may result in temporary ground disturbance. Vegetation clearance heights are set by TransGrid for operational and safety requirements, including bushfire risk management. For this report clearance heights are set at vegetation that exceeds two metres in height above ground level. This zone is a subset to the indicative disturbance area.
- **Locality** – the area within 10 kilometres of the proposal study area.
- **Subject land** – this is the same area as the proposal study area and used in the Stage 1 of the BAM.
- **Transmission line corridor** – the corridor in which the final easement and transmission line is expected to be contained within. It would consist of a 200 metre corridor along the transmission line component of the proposal. Essentially this is a refined proposal study area for the indicative disturbance areas associated with the main transmission line, excluding some access tracks and construction sites/camps.

1.7 LIMITATIONS

This Report is provided by WSP Australia Pty Limited (WSP) for TransGrid (Client) in response to specific instructions from the Client and in accordance with WSP's proposal and agreement with the Client (Agreement).

1.7.1 PERMITTED PURPOSE

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Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and/or recommendations in the Report (Conclusions) are based in whole or in part on information provided by the Client and other parties identified in the report (Information), those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

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This Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose. The Report does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise. It is the responsibility of the Client to accept (if the Client so chooses) any Conclusions contained within the Report and implement them in an appropriate, suitable and timely manner.

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1.7.5 FIELD SURVEY LIMITATIONS

No sampling technique can eliminate the possibility that a species is present on a site. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present on site during surveys. The conclusions in this report are based upon previous studies, data acquired for the site and the biodiversity field surveys and are, therefore, merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of species. Also, it should be recognised that site conditions, including the presence of threatened species, can change with time.

Given the nature and access restrictions of some sections of the study area were unable to be inspected. Where access was not available biodiversity values were extrapolated from desktop assessment.

2 LEGISLATIVE CONTEXT

This chapter provides an outline of the key biodiversity legislative requirements and policy guidelines relating to the proposal.

2.1 AUSTRALIAN GOVERNMENT

2.1.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

Based on an initial assessment of potential impacts to the listed threatened species identified the Preliminary Biodiversity Assessment (WSP 2020), a referral under the EPBC Act was submitted on 27 May 2020. Determination by the Department of Agriculture, Water and the Environment (DAWE) on 26 June 2020 confirmed the proposal to be a controlled action.

Part 5 provides for a written agreement between the Commonwealth and a State that is aimed at minimising duplication in the environmental assessment and approval process through the accreditation of that State's processes.

In February 2015, the Australian and NSW Governments entered a bilateral agreement under section 45 of the EPBC Act. Since entering that agreement, NSW has amended the accredited process through the repealing of the Threatened Species Conservation Act 1995 and the commencement of the BC Act and the Environmental Planning and Assessment Amendment Act 2017. The current agreement provides for certain actions that are State significant development or State significant infrastructure within the meaning of the EP&A Act to be accredited for the purposes of meeting the requirements for assessment and public exhibition of an action under the provisions of the EPBC Act.

Based on the proposal being deemed a controlled action by DAWE, the proposal is subject to the bilateral assessment process that has been established between the Australian and NSW governments. The requirements to meet this bilateral process have been included within the SEARs (refer to Section 1.4.1) and addressed in this report.

2.2 STATE GOVERNMENT

2.2.1 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

The EP&A Act provides the statutory controls that establish a framework governing what development is permitted or prohibited, and the processes for how assessment and gaining approval for development is undertaken in NSW. It is supported by the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) which provides additional detail and gives effect to the legislation.

Of relevance to the proposal, Part 5 of the EP&A Act deals with infrastructure and environmental impact assessment. Division 5.2 of Part 5 sets out the requirements for the assessment and approval of State Significant Infrastructure (SSI) and Critical State Significant Infrastructure (CSSI).

The Minister for Planning and Public Spaces has declared the proposal to be a CSSI project under Section 5.13 of the EP&A Act.

2.2.2 BIODIVERSITY CONSERVATION ACT 2016

The BC Act, together with the *Biodiversity Conservation Regulation 2017* (BC Reg), outlines the framework for assessment and approval of biodiversity impacts associated with developments that require consent under the EP&A Act. It introduces a Biodiversity Offsets Scheme (BOS), a framework to avoid, minimise and offset impacts on biodiversity from development and clearing. The proponent for a development to which the BOS applies is required to prepare a Biodiversity Development Assessment Report (BDAR) in support of an application for approval to undertake that development. The BDAR uses the Biodiversity Assessment Method (BAM) established under these biodiversity reforms to provide a methodology for determining the number and type of biodiversity credits required to offset biodiversity impacts.

CSSI projects are required to prepare a BDAR to identify and assess biodiversity impacts under the provisions of the BC Act and offset those impacts by retiring biodiversity credits, determined using the BAM, through the BOS.

This BDAR has been specifically prepared to address the BAM and associated guidance documents to enable development approval under Part 5 of the EP&A Act.

2.2.3 BIOSECURITY ACT 2015

The *Biosecurity Act 2015* provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Priority weeds recorded in the study area and their control measures are detailed in Section 5.3.

2.2.4 FISHERIES MANAGEMENT ACT 1994

The FM Act was introduced to conserve, develop and share the fishery resources of the State for the benefit of present and future generations, and applies to all waters within the area occupied by the proposal. Part 7 of the FM Act relates to the protection of fish and aquatic habitats with the objective of conserving the biodiversity of fish and aquatic vegetation. It provides for the management of certain works located on land that is permanently or intermittently submerged by water.

Pursuant to sections 201, 205 and 219 of the FM Act, works and activities such as those required for the proposal, may be undertaken under the authority of a permit.

The provisions of the FM Act do not apply to the proposal as it is CSSI under section 5.13 of the EP&A Act. Under the provisions of section 5.23(3) of the EP&A Act, directions, orders or notices that could otherwise be issued under Division 7 of Part 7A of the FM Act cannot be issued for approved CSSI .

Nevertheless, this report addresses biodiversity matters relating to threatened aquatic entities listed under the FM Act.

2.2.5 LOCAL LAND SERVICES ACT 2013

The LLS Act was introduced to provide direction around programs and services associated with agricultural production, biosecurity, natural resource management and emergency management. It aims to ensure the proper management of natural resources in the social, economic and environmental interests of the State, consistent with the principles of ecologically sustainable development. One of the ways that it intends to achieve this is through the regulation of clearing of native vegetation.

Part 5A of the LLS Act sets out the ways in which the regulating of activities (in connection with land management) would occur and the areas of the State to which it would apply. Section 60A applies Part 5A to rural area including lands associated with the proposal study area although Section 60O of the LLS Act deals excludes clearing that is authorised under other legislation. Furthermore, under the provisions of section 60O of the LLS Act the clearing of native vegetation is authorised if the clearing was authorised by a State significant infrastructure approval under Division 5.2 of the EP&A Act.

Under the BC Act, section 6.8(3) regulates that the BAM is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of LLS Act).

Category 1-exempt land is defined under the LLS Act (Part 5A Division 2 Section 60H) as:

Land is to be designated as category 1-exempt land if the Environment Agency Head reasonably believes that:

- *the land was cleared of native vegetation as at 1 January 1990, or*
- *the land was lawfully cleared of native vegetation between 1 January 1990 and the commencement of this Part.*

Land is to be designated as category 1-exempt land if the Environment Agency Head reasonably believes that:

- *the land contains low conservation value grasslands, or*
- *the land contains native vegetation that was identified as regrowth in a property vegetation plan referred to in section 9 (2) (b) of the Native Vegetation Act 2003, or*
- *the land is of a kind prescribed by the regulations as category 1-exempt land.*

All other rural lands that do not meet category 1 definition would form part of category 2 – regulated land or excluded lands as defined under the LLS Act. This BDAR applies to all lands containing native vegetation with the exception of category 1 – exempt land. The method for determining category 1 – exempt land for this proposal is outlined in Section 3.6.

3 METHODS

This section provides an outline of the methodology used for the preparation of this BDAR and to address MNES listed under the EPBC Act. All work was carried out under the appropriate licences, including a scientific licence as required under Part 2 of the BC Act (License Number: SL100630), and an Animal Research Authority issued by the Department of Primary Industries (Agriculture).

3.1 PERSONNEL

The contributors to the preparation of this report, their qualification and roles are provided below in Table 3.1.

Table 3.1 Contributors and their roles

NAME	QUALIFICATIONS	ROLE
Alex Cockerill	BSc (Hons), accredited BAM assessor BAAS17020	Principal Ecologist – technical review and field surveys
Toby Lambert	BEnvSc, accredited BAM assessor BAAS17046	Principal Ecologist – technical review, report preparation and field surveys
Mark Stables	BSc (Hons), accredited BAM assessor BAAS18097	Principal Ecologist – report preparation field surveys
Nathan Cooper	BEnvSc, GradDipOrnith	Senior Ecologist – field surveys
Josie Stokes	BSc (Zoology)	Principal Ecologist – field surveys
Lukas Clews	BSc, GradCertAppSci, MSciStud Accredited BAM Assessor (BAAS17060)	Principal Ecologist – field surveys and report preparation
Tanya Bangel	BSc (Hons), DipConsLdMgt, accredited BAM assessor BAAS18076	Senior Ecologist – field surveys and reporting
Allan Richardson	BSc (Hons)	Senior Ecologist – field surveys and report preparation
Julia Emerson	BSc, accredited BAM assessor BAAS18034	Ecologist – report preparation, field surveys
Troy Jennings	BSc, Dip Wildlife Mgt	Ecologist – report preparation, field surveys
Gavin Shelley	BEnvScMgt	Ecologist – field surveys
Clementine Watson	BEnvScMgt, accredited BAM assessor BAAS18164	Ecologist – report preparation
Trent Bowman	BSc (Hons), Masters of Science (Geoscience)	GIS Consultant – mapping and data management
Robert Suansri	BSc (GIS)	GIS Consultant – spatial data management and figure preparation
Dr Ian Sluiter	BSc (Hons), Ph.D. Monash University	Principal Director – Mallee Ecological Expert Ogyris Ecological Research – targeted threatened flora and fauna surveys
Geoffrey Allen	BSc (Hons)	Senior Ecologist – Ogyris Ecological Research – targeted threatened flora and fauna surveys

3.2 NOMENCLATURE

Names of vegetation communities used in this report are based on the Plant Community Type (PCT) used in the NSW BioNet Vegetation Classification Database (Office of Environment & Heritage, 2020a).

These names are cross-referenced with those used for threatened ecological communities listed under the BC Act and/or the EPBC Act.

Names of plants used in this document follow PlantNet (Royal Botanic Gardens, 2020) and VICFLORA (Royal Botanical Gardens Victoria (2020). Scientific names are used in this report for species of plant. The names of introduced species are denoted with an asterisk (*).

For threatened species of plants, the names used in the BioNet Atlas of NSW Wildlife (Office of Environment & Heritage, 2020b) are also provided where these differ from the names used in the PlantNet VICFLORA databases.

Names of vertebrate fauna follow the Australian Faunal Directory maintained by the Department of Environment and Energy (2020a). Common names are used in the report for species of animal. Both common and scientific names are provided in appendices.

For threatened species of animals, the names used in the BioNet Atlas of NSW Wildlife and NSW Department Primary Industries (Office of Environment & Heritage, 2020b) are provided.

3.3 SOURCES OF INFORMATION USED IN THIS ASSESSMENT

The following information sources have been used in the preparation of this report:

- Aerial photographic imagery (Land and Property Information, 2020a)
- NSW Mitchell Landscapes (Land and Property Information, 2020b)
- Interim Biogeographic Regionalisation of Australia (IBRA version 7.0) (Department of Environment & Energy 2016)
- Atlas of Groundwater Dependent Ecosystems (GDE) (Australian Bureau of Meteorology 2020)
- Directory of Important Wetlands of Australia (Department of Environment & Energy 2020b)
- Register of Declared Areas of Outstanding Biodiversity Value – Critical habitat declarations in NSW (Office of Environment & Heritage 2020a)
- State Vegetation Type Map: Western Region Version v1.0 – VIS_ID 4492 (Office of Environment & Heritage 2016)
- BioNet Threatened Species Profile Database (Office of Environment & Heritage 2020b)
- Species Profiles and Threats Database (Department of the Environment and Energy 2020a)
- Atlas of Living Australia – interactive map search (Atlas of living Australia 2020).

A review of proposal specific documentation including:

- Preliminary Biodiversity Assessment, Project EnergyConnect Border to Buronga. WSP 2020
- Project EnergyConnect – EPBC Act Protected Matters Significant Impact Assessment – SA / NSW Border to Buronga, Draft (Jacobs, 2019a)
- Preliminary Ecological Constraints Assessment, prepared for ElectraNET and TransGrid. Jacobs (2019b).
- Relevant DAWE requirements including the SEARs and conservation advices and recovery plans (as outlined in Section 9.9.7 of this BDAR).

3.4 DATABASE SEARCHES

The aim of the background research was to identify threatened flora and fauna species, populations and ecological communities, Australian Government listed Migratory species or critical habitat recorded previously or predicted to occur in the locality.

This allowed for known habitat characteristics of to be compared with those present within the proposal study area to determine the habitat suitability of each species or populations. It also further enabled justification for inclusion of any additional predicted or candidate threatened flora and fauna species not identified by the BAM calculator.

Records of threatened species, populations and ecological communities known or predicted to occur in the locality of the proposal study area were obtained from a range of databases as detailed in Table 3.2.

Table 3.2 Database searches

DATABASE	SEARCH DATE	AREA SEARCHES	REFERENCE
PlantNet Database	21/08/2020	The Wentworth Local Government Area	(Royal Botanic Gardens, 2020)
EES BioNet Atlas of NSW Wildlife	21/08/2020	North: -33.60 West: 140.96 East: 142.42 South: -34.47	(Office of Environment Energy and Science, 2020)
EPBC Protected Matters Search Tool	21/08/2020	25 km buffer of the proposal study area	(Department of Environment and Energy, 2020e)
Biodiversity Assessment Method (BAM) Calculator (Credit Calculator)	N/A	The following IBRA subregions: — South Olary Plain — Great Darling Anabranch — Pooncarie – Darling — Robinvale Plain	(NSW Government, 2020)
NSW Department of Primary Industries (Fishing and Aquaculture) threatened Aquatic Fauna Database	21/08/2020	The Wentworth Local Government Area	(NSW Department of Primary Industries, 2020)

3.4.1 LIKELIHOOD OF OCCURRENCE ASSESSMENT

An assessment was completed to assess the likelihood of occurrence of each threatened species, population and community (threatened biodiversity) identified with the potential to occur in the proposal study area. All threatened biodiversity identified during background research were considered (refer to Table 3.2). The habitat assessment was utilised to inform the identification of appropriate targeted surveys. The assessment was based on the habitat profile for the species and other habitat information in the *Threatened Species Profile Database* (Office of Environment and Heritage, 2020) and the *Species Profile and Threats Database* (Department of the Environment and Energy, 2020). The assessment also included consideration of the dates and locations of nearby records and information about species populations in the locality. The assessment results are provided in full in Appendix D-1 and Appendix D-2.

The likelihood of potential habitat for each threatened flora species was further reviewed by a local mallee flora expert, Dr Ian Sluiter.

For this study, the likelihood of occurrence of threatened and migratory species and populations was determined based on the criteria shown in Table 3.3 and Table 3.4.

Table 3.3 Likelihood of occurrence criteria for threatened flora species

LIKELIHOOD	CRITERIA
Known	The species was observed in the study area either during the current survey or during another survey less than one year prior.
High	A species has a high likelihood of occurrence if: — the study area contains or forms part of a large area of high-quality suitable habitat that has not been subject to recent disturbance (e.g. fire), the species is known to form a persistent soil seedbank and the species has been recorded recently (within 10 years) in the locality — the species is a cryptic flowering species that has been recorded recently (within 10 years) in the locality and has a large area of high-quality potential habitat within the proposal disturbance area that was not seasonally targeted by surveys.
Moderate	A species has a moderate likelihood of occurrence if: — the species: — has a large area of high-quality suitable habitat in the study area that has not been subject to recent disturbance (e.g. fire) — the species is known to form a persistent soil seedbank — the species has not been recorded recently (within 10 years) in the locality — the species: — has a small area of high-quality suitable habitat or a large area of marginal habitat in the study area that has not been subject to recent disturbance (e.g. fire) — the species is known to form a persistent soil seedbank — the species has been recorded recently (within 10 years) in the locality — the species is a cryptic flowering species, with a small area of high-quality potential habitat or a large area of marginal habitat within the proposal disturbance area, that was not seasonally targeted by surveys.
Low	A species has a low likelihood of occurrence if: — it is not a cryptic species, nor a species known to have a persistent soil seedbank species and was not detected despite targeted searches — the species is a cryptic flowering species, with a small area of high-quality potential habitat or a large area of marginal habitat within the proposal disturbance area, that was not seasonally targeted by surveys as the species has not been recorded within 50 years in the locality.
None	Suitable habitat is absent from the proposal disturbance area.

Table 3.4 Likelihood of occurrence criteria for threatened fauna species

LIKELIHOOD	CRITERIA
Known	The species was observed in the study area either during the current survey or during another survey less than one year prior.
High	A species has a high likelihood of occurrence if: — the study area contains or forms part of a large area of high-quality suitable habitat — important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are abundant within the study area — the species has been recorded recently in similar habitat in the locality — the study area is likely to support resident populations or to contain habitat that is visited by the species during regular seasonal movements or migration.
Moderate	A species has a moderate likelihood of occurrence if: — the study area contains or forms part of a small area of high-quality suitable habitat — the study area contains or forms part of a large area of marginal habitat — important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are sparse or absent within the study area — the study area is unlikely to support resident populations or to contain habitat that is visited by the species during regular seasonal movements or migration but is likely to be used occasionally during seasonal movements and/or dispersal.
Low	A species has a low likelihood of occurrence if: — potentially suitable habitat exists but the species has not been recorded recently (previous 10 years) in the locality despite intensive survey (i.e. the species is considered to be locally extinct) — the species is considered to be a rare vagrant, likely only to visit the study area very rarely; e.g. during juvenile dispersal or exceptional climatic conditions (e.g. extreme drought conditions in typical habitat of inland birds).
None	Suitable habitat is absent from the study area.

3.4.2 IDENTIFICATION OF PREDICTED AND CANDIDATE SPECIES

Candidate species are those that have been assessed as having a moderate to high likelihood of occurring in the proposal study area based on desktop assessment and field assessment. Candidate species can form ecosystem credit species or species credit species as defined under the BAM:

- Ecosystem species credits: are a measurement of the value of threatened communities and habitat for those species that can be reliably predicted to occur with a Plant Community Type (PCT).
- Species credits: are generated by those species that were recorded during field surveys (or recorded during previous surveys) (as per Biodiversity Assessment Methodology).
- Targeted surveys were undertaken for candidate species as outlined in Chapter 3 & Appendix A-2 and Appendix A-3 below.

As stated in the BAM subsection 6.4.1.17 (Office of Environment & Heritage, 2017), a candidate species credit species will be considered unlikely to occur in the proposal study area if:

- after carrying out a field assessment of the habitat constraints or microhabitats on the proposal study area, the assessor determines that the habitat is substantially degraded such that the species is unlikely to utilise the proposal study area; or
- an expert report that is prepared in accordance with subsection 6.5.2 states that the species is unlikely to be present on the proposal study area or specific vegetation zones.

A candidate species credit species that is not considered to have suitable habitat on the proposal study area does not require further assessment on the proposal study area (Office of Environment & Heritage, 2017). A likelihood of occurrent assessment has been undertaken for all identified threatened species in Appendix D-1 and Appendix D-2

3.5 SURVEY DATES AND WEATHER

3.5.1 RAINFALL

Rainfall leading up to and during the survey period is discussed in this section. Drought conditions experienced across the proposal study area were prevailing throughout 2018 and 2019. Table 3.5 compares the seasonal rainfall and total annual rainfall of two weather stations; Irymple (Arlington) and Renmark Irrigation.

Irymple (Arlington) weather station (AWS 76015) is approximately 10 kilometre south of the most easterly section of the proposal study area near Red Cliffs. The mean annual rainfall recorded at this weather station is 270.9 millimetres. A total of 60 percent and 40 percent of the mean was recorded in 2018 and 2019 respectively.

Renmark Irrigation weather station (AWS 24003) is approximately 40 kilometres south west of the most westerly section of the proposal study area near the SA border. The mean annual rainfall recorded at this weather station is 251.4 millimetres. A total of 66 per cent and 44 per cent of the mean was recorded in 2018 and 2019 respectively.

Table 3.5 Rainfall averages 2015–2020

PERIOD	SUMMER	AUTUMN	WINTER	SPRING	TOTAL
Irymple (Arlington) AWS 76015					
2015	60.6	99.8	53.8	26	240.2
2016	46.4	58.2	69.2	171.2	345
2017	83.6	64.6	35.2	108.8	292.2
2018	64.2	23.6	29.6	44.6	162
2019	6.8	37.8	37.2	26	107.8
2020	4.8	73.4	–	–	–
Renmark Irrigation AWS 24003					
2015	60.4	71.8	39.2	61.2	232.6
2016	64	45.7	56.4	148.8	314.9
2017	84	52.2	47.6	56.7	240.5
2018	43.8	21.8	66	34.6	166.2
2019	5	22.2	43.9	39.6	110.7
2020	31.6	85.6	–	–	–

Source: Climate data online (Bureau of Meteorology 2020)

Drought conditions influenced the diversity and cover of all species in the ground and shrub stratum as well as the detectability of threatened flora species for surveys carried out in 2019 and summer 2020.

Following these drought conditions, above average autumn and late winter rainfall in 2020 was recorded across the proposal study area (refer to Table 3.6). This created suitable non-drought field survey conditions for targeted threatened species 2020 autumn and spring surveys.

Table 3.6 Mean monthly rainfall for Mildura and recorded monthly rainfall during field surveys

MILDURA	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Mean rainfall (mm)	26.6	28.2	25.9	25.2	21.9	21.5	19.4	19.5	25.1	21.8	24.5	25.4
Total	12.0	0.0	13.8	2.6	2.8	11.0	27.6	48.6	9.6	8.4	6.2	41.6

Source: Mildura Airport 076031 (Bureau of Meteorology 2020)

3.5.2 DROUGHT-AFFECTED/NON-DROUGHT AFFECTED

The field survey design for candidate threatened flora species initially assessed a species susceptibility and detectability under drought conditions. This assessment was informed by relevant threatened species profile advice and the BAM-C, along with Bionet atlas database records and genus and habit/growth form of species. This included forbs such as *Lepidium monoplocoides* and *Solanum karsense* that considered likely to dieback as well as perennial grasses such as *Austrostipa nullanulla* due to intensity of grazing pressure. Those species considered drought-affected were unlikely to be detected during targeted surveys in 2019 and subject to additional post drought surveys in 2020.

Non-drought affected species were grouped according to life form, seasonal survey requirements and areas of potential habitat within the proposal study area.

Non-drought affected species included small trees and shrubs such as *Acacia carneorum* and *Santalum murrayanum* as well as perennial forbs known to be drought tolerant such as *Atriplex infrequens* and *Kippistia suaedifolia*. These species could be reliably detected through targeted surveys during extreme drought conditions throughout 2019 and 2020.

3.5.3 SURVEY DATES AND WEATHER OBSERVATIONS

Weather conditions observed during the biodiversity field survey period are outlined in Table 3.7.

Table 3.7 Weather conditions observed during biodiversity field survey period

SURVEY DATE	TEMPERATURE (°C)		RAINFALL (MILLIMETRES)	WIND DIRECTION/SPEED (KPH)	
	Minimum	Maximum		9 am	3 pm
5/08/19 *	0.9	17.3	0	N 11	NNE 7
6/08/19 *	3.2	19.9	0	NNE 11	NNW 15
7/08/19 *	3.0	20.6	0	NNE 7	NNW 11
8/08/19 *	7.2	16.1	0	WNW 22	WNW 37
9/08/19 *	7.4	14.3	1.2	W 20	W 26
10/08/19 *	4.4	14.3	0.4	WSW 19	SW 24
11/08/19 *	6.5	14.2	1.6	SW 24	SSW 22
12/08/19 *	1.5	14.8	0.2	SSW 11	SSW 13
13/08/19 *	1.5	14.5	0	Calm	SSW 11

SURVEY DATE	TEMPERATURE (°C)		RAINFALL (MILLIMETRES)	WIND DIRECTION/SPEED (KPH)	
	Minimum	Maximum		9 am	3 pm
13/10/19	12.6	25.8	0	NNE 20	N 24
14/10/19	13.4	27.6	0	S 20	W 13
15/10/19	9	25.1	0	SW 11	SSW 13
16/10/19	12.3	20.8	0	S 15	S 19
17/10/19	8.5	20.7	0	WSW 17	WSW 22
18/10/19	4.1	28.2	0	NNE 26	NW 26
19/10/19	7.8	21.3	0	WSW 17	WSW 24
20/10/19	5.6	23.3	0	SSW 15	SSW 11
21/10/19	7.2	27.1	0	ESE 15	S 19
22/10/19	8.4	31.3	0	ESE 13	SE 9
23/10/19	11.2	34.4	0	NE 13	W 7
24/10/19	16.2	37.9	0	NE 15	NW 24
25/11/19	13	34.2	0	NNE 24	NW 19
26/11/19	11.7	23.7	0	SW 28	SW 28
27/11/19	7.5	28.5	0	E 6	NW 15
28/11/19	12.1	32.2	0	SSE 17	W 11
29/11/19	14.2	32.2	0	SSW 11	WNW 22
30/11/19	9.9	22.5	1.2	SSW 17	SW 19
1/12/19	8.8	21	0	WNW 13	WNW 28
2/12/19	11.7	21.1	2.6	WSW 24	SW 24
3/12/19	9.1	26.3	0	WSW 19	SW 22
4/12/19	9.5	29.2	0	SSW 24	W 15
5/12/19	11	31.5	0	W 9	WSW 24
6/12/19	10.2	29	0	SSW 15	SW 15
19/12/19	21.5	45.2	0	S 6	NNW 7
20/12/19	27.8	46.8	0	NE 19	N 26
21/12/19	22	33.4	0	SSW 17	S 20
22/12/19	15.5	32.8	0	SSE 19	ESE 15
23/12/19	17.6	37.1	0	E 13	SSE 7
10/02/20	18.5	29.8	0	S 17	S 19
11/02/20	18.8	34	0	SW 11	SSW 19
12/02/20	18.7	33.5	0	SSE 24	SSW 13

SURVEY DATE	TEMPERATURE (°C)		RAINFALL (MILLIMETRES)	WIND DIRECTION/SPEED (KPH)	
	Minimum	Maximum		9 am	3 pm
13/02/20	21.3	38	0	SE 17	E 11
14/02/20	25.9	37.2	0	N 7	W 15
15/02/20	19.5	32	0	SSW 17	SSW 13
16/02/20	15.5	31.5	0	S 13	W 15
17/02/20	15	34.1	0	SW 11	SSW 13
18/02/20	18.2	27.5	0	WSW 28	WSW 28
19/02/20	14.5	26.1	0	SW 20	S 22
20/02/20	11.4	25.8	0	SSE 17	SSW 19
17/03/20	14.2	31.5	0	NE 17	NNE 15
18/03/20	18.3	34.4	0	NNE 13	NW 13
19/03/20	21	36.8	0	N 15	N 22
20/03/20	13	27.6	0	WSW 17	SW 19
21/03/20	12.1	26.6	0	SE 11	WSW 9
22/03/20	13.1	25.2	0	S 17	S 13
29/04/20	12.5	18	3.6	NNW 11	N 9
30/04/20	9.1	15	11.4	W 15	W 22
01/05/20	8.3	15.5	0.4	WNW 22	WSW 24
02/05/20	10.1	18.2	7.2	W 20	WSW 24
03/05/20	5.6	15.7	0.2	SW 11	SW 11
04/05/20	5.1	15.2	0	SSW 6	SSE 9
05/05/20	4.0	18.3	0	NNE 7	NE 9
06/05/20	6.6	21.3	0	NNE 13	N 20
15/07/20	-0.5	16.3	0	SSW 4	W 9
16/07/20	-1.2	17.5	0	Calm	SSE 9
17/07/20	-1.2	16.8	0	Calm	WSW 4
18/07/20	3.0	16.6	0	NNE 13	N 20
19/07/20	5.5	18.3	0	NW 11	W 26
20/07/20	2.6	16.3	0	W 9	SW 13
21/07/20	4.0	13.3	0	S 7	S 13
22/07/20	0.7	14.3	0	S 4	S 17
23/07/20	-2.2	15.5	0	S 6	E 9
24/07/20	1.4	18.9	0	NE 9	N 13

SURVEY DATE	TEMPERATURE (°C)		RAINFALL (MILLIMETRES)	WIND DIRECTION/SPEED (KPH)	
	Minimum	Maximum		9 am	3 pm
01/09/20	2.4	18.4	0	NNE 19	N 22
02/09/20	9.6	29.3	0	NNE 24	NW 19
03/09/20	7.7	22.7	0	NW 20	W 24
04/09/20	6.7	19.3	0	N 13	W 17
05/09/20	8.8	20.2	0	W 11	W 15
06/09/20	6.5	24.7	0	NNE 20	NNE 26
07/09/20	10.4	26.8	0	NNE 19	NNE 33
08/09/20	15.3	28.7	0	NNW 17	S 11
09/09/20	11.4	20.4	2.2	SSE 17	S 15
10/09/20	2.1	22.9	0	ESE 11	ESE 7

Note: * Preliminary ecology surveys conducted by Jacobs.

3.6 NATIVE VEGETATION METHODS

3.6.1 METHOD FOR DETERMINING CATEGORY 1 – EXEMPT LAND

Category 1-exempt land has not currently been mapped for use in NSW and as such native vegetation regulatory mapping has been determined based on an analysis of the following datasets:

- historical and current aerial imagery of the proposal study area
- historical and current land use component – NSW Landuse 2013 (https://data.nsw.gov.au/data/dataset/nsw-landuse-2013). This dataset is used to classify areas as either cleared/highly disturbed, impacted affected areas of native vegetation and undisturbed or protected areas of native vegetation
- detectable woody vegetation clearing component – NSW Woody Vegetation Extent 2011 (https://datasets.seed.nsw.gov.au/dataset/nsw-woody-vegetation-extent-2011c0569). This dataset is used to identify areas of extant remnant vegetation and cleared lands/non-woody vegetation
- sensitive regulated and vulnerable regulated lands on the Native Vegetation Regulatory Map portal
- field validated high resolution vegetation mapping of the proposal study area (WSP 2020)
- State Vegetation Type Map: Western Region Version v1.0 – VIS_ID 4492 (OEH 2016) (This vegetation mapping project was only used where field validation was unable to be conducted due to restricted landholder access).A draft Category 1 map was supplied to the Biodiversity and Conservation Division (BCD) of DPIE on 8 July 2020 and a response received on 5 August 2020 requesting further information on specific areas and more detailed methodology requirements. All areas of Category 1 lands have subsequently been field verified and updated within this BDAR accordingly such that these requests for additional information have been resolved.

3.6.2 STRATIFICATION AND VERIFICATION OF EXISTING NATIVE VEGETATION MAPPING

Preliminary mapping of vegetation community boundaries was undertaken through analysis of existing vegetation mapping and aerial photograph interpretation.

Vegetation within the proposal study area and locality has been mapped at the regional scale in:

- State Vegetation Type Map: Western Region Version v1.0 – VIS_ID 4492 (OEH 2016c).

This mapping was further refined within the proposal study area as part of preliminary documentation for the proposal in:

- Preliminary Ecological Constraints Assessment, prepared for ElectraNET and TransGrid. (Jacobs 2019b).

Data on geology, dominant canopy species, native species richness, vegetation structure and condition was collected from areas able to be accessed during field surveys to validate and refine this existing vegetation mapping to determine their associated PCT in accordance with the BioNet Vegetation Classification System (EES, 2020).

In areas that were unable to be surveyed due access restrictions, existing mapping undertaken as part of the State vegetating mapping of the western region (OEH 2016c) was adopted.

3.6.3 MAPPING OF NATIVE VEGETATION ZONES

The vegetation within the proposal study area was firstly assessed to a PCT level and then aligned to a vegetation zone which is defined in the BAM as 'an area of native vegetation on the study area that is the same PCT and has a similar broad condition state' (OEH, 2017a).

A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition.

Broad condition state is used for stratifying areas of the same PCT into a vegetation zone for determining the vegetation integrity score. Broad condition states used for this report are outlined in Table 3.8.

Table 3.8 Native vegetation broad condition states

BROAD CONDITION STATE	DESCRIPTION
Intact	Native vegetation where all tree, shrub, grass and/or forb structural growth form groups expected for a plant community type are present. Exotic weed cover is generally <30%.
Modified	Native vegetation where one or more structural understorey components of the vegetation is entirely removed or severely reduced. Exotic weed cover is generally >30%. Two variants of this broad condition state were applied to the Mallee vegetation, being 'Bull' and 'Whipstick'. These variants were used to distinguish between areas which either contained a mature or semi-mature canopy cohort due to past disturbances such as fire regimes and past tree clearing. Where these disturbances were higher the canopy cohort was generally younger and had not yet had time to form hollows (whipstick variant). Where these disturbances were less the canopy cohort was generally older (Bull) and contained hollow bearing trees.
Derived	PCTs that have changed to an alternative stable state because of land management practices since European settlement. Over-storey structural components of derived communities have either entirely been removed or are severely reduced (i.e. derived native grasslands with or without scatted paddock trees). Exotic weed cover is <50%.

3.6.4 VEGETATION INTEGRITY PLOTS METHOD

Vegetation integrity plots were completed in accordance with BAM. A schematic diagram illustrating the layout of each vegetation integrity plot is provided in Figure 3.1.

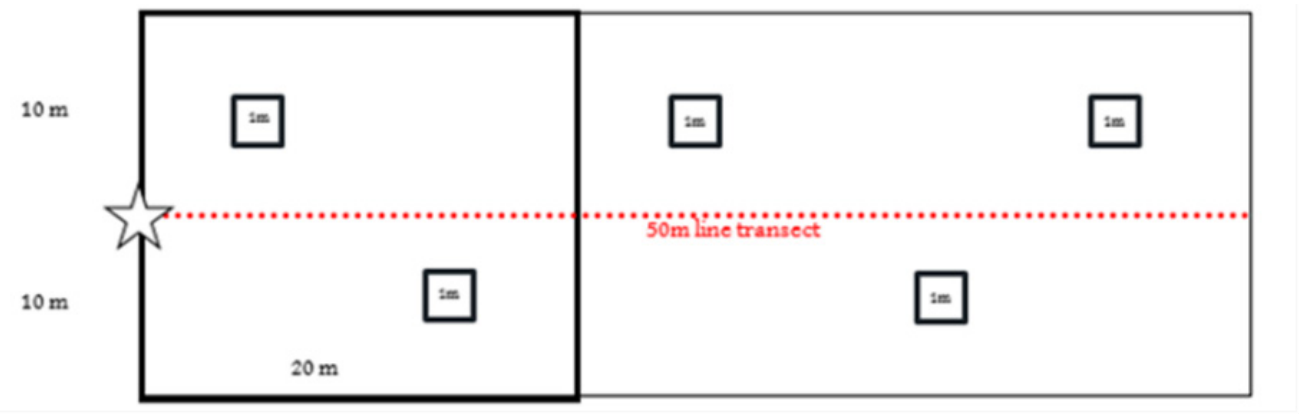

Figure 3.1 Vegetation integrity plot layout

The following site attributes were recorded at each vegetation integrity plot location:

- **location:** (easting – northing grid type MGA 94, Zone 56)
- **vegetation structure and dominant species and vegetation condition:** Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer
- **native and exotic species richness** (within a 400-metre squared quadrat): This consisted of recording all species by systematically walking through each 20 metre x 20 metre plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded
- **number of trees with hollows** (1000 metre squared quadrat): This was the frequency of hollows within living and dead trees within each 50 metre x 20 metre plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least five centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least one metre above the ground and the (e) the centre of the tree was located within the sampled quadrat
- **number of large trees and stem size diversity** (1000 metre squared quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of all living trees (greater than five centimetre DBH) within each 50 metre x 20 metre plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks
- **total length of fallen logs** (1000 metre squared quadrat): This was the cumulative total of logs within each 50 metre x 20 metre plot with a diameter of at least 10 centimetres and a length of at least 0.5 metre
- **litter cover:** This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 centimetre which is detached from a living plant) from within five 1 metre x 1 metre sub-plots spaced evenly either side of the 50-metre central transect
- **evaluation of regeneration:** This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height less than or equal to five centimetres).

Prior to establishing plot survey locations, vegetation stratification was undertaken to provide a representative vegetation zone for sampling. Stratification involved marking waypoints and bearings randomly to provide a representative assessment of the vegetation integrity of the vegetation zone in the study area and establishing the required number of plots at some of these waypoints.

Vegetation integrity plots used for BAM calculations rely on a combination of plots collected by WSP (2020) and Jacobs (2019).

Vegetation integrity plots used for BAM calculations for each IBRA subregion have been sampled within the broader proposal study area. Given the relatively homogenous broad condition states for vegetation types over the four IBRA subregions, plots have been used for multiple IBRA subregions rather than individual sampling for each subregion.

3.6.5 VEGETATION INTEGRITY PLOT SURVEY EFFORT

A total of 86 vegetation integrity plots were sampled using the method contained in the BAM and as described in section 3.6.4. The minimum number of vegetation integrity plots required per vegetation zone is presented in Table 3.9 with plot locations details outlined in Appendix A-1 and Appendix A-4. Full vegetation integrity plot data is presented in Appendix C-3.

Table 3.9 Minimum number of vegetation integrity plots required per vegetation zone area

VEGETATION ZONE	INDICATIVE DISTURBANCE AREA (HA)[1]	MINIMUM PLOTS REQUIRED	PLOTS COMPLETED
Arid Shrublands (Acacia sub-formation)			
PCT 139 – Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions (modified)	2.05	2	Q79, Q80
PCT 143 – Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes (modified)	0.99	1	Q100
Arid Shrublands (Chenopod sub-formation)			
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (modified)	62.73	5	Q54, Q55, Q76, Q78, Q87, Q88
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains (modified)	9.88	3	Q47, Q53, Q67
PCT216 – Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion (modified)	0.54	1	Q31
Forested Wetlands			
PCT11 – 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) (modified)	1.58	1	Q34, Q83
Freshwater Wetlands			
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	0.04	1	Q33
Saline Wetlands			
PCT 63 – Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones (modified)	0.30	1	Q39, Q86
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW (modified)	2.53	2	Q81, Q82

VEGETATION ZONE	INDICATIVE DISTURBANCE AREA (HA)[1]	MINIMUM PLOTS REQUIRED	PLOTS COMPLETED
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified – boninka)	2.84	2	Q48, Q65
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified – lunette)	2.07	2	Q49, Q50, Q56, Q64
Semi-arid Woodlands (Grassy sub-formation)			
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	6.81	3	Q27, Q32, Q103
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (derived)	0.47	1	Q35
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	83.33	5	Q70, Q73, Q77, Q84, Q85
Semi-arid Woodlands (Shrubby sub-formation)			
PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains (modified)	2.91	2	Q36, Q68, Q69
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion (modified)	11.11	3	Q37, Q38, Q42, Q66
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion (modified)	89.67	5	Q41, Q60, Q74, Q98, Q110
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion (derived)	36.63	4	Q52, Q63, Q71, Q75, Q97
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (modified bull)	28.03	4	Q91, Q92, Q93, Q95
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (modified whipstick)	133.00	6	Q44, Q46, Q102, Q104, Q105, Q111
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (derived)	34.53	4	Q28, Q29, Q40, Q61
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion (modified bull)	6.35	3	Q62, Q89, Q90
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion (modified whipstick)	49.13	5	Q43, Q45, Q99, Q101, Q106
PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone (modified whipstick)	28.17	4	Q94, Q96, Q107, Q108

VEGETATION ZONE	INDICATIVE DISTURBANCE AREA (HA)[1]	MINIMUM PLOTS REQUIRED	PLOTS COMPLETED
PCT 221 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones (modified)	3.37	2	Q51, Q109
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion (modified)	2.38	2	Q59, Q72
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion (derived)	5.32	3	Q57, Q58, Q112

(1) This is the total indicative disturbance area that includes a sum of all vegetation zones within all four IBRA subregions.

3.7 THREATENED FLORA SURVEY METHODS

3.7.1 CANDIDATE THREATENED FLORA SPECIES FIELD SURVEY APPROACH

Targeted threatened flora surveys were planned with a phased approach:

- survey was designed to maximise the likelihood of detection of targeted threatened plant species by:
  - identifying drought and non-drought affected species
  - grouping those species considered likely to be reliably detected through survey according to optimal months of survey and their specific associated habitat
- field survey techniques were assigned to areas of associated habitat based on number of associated candidate species, likelihood to support candidate species, condition and presence of associated microhabitats. The likelihood of potential habitat for each threatened flora species was further reviewed by the local mallee flora expert Dr Ian Sluiter
- the following field survey techniques were used to undertake targeted seasonal surveys in general accordance with the NSW Guide to Surveying Threatened Plants (Office of Environment and Heritage, 2016) and Surveying threatened plants and their habitats; NSW guide for the BAM (Department of Planning, Industry and Environment, 2020):
  - parallel field traverses
  - representative parallel field traverses (1 and 0.5 kilometre sections)
  - parallel field traverses of microhabitats
  - rapid data point assessment of threatened flora habitats
  - driving transects for large and medium tree and shrub forms of plants (driving slowly) along entire indicative disturbance area

  It is acknowledged that the later field survey guidelines published by the Department of Planning, Industry and Environment were released during and following completion of most of the surveys for this proposal. It is considered that the method of representative parallel field traverses for one kilometre and 500 metre distances is not strictly in accordance with the recently released guideline *Surveying threatened plants and their habitats; NSW guide for the BAM (Department of Planning, Industry and Environment, 2020),* which provides a preferred method of surveying large areas using a systematic grid based sampling methodology.

  The adopted systematic parallel transect method applied to this proposal was considered more suitable for the extensive linear nature of the proposal than a systematic plot-based approach for the following reasons:

  - it more comprehensively sample of the indicative disturbance area within each sample section and
  - the relatively homogeneous nature of the PCT and condition for large sections provide relatively consistent habitat potential.

Furthermore, to demonstrate the adequacy of the adopted systematic parallel transect method compared to the systematic plot-based approach within the guideline a comparative desktop analysis of the sample area covered by the two approaches was undertaken. The assessment of PCTs in moderate to good condition sampled under an indicative calculation using the new guidelines plot based approach totalled 43 hectares while the actual sampled area subject to the representative parallel field traverses was approximately 1166 hectares.

3.7.2 PARALLEL FIELD TRAVERSES

Parallel field traverses were used in vegetation types which were considered the most suitable habitat for non-drought affected threatened species. This involved two senior botanists walking on a fixed bearing at distances according to the life form of the candidate threatened species in accordance with Table 1 (section 4.2) of the NSW guide for the BAM (Department of Planning, Industry and Environment, 2020) where possible.

Given the scale of the proposal study area, being one kilometre in width for a length of about 135 kilometres and 200 metres in width for an additional 25 kilometres in length, a 20 metre distance between parallel field traverses was considered appropriate to adequately survey for candidate tree, shrub and sub-shrub species based on the open nature of associated habitat.

Parallel field traverses were designed to cover the indicative disturbance area being 60 metres each side of the centreline of the proposal study area that allowed for a total coverage of a 120 metre corridor.

This technique was used in vegetation communities which were associated with the highest number of candidate threatened flora species. This approach was limited to modified condition (whipstick variant) of:

- PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones
- PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion
- PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone.

Vegetation recorded in this condition and variation was the most floristically diverse and likely habitat to support candidate species. Based on this rationale, all patches of these vegetation types were subject to this technique.

3.7.3 REPRESENTATIVE PARALLEL FIELD TRAVERSES (ONE KILOMETRE SECTIONS)

Representative sampling of one kilometre sections of the centreline of the indicative disturbance area was undertaken in vegetation types which habitat considered suitable for numerous candidate flora species. This approach involved two senior botanists walking on a fixed bearing at 20 metres apart over one kilometre sections. These surveys were designed to cover the indicative disturbance area being 60 metres each side of the centreline of the indicative disturbance area that allowed for a total coverage of a 120 metre corridor.

This systematic survey approach was considered appropriate given it provides a more comprehensive sample of the indicative disturbance area within each sample section and due to the relatively homogeneous nature of the PCT and condition for large sections providing relatively consistent habitat potential.. This technique was used in vegetation communities with less floristic diversity in the shrub and ground stratum. Derived condition categories were not subject to representative parallel field traverses.

This approach was applied to modified condition of:

- PCT 11 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 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)
- PCT 15 Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- PCT 19 Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains

- PCT 21 Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion
- PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion
- PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (Bull variant)
- PCT 221 Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones
- PCT 252 Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion.

3.7.4 REPRESENTATIVE PARALLEL FIELD TRAVERSES (500 METRE SECTIONS)

Representative sampling of 500 metre sections of the centreline of the indicative disturbance area was undertaken in dense vegetation types (i.e. arid shrublands and saline wetlands). A 10 metre distance between parallel field traverses was considered appropriate to adequately survey for candidate shrub, sub-shrub and forb species based on the dense nature of associated habitat. This grid-based approach was considered appropriate given parallel field traverses across all areas of associated habitat within the centreline of the indicative disturbance area was impractical.

These surveys involved two senior botanists walking on a fixed bearing at 10 metres apart and were designed to cover the indicative disturbance area being 60 metres each side of the centreline of the indicative disturbance area that allowed for a total coverage of a 120 metre corridor.

This approach was applied to modified condition of:

- PCT 153 Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones
- PCT 154 Pearl Bluebush low open shrubland of the arid and semi-arid plains
- PCT 166 Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW
- PCT 216 Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion.

3.7.5 PARALLEL FIELD TRAVERSES OF MICROHABITATS

Parallel field traverses of microhabitats were undertaken for candidate flora species associated with specific microhabitats or habitat attributes. A five metre distance between parallel field traverses was considered appropriate to adequately survey for candidate grass and forb species based on the open nature of associated habitat. This approach was carried out in microhabitats (i.e. lunettes on gypsum soils for *Austrostipa nulla nulla*) known to support candidate threatened flora.

This approach was applied to microhabitats within:

- PCT 17 Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)
- PCT 63 Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones
- PCT 253 Gypseous shrubland on rises in the semi-arid and arid plains.

3.7.6 RAPID DATA POINT ASSESSMENT OF THREATENED FLORA HABITATS

During targeted threatened flora spring surveys, rapid data point (RDP) assessments of threatened flora habitat types was undertaken by local mallee flora experts, Dr Ian Sluiter and Geoffrey Allen. The RDP assessment surveys were supplementary to parallel field traverse methods and enabled greater site coverage and certainty around threatened flora survey results. RDP assessments involved walking point transects conducted at 571 waypoints sampling all threatened flora habitat types (refer to Appendix C-7).

Each waypoint or RDP has:

- a date (column A)
- an Easting and Northing (columns D and E)
- plant species recorded on a single line at that RDP (column F) in the format required by the NSW Atlas
- the collectors Ian and Geoffrey – in the format required by the NSW Atlas (column H).

3.8 THREATENED FAUNA SURVEY METHODS

This section outlines the fauna survey effort completed for candidate species which were predicted to have a moderate to high likelihood of occurrence within the indicative disturbance area based on the BAM-C, database searches and habitat assessments outlined in Section 3.4.

Threatened fauna surveys completed within the proposal study area and were carried out as described below and where applicable, considering the methodology detailed in:

- NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (Department of Environment and Conservation, 2004)
- Survey Guidelines for Australia's Threatened Birds (Department of Environment Water Heritage and the Arts, 2010)
- Threatened Species survey and assessment guidelines: field survey and methods for fauna-Amphibians (Department of Environment and Climate Change, 2009)
- Survey guidelines for Australia's threatened frogs (Department of the Environment Water Heritage and the Arts, 2010)
- Threatened Species Profile Database (Environment Energy and Science Group, 2020c).

3.8.1 FAUNA HABITAT STRATIFICATION

There are 20 PCTs that contain various types of habitats for fauna within the proposal study area and indicative disturbance area. These can broadly be categorised into the following four similar fauna habitat stratification units, being:

- Riverine: Native woodland broadly associated with riverine environments (92.19 hectares in indicative disturbance area)
- Arid woodland/shrublands: Native woodland and shrublands broadly associated with arid interior areas (430.29 hectares in indicative disturbance area)
- Chenopod shrublands: Low shrublands in arid and semi-arid interior areas (83.96 hectares in indicative disturbance area)
- Wetlands: Wet lignum-dominated wetlands (0.34 hectares in indicative disturbance area).

These fauna habitat stratification units were identified to ensure that fauna surveys were undertaken within each representative habitat type for the target threatened fauna species. The fauna habitat stratification units are as outlined below in Table 3.10.

Table 3.10 Vegetation zone and PCT types as they correspond to fauna habitat stratification types

FAUNA STRATIFICATION UNITS AND RELATED PCTS	INDICATIVE DISTURBANCE AREA (HA)[1]
Riverine	
PCT11 – 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) (modified)	1.58
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (derived)	0.47
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	6.81
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	83.33
Arid woodland/shrublands	
PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains (modified)	2.91
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion (modified)	11.11
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion (modified)	89.67
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion (derived)	36.63
PCT 139 – Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions (modified)	2.05
PCT 143 – Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes (modified)	0.99
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (modified bull)	28.03
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (modified whipstick)	133.00
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (derived)	34.53
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion (modified bull)	6.35
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion (modified whipstick)	49.13

FAUNA STRATIFICATION UNITS AND RELATED PCTS	INDICATIVE DISTURBANCE AREA (HA)[1]
PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone (modified whipstick)	28.17
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion (modified)	2.38
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion (derived)	5.32
Chenopod shrublands	
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones (modified)	62.73
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains (modified)	9.88
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW (modified)	2.53
PCT216 – Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion (modified)	0.54
PCT 221 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones (modified)	3.37
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified - boninka)	2.84
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified - lunette)	2.07
Wetland	
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	0.04
PCT 63 – Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones (modified)	0.30

3.8.2 FAUNA HABITAT ASSESSMENT

Fauna habitat assessments were undertaken to assess the likelihood of threatened species of animal (those species known or predicted to occur within the locality from the literature and database review) occurring within the proposal study area. Fauna habitat assessments were the primary assessment tool in assessing whether threatened species were likely to occur within the proposal study area. Fauna habitat characteristics assessed included:

- structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources
- presence of hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, Forest Owls, birds and reptiles
- presence of the ground cover vegetation, leaf litter, rock outcrops and fallen timber and potential to provide protection for ground-dwelling mammals, reptiles and amphibians
- presence of waterways (ephemeral or permanent) and water bodies
- presence of man-made structures (e.g. culverts) for roosting/breeding microchiropteran bats.

The criteria were used to evaluate the condition of habitat values is outlined in Table 3.11.

Table 3.11 Fauna habitat assessment evaluation criteria

HABITAT VALUE	EVALUATION CRITERIA
Good	A full range of fauna habitat components are usually present (for example, old growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
Moderate	Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
Poor	Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

3.8.3 OPPORTUNISTIC RECORDING OF FAUNA SPECIES AND EVIDENCE OF FAUNA ACTIVITY

Opportunistic sightings of animals were recorded during field surveys. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc., was also noted. This provided indirect information on animal presence and activity.

During these surveys, a hand-held GPS was used to record the locations of:

- hollow-bearing trees
- aquatic habitat
- rock outcrops.

3.8.4 DIURNAL BIRD SURVEYS

Formal 20-minute diurnal bird searches were completed by two ecologists. Bird surveys were completed by actively walking through the nominated site (transect) over a period of 20 minutes. All birds were identified to the species level, either through direct observation or identification of calls.

Targeted survey effort for each bird group (waterbirds, etc) is outlined in the summary table (Table 3.12) at the end of this Section.

Bird surveys were completed during different times of the day, but generally occurred during morning hours or evening. Birds were also recorded opportunistically during all other surveys.

Wherever threatened bird species were absent from the site, habitat assessments were conducted to determine the likelihood that the indicative disturbance area might support those species that are known to occur in the region.

3.8.5 MICROCHIROPTERAN BATS

Passive Ultrasonic Anabat Bat detection (Anabat SD1/SD2 or Anabat Express unit – Titley Scientific, Brendal QLD) was used to record and identify the echolocation calls of microchiropteran bats foraging at each survey site. Passive monitoring of survey sites was achieved by setting Anabat bat detectors to record throughout the night.

Anabat Bat detectors recorded bat vocalisations throughout the full night, with the recording starting before dusk. Bat activity throughout the night does vary (Taylor and Oneill 1988, Department of Environment and Conservation 2004), but the peak in activity is usually within a few hours of dusk. For this study the sampled population was defined as those active up to two hours after last light. Bat activity is used as a substitute for abundance, and is based on the number of microchiropteran bat calls recorded during the survey period, including those calls assigned to a species complex (i.e. not

positively attributable to an individual species). Calls were analysed by Rob Gration using Analook (Version 4.7) software with reference to 'Bat Calls of NSW: Region Based Guide to the Echolocation Calls of Microchiropteran Bats' (Pennay, Law et al. 2004).

Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.6 TARGETED MICROBAT SURVEYS

Like other Long-eared Bat species Corben's Long-eared Bat (*Nyctophilus corbeni*) uses understorey strata for foraging and they roost in hollow-bearing trees. Although many microchiropteran bat species are detectable through use of Anabat call detection methodologies, the vocal differences between *Nyctophilus* spp. are too subtle to reliably differentiate between the various species occurring in the locality of the BOAs. Therefore, surveys for Corben's Long-eared Bat needed to be conducted with a methodology that enabled bats to be identified in the hand.

Harp traps are excellent for capture and release of microchiropteran bats and they are well suited to the capture of *Nyctophilus* spp. due to their propensity to use lower forest strata for their foraging habits. Site selection for the setting of harp traps included a number of rationale, such as targeting of those areas where *Nyctophilus* spp. had been previously detected during previous monitoring programs, woodland habitats in areas where hollow-bearing trees provide potential roosting sites and where suitable flyways were detected in forest and woodland settings.

Harp traps were set at each location over a single night period during November and December 2019, and February and March 2020 (surveys best conducted between October and April).

Captured bats were identified to species level, sexed, measured and weighed. Bats were released immediately after processing during dark conditions. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.7 SPOTLIGHTING

Spotlighting surveys were completed on foot by pairs of two ecologists, targeting arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians. At least one person hour of survey effort was completed per site.

The spotlighting methodology also included the use of a thermal imaging monocular to assist in nocturnal species identification, including target Western Pygmy Possum. The FLIR Thermal Imaging Monocular Scout II was used for this purpose. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.8 PITFALL AND FUNNEL TRAPPING

Pitfall traps, supplemented with funnel traps were used in conjunction with drift fences to target amphibians, reptiles and small ground-dwelling mammals. Pitfall traps consisted of 20 litre buckets, buried in the ground with the lip flush to the ground's surface. Funnel traps consisted of a fabric mesh with both ends forming an inward-directed cone. Buckets were supplemented with a small amount of leaf litter, soil and damp cloth. Funnel traps were covered with ground cover debris to afford captured specimens some protection from weather variables.

As pitfall and funnel trapping was used specifically to target a range of mallee reptiles and terrestrial fauna, four pitfall traps and six funnel traps were used to sample six locations, including spinifex dune and chenopod understory habitats with an overstorey of mallee canopy species. Surveys are generally completed over a four-night period. However, weather forecasts are monitored for very cool conditions or high rainfall events, which might place small animals at risk of drowning or freezing. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

All live trapping followed guidelines and policies for wildlife research as set by the Animal Research Review (Australian Government 2004). Trap lines were checked during early morning and late afternoon hours with trapped specimens recorded to species level. All animals were released at the site of capture, immediately following processing.

3.8.9 ELLIOTT-A AND ELLIOTT-E TRAPS

Elliott traps, in two sizes, were used to target small mammals. The standard Elliott A traps were set in transects of 25 with a minimum spacing of five metres. The smaller Elliott E traps were set in lines of six to target Western Pygmy Possum. Both traps were set with bait containing peanut butter, honey and oats and positioned so that they are sheltered from strong sunshine, to prevent heat exposure for captured animals. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.10 REMOTE CAMERAS

Remote cameras were employed for long-term observations of fauna using the habitats associated with the study area. Three cameras were used with each trapline as part of each trapping station suite for four nights, totalling 36 trap nights for the 12 trapping stations. Another 31 cameras were employed for longer periods of time to target species that occur more sparsely within the environment. Cameras were baited with chicken necks and/or peanut butter, honey and oats. Fifteen (15) traps were positioned in late October 2019 and a further 16 cameras set in early May 2020. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.11 ROOF TILE SURVEYS

Roofing tiles placed on the ground for long periods of time become part of the landscape for small fauna and offer excellent shelter in habitats where protection is sparse. Setting them for long periods of time, in suitable numbers, provides another method to target animals that are sparsely distributed in habitats. Three grids of 50 tiles, placed in a 10x5 setting, at five metre intervals, were set in early May 2020. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.12 NEST BOX SURVEYS

Nest boxes were placed for long periods of time become part of the landscape for small fauna and offer excellent shelter in habitats where protection is sparse. Setting them for long periods of time, in suitable numbers, provides another method to target animals that are sparsely distributed in habitats. Nest boxes (suitable for Western Pygmy Possum but also other hollow-dependent fauna species) were set in the mallee PCT's (Arid Woodlands/Shrublands habitat).

A total of 34 boxes, in groups of four to five, were set in early May 2020. Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.13 HERPETOLOGICAL SEARCHES

Searches for reptiles and frogs were undertaken constantly during field surveys wherever suitable habitat occurred.

For reptiles this mostly consisted of targeted searches of areas containing suitable substrate such as leaf litter, logs, hollows and grasses and *Triodia*.

For frogs, the available habitat was very limited in terms of aquatic resources, though when opportunities occurred, targeted surveys occurred.

Targeted survey effort for each fauna group is outlined in the summary table (Table 3.12) at the end of this Section.

3.8.14 FAUNA SURVEY SUMMARY

Fauna surveys as described above were undertaken in a stratified manner to ensure that all habitat types were sampled (refer to Section 5.6 for detail).

Table 3.12 summarises the fauna surveys completed within each fauna habitat stratification unit. For more survey detail including on targeted surveys for candidate species refer to the tables in Appendix A-3.

Table 3.12 Fauna survey summary

FAUNA GROUP	SURVEY TECHNIQUE	SURVEY EFFORT	OPTIMUM SURVEY PERIOD	DATES SURVEYED
Wetlands – May include PCT11 during times of inundation				
Amphibians	Assessment of wetland habitats.	12 person hours of opportunistic surveys	Oct – Feb	14–24 Oct 2019; 26 Nov – 5 Dec 2019
Aerial bird species (Swifts)	Targeted opportunistic surveys	102 person hours of opportunistic surveys	Nov – Mar	26 Nov – 5 Dec 2019; 17–24 Mar 2020
Birds of prey	Targeted Opportunistic and Targeted formal surveys in suitable habitat	8 x 20 min/2 ha formal bird surveys 39.5 person hours of opportunistic surveys	All year	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 15–24 July 2020
Migratory Birds	Targeted wetland surveys during the Spring and Summer	29 person hours	Sep – Mar	14–24 Oct 2019; 26 Nov – 5 Dec 2019
Threatened Migratory and Nomadic resident Shorebirds	Targeted wetland surveys during the Spring and Summer and habitat assessments	8 x 20 min/2 ha formal bird surveys 39.5 person hours of opportunistic surveys	Sep – Mar & where suitable conditions occur	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 15–24 July 2020
Waterfowl	Targeted wetland surveys and habitat assessments	8 x 20 min/2 ha formal bird surveys 39.5 person hours of opportunistic surveys	All year – where suitable conditions occur	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 15–24 July 2020
Wading Birds	Targeted wetland surveys and habitat assessments	8 x 20 min/2 ha formal bird surveys 39.5 person hours of opportunistic surveys	All year – where suitable conditions occur	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 15–24 July 2020

FAUNA GROUP	SURVEY TECHNIQUE	SURVEY EFFORT	OPTIMUM SURVEY PERIOD	DATES SURVEYED
Riverine Woodlands/wetlands – PCT11, PCT13, PCT15, PCT17, PCT63				
Aerial bird species (Swifts)	Opportunistic surveys	126 person hours of opportunistic surveys	Nov – Mar	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 17–24 Mar 2020; 6–10 Sept 2020
Amphibians	Targeted surveys and call playback during suitable conditions	Habitat assessments & 22 person hours of opportunistic surveys	Oct – Feb or during significant rainfall events	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 6–10 Sept 2020
Birds of Prey	Targeted Opportunistic and Targeted formal surveys in suitable habitat	8 x 20 min/2 ha formal bird surveys 381 person hours of opportunistic surveys	All year	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 17–24 Mar 2020; 29 Apr – 6 May 2020; 15–24 July 2020; 3–10 Sept 2020
Blossom Nomads	Favoured habitat surveys and assessment	8 x 20 min/2 ha Formal Bird surveys 436 person hours of opportunistic surveys	Nov – Feb – Mistletoe fruiting OR Associated with strong winter blossoming events Apr – Sep	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 17–24 Mar 2020; 29 Apr – 6 May 2020; 15–24 July 2020; 6–10 Sept 2020
Ground Birds	Opportunistic surveys in suitable habitats and Nocturnal call playback	392 person hours of opportunistic surveys 8 x 20 min/2 ha formal bird surveys 12 person hours of nocturnal survey	All year & breeding cycle Sep – Dec	14–24 Oct 2019; 26 Nov – 5 Dec 2019; Feb 2020; 17–24 Mar 2020; 29 Apr – 6 May 2020; 15–24 July 2020; 6–10 Sept 2020
Microchiropteran bats	Harp trap and Anabat surveys	5 x Harp site locations 6 x Anabat locations	All year	26–30 Nov 2019

FAUNA GROUP	SURVEY TECHNIQUE	SURVEY EFFORT	OPTIMUM SURVEY PERIOD	DATES SURVEYED
Reptiles	Habitat searches, nocturnal surveys and Pitfall/Funnel surveys	33 person hours of opportunistic surveys 32 x Pitfall trap nights 32 x Funnel trap nights	All year	17–21 Mar 2020; 6–10 Sept 2020
Shrubland Birds	Formal 20 min/2 ha surveys and opportunistic surveys	8 x 20 min/2 ha Formal Bird surveys 381 person hours of opportunistic surveys	All year	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 17–24 Mar 2020; 29 Apr – 6 May 2020; 15–24 July 2020; 6–10 Sept 2020
Wetland Birds	Targeted wetland surveys and habitat assessments	55.5 person hours of opportunistic surveys 8 x 20 min/2 ha formal bird surveys	All year	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 15–24 July 2020; 6–10 Sept 2020
Woodland Birds	Nocturnal call playback and habitat searches, formal 20 min/2 ha surveys, opportunistic surveys and habitat assessments	Spotlighting & owl call playback 8 x 20 min/2 ha formal bird surveys 381 person hours of opportunistic surveys	All year & during breeding Sep – Jan	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 17–24 Mar 2020; 29 Apr – 6 May 2020; 15–24 July 2020; 6–10 Sept 2020
Woodland Mammals	Habitat searches and assessments Elliott A surveys Pitfall/Funnel surveys Spotlighting/Infrared scope	 200 x Elliot A trap nights 32 x Elliot E trap nights 32 x Pitfall trap nights 32 x Funnel trap nights 6 Nights 11 person hours	All year	28 Nov 2019; 15 Jul 2020; 16 Jul 2020; 9 Sep 2020 17–21 Mar 2020 6–10 Sept 2020 26&28 Nov 2019; 15&16 Jul 2020; 7&9 Sep 2020

FAUNA GROUP	SURVEY TECHNIQUE	SURVEY EFFORT	OPTIMUM SURVEY PERIOD	DATES SURVEYED
Chenopod Shrublands – PCT13, PCT153, PCT154, PCT166, PCT216, PCT221, PCT253				
Aerial bird species (Swifts)	Seasonal opportunistic surveys	114 person hours of opportunistic surveys	Nov – Mar	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 17–24 Mar 2020; 3–6 Sept 2020
Birds of Prey	Targeted Opportunistic and Targeted formal surveys in suitable habitat	7 – 20 min/2 ha Formal Bird surveys 366 person hours of opportunistic surveys	All year	Nov – Dec 2019; Feb 2020; 17–24 Mar 2020; 29 Apr – 6 May 2020; 3–6 Sept 2020
Ground Birds	Opportunistic surveys, nocturnal call playback and targeted spotlighting surveys	7 x 20 min/2 ha Formal Bird surveys 366 person hours of opportunistic surveys	All year & during breeding Sept – Dec	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 10–20 Feb 2020; 17–24 Mar 2020; 29 Apr – 6 May 2020; 3–6 Sept 2020
Reptiles	Habitat searches, nocturnal surveys and Pitfall/Funnel surveys	27 person hours of opportunistic surveys 12 x Pitfall trap nights 12 x Funnel trap nights	All year	14–24 Oct 2019; 10–20 Feb 2020; 15–24 July 2020; 3–6 Sept 2020
Shrubland Birds	Formal 20 min/2 ha surveys, opportunistic surveys and call playback survey	7 x 20 min/2 ha Formal Bird surveys 14 person hours of opportunistic surveys	All year	14–24 Oct 2019; 10–20 Feb 2020; 15–24 Jul 2020; 3–6 Sept 2020
Woodland Mammals	Habitat searches and assessments, Elliott A surveys, Pitfall/Funnel surveys Spotlighting/Infrared scope	12 x Pitfall trap nights 12 x Funnel trap nights 75 x Elliot A trap nights 6 Nights 11 person hours	All year	17–21 Mar 2020 3–6 Sept 2020

FAUNA GROUP	SURVEY TECHNIQUE	SURVEY EFFORT	OPTIMUM SURVEY PERIOD	DATES SURVEYED
Arid Woodlands/Shrublands – PCT19, PCT21, PCT58, PCT139, PCT143, PCT170, PCT171, PCT172, PCT19, PCT21, PCT252,				
Aerial bird species (Swifts)	Opportunistic surveys	44 x 20 min/2ha formal bird surveys 337 person hours of opportunistic surveys	Nov – Mar	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 10–20 Feb 2020; 17–24 Mar 2020; 29 Apr – 6 May 2020; 2–10 Sept 2020
Amphibians	Targeted surveys and call playback during suitable conditions	2.2 mm rainfall on 8th September during Sept survey period 80 x Pitfall trap nights	All year after significant rainfall	3–10 Sept 2020
Birds of Prey	Targeted Opportunistic and Targeted formal surveys in suitable habitat	44 x 20 min/2 ha Formal Bird surveys 497 person hours of opportunistic surveys	All year	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 10–20 Feb 2020; 17–24 Mar 2020; 29 Apr – 6 May 2020; 2–10 Sept 2020
Blossom Nomads	Favoured habitat surveys and assessment	44 x 20 min/2 ha Formal Bird surveys 497 person hours of opportunistic surveys	Associated with strong blossoming events	14–24 Oct 2019; 26 Nov – 5 Dec 2019; 10–20 Feb 2020; 17–24 Mar 2020; 29 Apr – 6 May 2020; 2–10 Sept 2020
Mallee Spinifex birds	Targeted habitat searches and assessments	12 x 20 min/2 ha formal bird surveys 225 person hours of opportunistic surveys	All year	14–24 Oct 2019; 29 Apr – 6 May 2020; 3–10 Sept 2020
Mallee, Woodlands and Shrubland birds	Formal 20 min/2 ha surveys, opportunistic surveys and habitat assessments	44 x 20 min/2 ha Formal Bird surveys 352 person hours of opportunistic surveys	All year & during breeding seasons for certain species (Aug–Jan)	14–24 Oct 2019; 17–24 Mar 2020; 29 Apr – 6 May 2020; 15–24 July 2020; 3–10 Sept 2020
Microchiropteran bats	Harp trap and Anabat surveys	6 x Harp trap locations 6 x Anabat trap nights	All year	26–30 Nov 2019

FAUNA GROUP	SURVEY TECHNIQUE	SURVEY EFFORT	OPTIMUM SURVEY PERIOD	DATES SURVEYED
Reptiles	Habitat searches, nocturnal surveys	Opportunistic reptile searches throughout survey periods	All year & certain species Oct–Mar	14–24 Oct 2019; 17–24 Mar 2020; 29 April – 6 May 2020; 15–24 July 2020; 3–10 Sept 2020
	Pitfall/Funnel surveys	144 x Pitfall trap nights Funnel trap nights		17–21 Mar 2020; 2–10 Sep 2020 (Pitfall, Funnel, Elliott A&E)
	In situ tile surveys	6 x 50 roof tile patterns (5x10 tiles) set		6 May 2020 – 7 Sep 2020
	Nocturnal searches conducted	5 nights 10 person hrs		27&30 Nov 2019; 3 Feb 2020; 18–19 Mar 2020
Woodland Mammals	Habitat searches and assessments		All year & certain species March – Jun & Aug – Dec	17-24 Mar 2020; 3-10 Sept 2020
	Pitfall/Funnel surveys	144 x Pitfall trap nights 216 x Funnel trap nights		17-21 Mar 2020; 2-10 Sep 2020 (Pitfall, Funnel, Elliott A&E)
	Elliott A and Elliott E surveys,	900 x Elliot A trap nights 128 x Elliott E trap nights		
	Remote Cameras (traplines)	48 x Remote Camera trap nights		17-21 Mar 2020 R.Cams)
	Remote Camera surveys	6,732 x Remote Cameras trap nights		Oct 2019 – Sept 2020 (cameras)
	Nest boxes for Western Pygmy Possum	34 traps x 125 nights; = 4,250 trap nights		May 2002 – Sept 2020
	Spotlighting	5 nights 10 person hrs		27&30 Nov 2019; 3 Feb 2020; 18–19 Mar 2020

4 LANDSCAPE CONTEXT

This chapter address landscape context in accordance with section 4 of the BAM and provides information on a range of landscape features that occur on the proposal study area and in surrounding areas.

The landscape features outlined below are used to inform the habitat suitability of the proposal study area for threatened species and the potential movement of species across the landscape.

4.1 LANDSCAPE FEATURES

4.1.1 IDENTIFICATION OF IBRA REGIONS AND SUBREGIONS

The proposal study area occurs with three IBRA regions that comprise of four IBRA subregions. An overview of each IBRA region and subregion is presented in Table 4.1.

Table 4.1 IBRA regions and subregions

IBRA REGION	IBRA SUBREGION
Murray Darling Depression	South Olary Plain
Darling Riverine Plains	Great Darling Anabranch
	Pooncarie – Darling
Riverine	Robinvale Plain

Given the long linear length nature of the proposal (160 kilometres) and that it traverses four separate IBRA subregions, habitat suitability assessments and BAM calculations have been undertaken for each subregion.

4.1.2 IDENTIFICATION OF LANDSCAPE FEATURES

An overview of landscape features for each IBRA subregion is presented in Figure 4.1 with details presented in Appendix B-1. A summary of landscape features for each IBRA subregion is provided in Table 4.2, Table 4.3, Table 4.4 and Table 4.5.

4.1.2.1 SOUTH OLARY PLAIN IBRA SUBREGION

Table 4.2 Summary of landscape feature for the South Olary Plain IBRA subregion

LANDSCAPE FEATURE	OCCURRENCE IN PROPOSAL STUDY AREA
NSW landscape regions (Mitchell landscapes)	Mallee Cliffs Dunes – 581.88 ha Mallee Cliffs Linear Dunes – 94.45 ha Mallee Cliffs Sandplains – 3022.53 ha Murray Lakes, Swamps and Lunettes – 233.30 ha Scotia Groundwater Basins – 505.99 ha Scotia Linear Dunes – 1548.90 ha Scotia Sandplains – 6426.82 ha For BAM calculation purpose, Scotia Sandplains has been selected as the default Mitchell landscape unit as it represents almost half of the proposal study area.
Local Government Area (LGA)	Wentworth
Rivers, streams and estuaries	One unnamed 1st order stream One unnamed 2nd order stream
Important and local wetlands	No important wetlands have been recorded within the proposal study area. A local wetland in the form of an unnamed salt (playa) lake occurs on Nulla Station. This salt lake forms part of the broader Nulla saline discharge complex (Sluiter 2010).
Connectivity features	Large areas of connected native vegetation occur within this subregion. To the west of Lake Victoria, patches of arid shrubland and semi-arid woodland connect with conservation areas in eastern SA that include Chowilla Regional Reserve and the broader Chowilla and Danggali Parks. On the eastern side of the proposal study area, mallee vegetation connects vegetated private lands to larger conservation patches including Mallee Cliffs National Park and Southern Mallee conservation lands.
Areas of geological significance and soil hazard features	One area of geological significance relating to biodiversity within the proposal study area are the gypsum soils associated with lunette rises that were observed in a restricted area on the eastern edge of Nulla Station and adjoin lands. These soils are preferentially favoured by rare gypsum obligate species such as *Austrostipa nullanulla* (Endangered) and the highly restricted *Elacanthus glaber* and *Roepera compressa*. Most of the remaining areas within the proposal study area are dominated by a surficial layer of Quaternary aged aeolian sediments comprising of sand, silt and clays of the Woorinen Formation.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value have been declared for this area.

4.1.2.2 GREAT DARLING ANABRANCH IBRA SUB-REGION

Table 4.3 Summary of landscape feature for the Great Darling Anabranch IBRA subregion

LANDSCAPE FEATURE	OCCURRENCE IN PROPOSAL STUDY AREA
NSW landscape regions (Mitchell landscapes)	Lower Darling Channels and Floodplains – 448.52 ha Scotia Sandplains – 101.32 ha For BAM calculation purpose, Lower Darling Channels and Floodplains has been selected as the default Mitchell landscape unit as it represents most of the proposal study area.
Local Government Area (LGA)	Wentworth
Rivers, streams and estuaries	One unnamed 1st order stream One unnamed 2nd order stream Great Darling Anabranch 6th order stream and above
Important and local wetlands	No important wetlands have been recorded within the proposal study area.
Connectivity features	Within the proposal study area, connectivity within this IBRA subregion is mostly associated with the Great Darling Anabranch where fringing Black Box Woodlands and arid shrublands (Chenopod sub-formation) dominate the landscape.
Areas of geological significance and soil hazard features	Alluvium sediments, mostly grey clays, extent laterally up to 5 km across the Great Darling Anabranch.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value have been declared for this area.

4.1.2.3 POONCARIE – DARLING IBRA SUB-REGION

Table 4.4 Summary of landscape feature for the Pooncarie – Darling IBRA subregion

LANDSCAPE FEATURE	OCCURRENCE IN PROPOSAL STUDY AREA
NSW landscape regions (Mitchell landscapes)	Lower Darling Alluvial Plains – 740.83 ha Lower Darling Channels and Floodplains – 473.77 ha Mallee Cliffs Sandplains – 165.33 ha Scotia Sandplains – 138.46 ha For BAM calculation purpose, Lower Darling Alluvial Plains has been selected as the default Mitchell landscape unit as it represents most of the proposal study area.
Local Government Area (LGA)	Wentworth
Rivers, streams and estuaries	One unnamed 1st order stream One unnamed 2nd order stream Darling River 6th order stream and above
Important and local wetlands	No important wetlands have been recorded within the proposal study area.
Connectivity features	Within the proposal study area, connectivity within this IBRA subregion is mostly associated with the Darling River where fringing River Red Gum Woodlands adjoining Black Box Woodlands and arid shrublands (Chenopod sub-formation) dominate the landscape.
Areas of geological significance and soil hazard features	Alluvium sediments, mostly grey clays, extent laterally up to 14 km across the Darling River floodplain.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value have been declared for this area.

4.1.2.4 ROBINVALE PLAIN IBRA SUB-REGION

Table 4.5 Summary of landscape feature for the Robinvale Plain IBRA subregion

LANDSCAPE FEATURE	OCCURRENCE IN PROPOSAL STUDY AREA
NSW landscape regions (Mitchell landscapes)	Mallee Cliffs Sandplains – 8.85 ha Murray Channels and Floodplains – 29.75 ha For BAM calculation purpose, Murray Channels and Floodplains has been selected as the default Mitchell landscape unit as it represents most of the proposal study area.
Local Government Area (LGA)	Wentworth
Rivers, streams and estuaries	One unnamed 1st order stream Murray River 6th order stream and above
Important and local wetlands	No important wetlands have been recorded within the proposal study area.
Connectivity features	Within the proposal study area, connectivity within this IBRA subregion is mostly associated with the Murray River where fringing River Red Gum Woodlands adjoining Black Box Woodlands, along with freshwater and saline wetland vegetation, dominate the landscape.
Areas of geological significance and soil hazard features	Alluvium sediments, mostly grey clays, extent laterally up to 2 km across the Murray River floodplain.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value have been declared for this area.

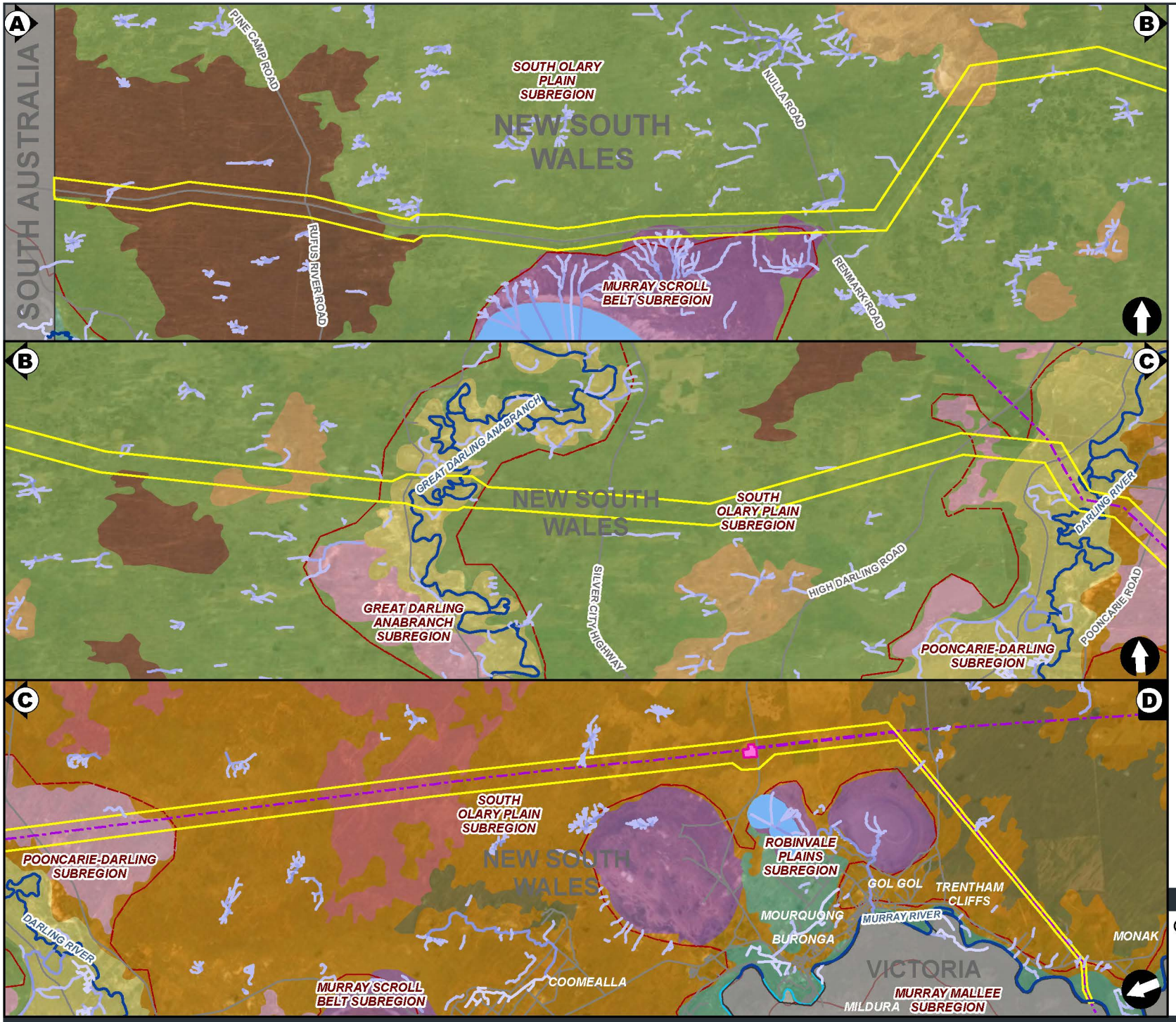

Figure 4.1

Overview of landscape features within the proposal study area

Refer to Appendix B.1 for further detail

Source: NSWSS, ESRI, Transgrid, WSP

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4.2 DETERMINING THE SITE CONTEXT

To determine site context as required under section 4.3 of the BAM, an assessment of native vegetation cover and patch size in accordance with subsections 4.3.2 and 5.3.2 of the BAM have been undertaken and are outlined below.

4.2.1 NATIVE VEGETATION COVER

Native vegetation cover within the study area and a 500-metre buffer area along each side of the centre line of the proposal study area was determined in accordance with subsection 4.2.2 of the BAM and is summarised in Table 4.6 and shown in Figure 4.2.

Table 4.6 Native vegetation cover

IBRA SUB-REGION	ASSESSMENT AREA	TOTAL ASSESSMENT AREA (HA)	AREA OF NATIVE VEGETATION COVER (HA)	NATIVE VEGETATION PERCENTAGE COVER (%)
South Olary Plain	500 metres along each side of the centre line of the proposed construction footprint	14,670	11,831	>70%
Great Darling Anabranch		430	391	>70%
Pooncarie-Darling		1,640	1,427	>70%
Robinvale Plain		239	170	>70%

For BAM calculator assessment purposes the native vegetation cover class >70% has been applied.

4.2.2 PATCH SIZE

Patch size is defined under the BAM (OEH, 2017) as an area of native vegetation that:

- occurs on the proposal study area
- includes native vegetation that has a gap of less than 100 metres from the next area of moderate to good native vegetation (or less than or equal to 30 metres for non-woody ecosystems).

Patch size may extend onto adjoining land that is not part of the study area. Patch size area is assigned to each vegetation zone as a class, being less than 5 hectares, 5–24 hectares, 25–100 hectares or greater than or equal to 100 hectares.

Given the large areas of contiguous native vegetation recorded within and adjacent to the proposal study area the patch size for all native vegetation zones has been applied as greater than 100 hectares. For BAM calculation purpose all native vegetation zones have been applied with a patch size area of 101 hectares.

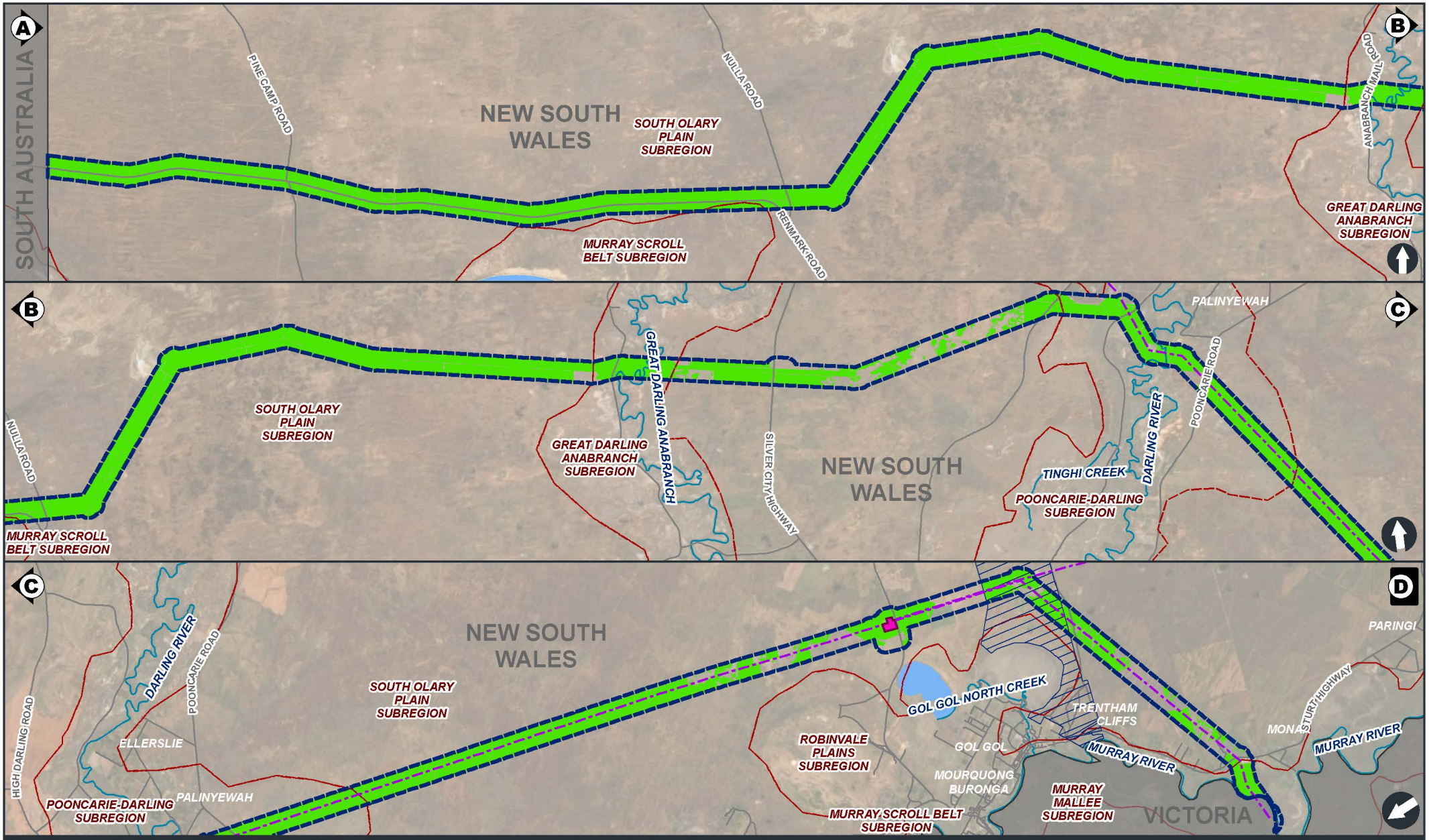

Figure 4.2

Overview of native vegetation cover (500m buffer) within the proposal study area

Refer to Appendix B-2 for further detail

- Proposed substation expansion area
- Existing transmission line infrastructure
- Native vegetation cover within 500m of the disturbance area
- 500m disturbance area buffer
- Property where no access available - State Vegetation Mapping shown

Source: NSWSS, ESRI, Transgrid, WSP

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5 NATIVE VEGETATION

This chapter address native vegetation in accordance with section 5 of the BAM and matters relating to the BC Act.

5.1 NATIVE VEGETATION REGULATORY MAPPING – CATEGORY 1 'EXEMPT LANDS'

This section summarises the method and results of native vegetation regulatory mapping of proposed category 1 – exempt land within the proposal study area.

5.1.1 NATIVE VEGETATION REGULATORY MAPPING

An analysis of the datasets identified that most of the proposal study area contains native vegetation cover that is defined as category 2 – regulated land and is subject to assessment under the BAM. Those areas that meet category 1 – exempt lands mostly comprise of transport corridors (roads and tracks), where land was cleared of native vegetation as at 1 January 1990, or the land was cleared of native vegetation between 1 January 1990 and the present along with grazing pastures, cropping and perennial horticulture.

Field validated high resolution vegetation mapping of the proposal study area (WSP 2020) identified that many grazing pastures contain derived native vegetation that exceeded 50 per cent cover. These areas have been assigned to grazing native vegetation landuse and mapped as category 2 – regulated land.

Sensitive regulated land (including land cover by Property Vegetation Plans) has been assigned to category 2 – regulated land.

Where native vegetation clearing has occurred post 1 January 1990 it has been assumed that the clearing was undertaken with approval and these areas have been assigned to category 1 – exempt land.

An overview of category 1 – exempt land and category 2 – regulated land within the proposal study area is presented in Figure 5.1 with detailed mapping provided in Appendix C-1.

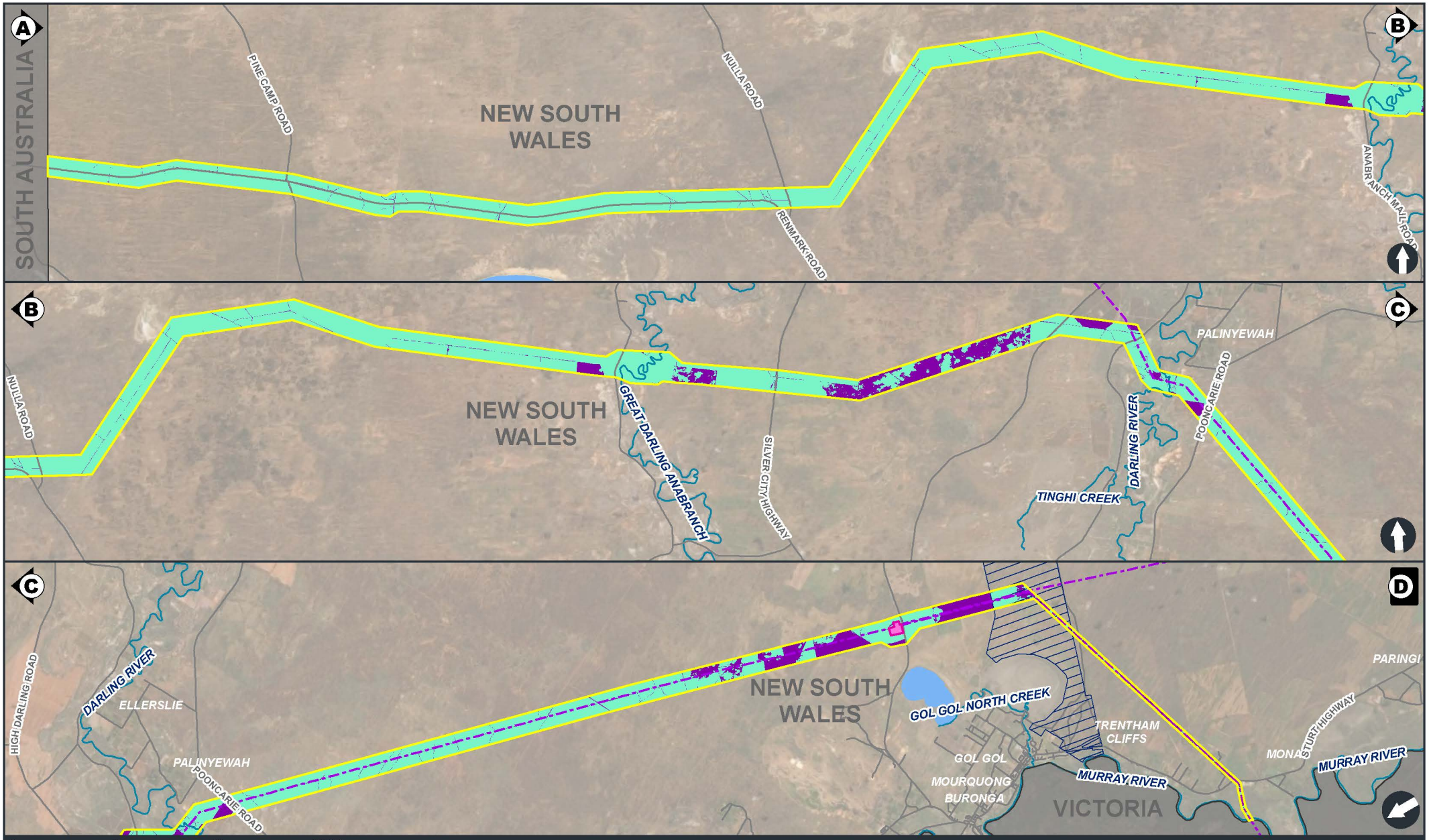

Figure 5.1

Overview of native vegetation regulatory mapping within the proposal study area

Refer to Appendix C.1 for further detail

- Proposal study area
- Proposed substation expansion area
- Existing transmission line infrastructure
- Category 2 lands
- Category 1 lands
- Property where no access available - State Vegetation Mapping shown

Source: NSWSS, ESRI, Transgrid, WSP

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5.2 NATIVE VEGETATION RECORDED

Native vegetation has been recorded by vegetation formation, class and associated PCT in accordance with the NSW BioNet Vegetation Classification System (EES, 2020). The mapping of vegetation zones was based on the sampling of native vegetation broad conditions states as described in Section 3.6.3.

Vegetation mapping undertaken for this BDAR was completed over the entire proposal study area to inform avoidance measures during design development. In accordance with the requirements of the BAM, vegetation integrity scores have been calculated using the indicative disturbance area.

5.2.1 OVERVIEW

Native vegetation recorded within the indicative disturbance area has been assigned to seven vegetation formations that occur within four IBRA subregions. The recorded vegetation formations are:

- Arid Shrublands (Acacia sub-formation)
- Arid Shrublands (Chenopod sub-formation)
- Forested Wetlands
- Freshwater Wetlands
- Saline Wetlands
- Semi-arid Woodlands (Grassy sub-formation)
- Semi-arid Woodlands (Shrubby sub-formation).

Of the seven recorded native vegetation formations, these have been assigned to nine vegetation classes, 20 PCTs and 27 vegetation zones. An overview of each vegetation formation, class, PCT and zone within each IBRA subregion is presented section 5.2.2 to 5.2.5.

A detailed description of each PCT, including selection justification, floristic and structural composition along with representative photos and summary of BAM plot data against IBRA region benchmarks are provided in Appendix C-2. Detailed vegetation integrity plot data for each PCT and associated vegetation zone is presented in Appendix C-3.

An overview of mapped native vegetation is shown in Figure 5.2 with detailed native vegetation mapping shown in Appendix C-4.

5.2.2 NATIVE VEGETATION TYPES AND ZONES OF THE SOUTH OLARY PLAIN IBRA SUBREGION

Native vegetation recorded within the indicative disturbance area for the South Olary Plain IBRA subregion comprises of five NSW vegetation formations that form part of eight vegetation classes, 13 PCTs and 19 vegetation zones. A summary of native vegetation recorded within the South Olary Plain IBRA subregion is presented in Table 5.1.

Table 5.1 Native vegetation types, zones and integrity recorded within the South Olary Plain IBRA subregion

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Arid Shrublands (Acacia sub-formation)											
PCT 143 – Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes	Sand Plain Mulga Shrublands	modified	30%	not a TEC	>100 ha	0.99	0	92.6	91.2	n/a	91.9
Arid Shrublands (Chenopod sub-formation)											
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	Aeolian Chenopod Shrublands	modified	40%	not a TEC	>100 ha	57.53	0	100	30.1	n/a	54.8
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plain		modified	43%	not a TEC	>100 ha	9.72	0	96.4	53.9	n/a	72.1

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Saline Wetlands											
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains	Inland Saline Lakes	modified 'boninka'	30%	not a TEC	>100 ha	2.84	0	85.5	18.4	n/a	39.7
		modified 'lunette'				2.07	0	93.6	11.3	n/a	32.6
Semi-arid Woodlands (Grassy sub-formation)											
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Inland Floodplain Woodlands	modified	50%	not a TEC	>100 ha	1.15	1.87	73.6	25.1	68.7	50.2

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Semi-arid Woodlands (Shrubby sub-formation)											
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	Riverine Sandhill Woodlands	modified	70%	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	>100 ha	0.59	0.32	83.4	80.5	26.1	56
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion		modified	80%		>100 ha	6.18	3.79	97.3	100	35.4	70.1
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	Semi-arid Sand Plain Woodlands	modified	50%	not a TEC	>100 ha	29.34	59.62	69.3	63.6	49.5	60.2
		derived				36.56	0	37.5	13	0	1.3

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
PCT 170 – Chenopod sandplain mallee woodland/ shrubland of the arid and semi-arid (warm) zones	Sand Plain Mallee Woodlands	modified – bull	41%	not a TEC	>100 ha	9.85	18.17	89.4	51.8	63.5	66.5
		modified – whipstick				45.43	87.56	91.8	44.5	49.3	58.6
		derived				34.53	0	76.8	20.2	0	2.6
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	Dune Mallee Woodlands	modified – bull	19%	not a TEC	>100 ha	1.82	4.53	78.6	59.3	62.7	66.4
		modified – whipstick				16.64	32.48	98.1	74.5	54.2	73.4
PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone		modified – whipstick	1%	not a TEC	>100 ha	8.69	19.48	93.8	63.3	39.9	61.9
PCT 221 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	Semi-arid Sand Plain Woodlands	modified	30%	not a TEC	>100 ha	1.26	2.11	69.1	93.9	44.7	66.2

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion		modified	50%	not a TEC	>100 ha	0.73	1.66	47.3	16.3	29.3	28.3
		derived				5.32	0	35.2	6	0	0.6

(1) Disturbance area A = is a subset of the indicative disturbance area where all native vegetation is removed

(2) Disturbance area B = is a subset of the indicative disturbance area where only native vegetation trimming above 2 metres in height is required

5.2.3 NATIVE VEGETATION TYPES AND ZONES OF THE GREAT DARLING ANABRANCH IBRA SUBREGION

Native vegetation recorded within the indicative disturbance area for the Great Darling Anabranch IBRA subregion comprises of five NSW vegetation formations that form part of six vegetation classes, four PCTs and five vegetation zones. A summary of native vegetation recorded within the Great Darling Anabranch IBRA subregion is presented in Table 5.2.

Table 5.2 Native vegetation types, zones and integrity recorded within the Great Darling Anabranch IBRA subregion

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Saline Wetlands											
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	Inland Saline Lakes	modified	34%	not a TEC	>100 ha	0.24	0	100	55.9	n/a	74.8
Semi-arid Woodlands (Grassy sub-formation)											
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Inland Floodplain Woodlands	modified	50%	not a TEC	>100 ha	7.16	12.07	73.7	73.5	68.7	72

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Semi-arid Woodlands (Shrubby sub-formation)											
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	Riverine Sandhill Woodlands	modified	70%	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	>100 ha	0.47	1.20	91.4	53.3	26.1	50.3
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	Semi-arid Sand Plain Woodlands	modified	50%	not a TEC	>100 ha	0.13	0.59	80.8	80.6	46.9	67.4
		derived				0.06	0	48.8	17.9	0	0.7

(1) Disturbance area A = is a subset of the indicative disturbance area where all native vegetation is removed

(2) Disturbance area B = is a subset of the indicative disturbance area where only native vegetation trimming above 2 metres in height is required

5.2.4 NATIVE VEGETATION TYPES AND ZONES OF THE POONCARIE-DARLING IBRA SUBREGION

Native vegetation recorded within the indicative disturbance area for the Pooncarie-Darling IBRA subregion comprises of six NSW vegetation formations that form part of six vegetation classes, eight PCTs and eight vegetation zones. A summary of native vegetation recorded within the Pooncarie-Darling IBRA subregion is presented in Table 5.3.

Table 5.3 Native vegetation types, zones and integrity recorded within the Pooncarie-Darling IBRA subregion

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Arid Shrublands (Acacia sub-formation)											
PCT 139 – Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions	Sand Plain Mulga Shrublands	modified	50%	not a TEC	>100 ha	1.11	0.94	82.4	64.8	n/a	73
Arid Shrublands (Chenopod sub-formation)											
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	Aeolian Chenopod Shrublands	modified	40%	not a TEC	>100 ha	5.20	0	100	69.9	n/a	83.6
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains		modified	43%	not a TEC	>100 ha	0.15	0	100	90.7	n/a	95.2

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Forested Wetland											
PCT11 – 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)	Inland Riverine Forest	modified	42%	not a TEC	>100 ha	1.05	0.43	70.6	62.1	48.7	59.8
Saline Wetlands											
PCT 63 – Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	Inland Saline Lakes	modified	10%	not a TEC	>100 ha	0.30	0	86.7	17.4	n/a	38.9
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW		modified	34%	not a TEC	>100 ha	2.29	0	94.1	38.6	n/a	60.3

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Semi-arid Woodlands (Grassy sub-formation)											
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion).	Inland Floodplain Woodlands	modified	50%	not a TEC	>100 ha	20.54	40.55	75.6	78	70.7	74.7
Semi-arid Woodlands (Shrubby sub-formation)											
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	Riverine Sandhill Woodlands	modified	80%	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	>100ha	0.46	0.68	97.2	96.6	31.4	66.5

(1) Disturbance area A = is a subset of the indicative disturbance area where all native vegetation is removed

(2) Disturbance area B = is a subset of the indicative disturbance area where only native vegetation trimming above 2 metres in height is required

5.2.5 NATIVE VEGETATION TYPES AND ZONES OF THE ROBINVALE PLAIN IBRA SUBREGION

Native vegetation recorded within the indicative disturbance area for the Robinvale Plain IBRA subregion comprises of five NSW vegetation formations that form part of five vegetation classes, five PCTs and six vegetation zones. A summary of native vegetation recorded within the Robinvale Plain IBRA subregion is presented in Table 5.4

Table 5.4 Native vegetation types, zones and integrity recorded within the Robinvale Plain IBRA subregion

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Arid Shrublands (Chenopod sub-formation)											
PCT216 – Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion	Riverine Chenopod Shrublands	modified	0%	not a TEC	>100 ha	0.54	0	58.2	84.5	n/a	70.1
Forested Wetland											
PCT11 – 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)	Inland Riverine Forest	modified	42%	not a TEC	>100 ha	0.10	0	69.7	51.3	61.4	60.3

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Freshwater Wetlands											
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Inland Floodplain Shrublands	modified	63%	not a TEC	>100 ha	0.04	0	43	82.4	n/a	59.5
Semi-arid Woodlands (Grassy sub-formation)											
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	Inland Floodplain Woodlands	modified	57%	not a TEC	>100 ha	2.25	4.56	79.8	80.8	62.8	74
		derived				0.47	0	72.3	60	1.5	18.6

VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	ASSOCIATED TEC	PATCH SIZE CLASS	DISTURBANCE AREA A (HA)[1]	DISTURBANCE AREA B (HA)[2]	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE
Semi-arid Woodlands (Shrubby sub-formation)											
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	Riverine Sandhill Woodlands	modified	70%	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	>100 ha	0.18	0.17	78.6	43.8	28.7	46.2

(1) Disturbance area A = is a subset of the indicative disturbance area where all native vegetation is removed

(2) Disturbance area B = is a subset of the indicative disturbance area where only native vegetation trimming above 2 metres in height is required

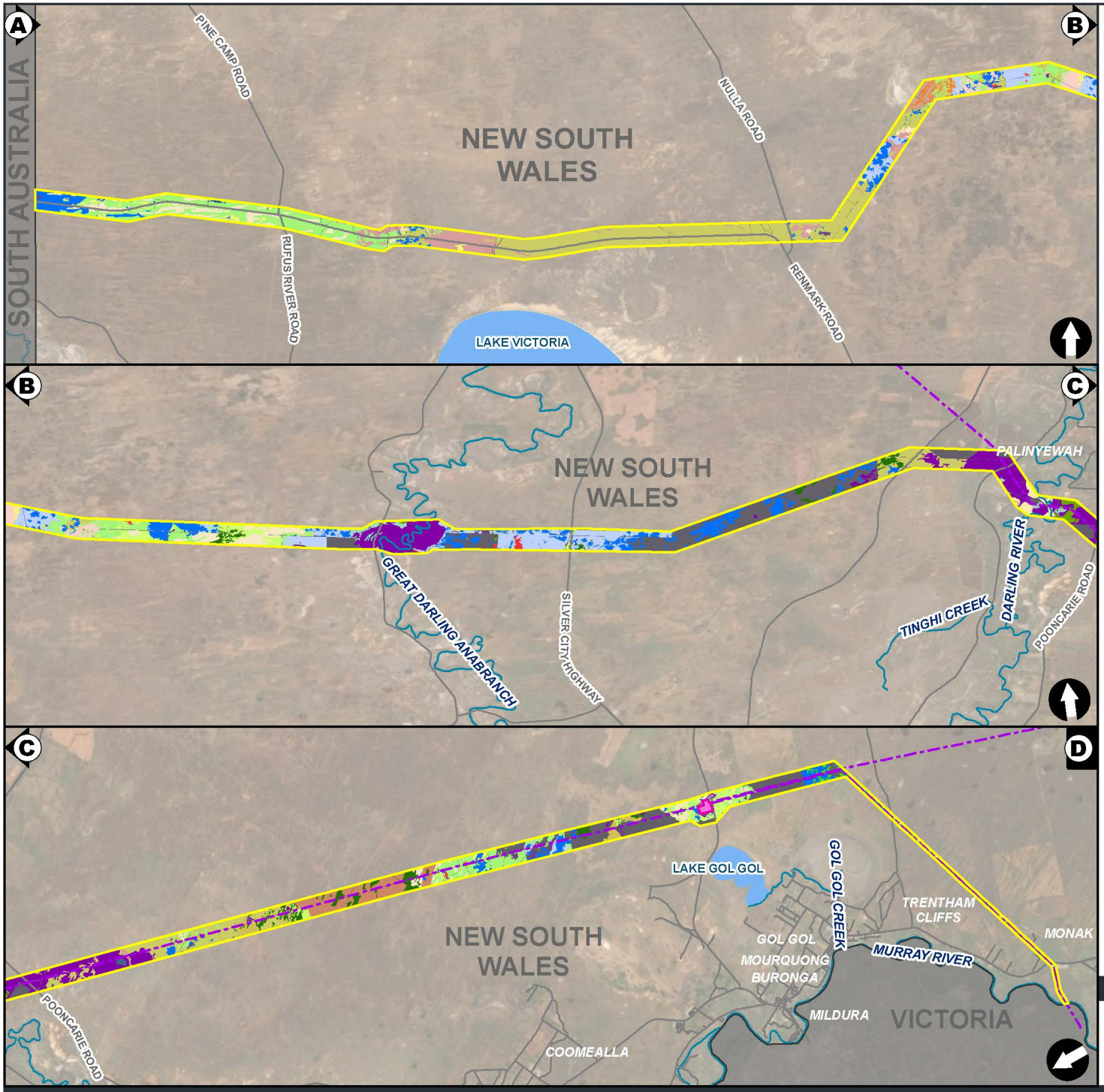

Figure 5.2

Overview of native vegetation types and zones within the proposal study area

Refer to Appendix C.4 for further detail

Source: NSWSS, ESRI, Transgrid, WSP

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5.3 PRIORITY WEEDS AND WEEDS OF NATIONAL SIGNIFICANCE RECORDED

Two exotic flora species recorded within the proposal study area during field surveys were listed under the NSW *Biosecurity Act 2015* (BA Act) as priority weeds for the Western region (Department of Planning, Industry and Environment, 2020). These two species are also listed as Weeds of National Significance (WONS) (Australian Weeds Committee, 2020). All priority weeds and weeds of National Significance are outlined below in Table 5.5.

Table 5.5 Priority weeds and weeds of national significant recorded within the proposal study area

SPECIES NAME	PRIORITY WEEDS	WONS
Lycium ferocissimum (African boxthorn)	**Prohibition on dealings** Must not be imported into the State or sold **Regional Recommended Measure** Land managers mitigate the risk of the plant spreading from their land. Land managers reduce impact of plant on priority assets (riparian areas and floodplains).	Yes
Opuntia species (Prickly pear – Opuntia)	**Prohibition on dealings** Must not be imported into the State or sold Except for *Opuntia ficus-indica* (Indian fig) **Regional Recommended Measure** Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. This Regional Recommended Measure applies to all species of Opuntia except for *Opuntia ficus-indica* (Indian fig)	Yes

In addition to priority weeds and weeds of National Significance the following environmental weeds were also recorded:

- *Asphodelus fistulosus* (onion weed)
- *Emex australis* (Spiny Emex)
- *Marrubium vulgare* (Horehound)
- *Nicotiana glauca* (Tree Tobacco)
- *Onopordum acaulon* (Stemless Thistle)
- *Tribulus terrestris* (Cat-head)
- *Xanthium occidentale* (Noogoora Burr).

A full inventory of weed species recorded within each BAM vegetation integrity plots, including high threat weeds, is provided in Appendix C-3.

5.4 THREATENED ECOLOGICAL COMMUNITIES

A total of four candidate threatened ecological communities listed under the BC Act were considered to have potential to occur within the proposal study area. These are:

- *Allocasuarina luehmannii* Woodland in the Riverina and Murray-Darling Depression Bioregions
- Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregions
- *Halosarcia lylei* low open-shrubland in the Murray Darling Depression Bioregion
- Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions.

Of these four candidate threatened ecological communities, only Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions (Sandhill Pine Woodland) was recorded within the proposal study area. This community is listed as endangered under the BC Act. Sandhill Pine Woodland is not listed under the EPBC Act.

Within the proposal study area two vegetation types were considered likely to be associated with this threatened ecological community, these are:

- PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains
- PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion.

A summary of Sandhill Pine Woodland threatened ecological community, associated PCT and extent within the indicative disturbance area for each IBRA subregion is summarised in Table 5.6.

Table 5.6 Summary of Sandhill Pine Woodland within the indicative disturbance area

THREATENED ECOLOGICAL COMMUNITY	VEGETATION TYPE	VEGETATION ZONE	SOP	GDA	PD	RP	DIRECT IMPACT (HA)
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area A	0.59	0.47	0	0.16	**1.22**
		modified – disturbance area B	0.32	1.20	0	0.17	**1.69**
	PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	modified – disturbance area A	6.18	0	0.46	0	**6.64**
		modified – disturbance area B	3.79	0	0.68	0	**4.47**
Total			**10.88**	**1.67**	**1.14**	**0.33**	**14.02**

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

A comparison of the final determination for Sandhill Pine Woodland threatened ecological community and candidate PCT is provided in Table 5.7. Each element of the final determination including locality, species composition, characteristic species and resilience is compared to each condition class for candidate PCTs to determine if vegetation recorded is consistent with the listing criteria.

The location of Sandhill Pine Woodland threatened ecological community in relation to the proposal study area is provided in Figure 5.3.

Table 5.7 Correlation of BC Act-listed Sandhill Pine Woodland and associated PCTs

SCIENTIFIC DETERMINATION	PCT 19 CYPRESS PINE WOODLAND OF SOURCE-BORDERING DUNES MAINLY ON THE MURRAY AND MURRUMBIDGEE RIVER FLOODPLAINS	PCT 21 SLENDER CYPRESS PINE - SUGARWOOD - WESTERN ROSEWOOD OPEN WOODLAND ON SANDY RISES MAINLY IN THE RIVERINA BIOREGION AND MURRAY DARLING DEPRESSION BIOREGION
Does the PCT occur in the Riverina, Murray-Darling Depression or South Western Slopes Bioregions?	Yes Recorded in the Murray Darling Depression, Darling Riverine Plains and Riverina IBRA regions.	Yes Recorded in the Murray Darling Depression and Darling Riverine Plains IBRA regions.
Is the PCT dominated by *Callitris glaucophylla* or infrequently by *Callitris gracilis subsp. murrayensis*	Yes This PCT is dominated by *Callitris glaucophylla.* and *Callitris gracilis subsp. Murrayensis.*	Yes This PCT was dominated by *Callitris gracilis subsp. murrayensis.*
Does the PCT occur on 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? Or In the Riverina bioregion and the far south-western portion of the NSW South Western Slopes bioregion, 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. Or Murray-Darling Depression bioregion, the community occurs as scattered patches on sandhills and lunettes within an extensive aeolian sandplain dominated by woodlands of mallee eucalypts or belah.	Yes This PCT occurred on sandy soils and colonised crescent shaped dunes on the outskirts of the floodplain of major river systems.	Yes This PCT occurred as scattered patches on sand hills in areas of higher elevation away from the floodplain.

SCIENTIFIC DETERMINATION	PCT 19 CYPRESS PINE WOODLAND OF SOURCE-BORDERING DUNES MAINLY ON THE MURRAY AND MURRUMBIDGEE RIVER FLOODPLAINS	PCT 21 SLENDER CYPRESS PINE - SUGARWOOD - WESTERN ROSEWOOD OPEN WOODLAND ON SANDY RISES MAINLY IN THE RIVERINA BIOREGION AND MURRAY DARLING DEPRESSION BIOREGION
Does the PCT structure comprise of an open tree canopy with sometimes sparse, but highly variable ground layer dominated by grasses and herbs, sometimes with scattered shrubs and/or small trees?	Yes This PCT has an open tree canopy with percentage tree cover ranging from 0-8% The understory is dominated by a high % cover of herbs. A low percentage cover of grasses and shrubs was recorded.	Yes This PCT has an open tree canopy with percentage tree cover ranging from 0-10% The understory is dominated by high percentage cover of shrubs and herbs cover. A low percentage cover of grasses occurred within this PCT.
Paragraph 2 Does the PCT have the assemblage of species that are listed as frequently and infrequently occurring within this EEC	Yes This PCT has 19% of the frequently recorded species and 37% of the infrequently recorded species. Whilst these numbers are relatively low the PCT was degraded within the proposal study area.	Yes This PCT has 26% of the frequently recorded species and 47% of the infrequently recorded species. The former species diversity was relatively low however infrequently recorded species was half of the species identified within the scientific determination.
Paragraph 3 There is no condition threshold described for this community in the determination. Any vegetation in which characteristic native species dominate any structural layer present is considered to constitute the community.	Yes This PCT has characteristic dominant native species in the canopy layer (>50% of cover layer). The herb layer is at least 10% dominant within this community.	Yes This PCT does not have the canopy species present in the form of *Callitris glaucophylla* however the final determination lists *Callitris gracilis subsp. murrayensis* as an infrequently recorded species that is characteristic of this community. The dominant species in the understorey and ground layer are consistent with the species listed within the final determination. The understorey and ground layer have high percentage cover for shrubs, herbs and grasses.
Does this PCT meet the criteria for this EEC?	**Meets Criteria**	**Meets Criteria**

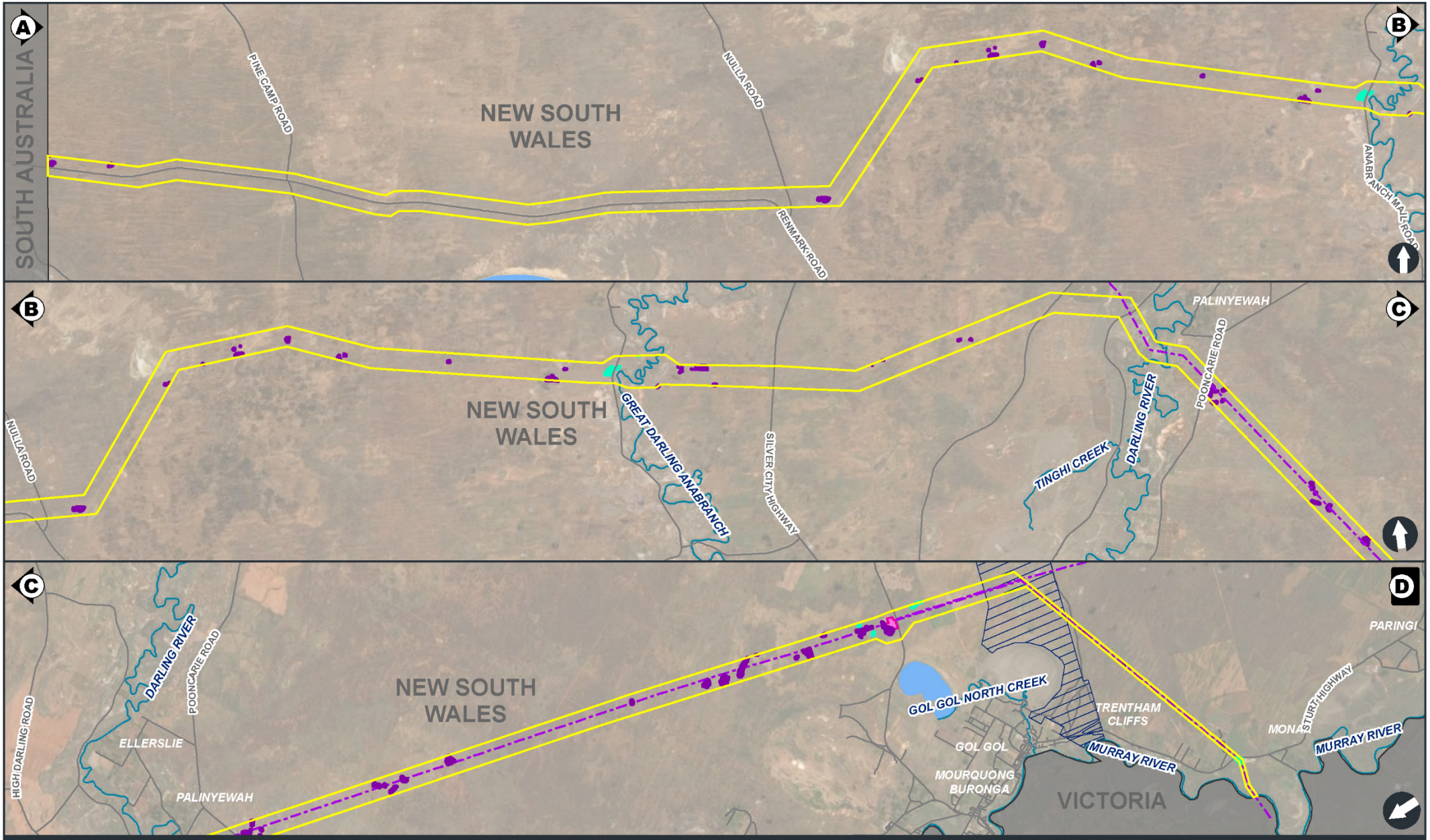

Figure 5.3

Overview of threatened ecological communities within the proposal study area

Refer to Appendix C.6 for further detail

- Proposal study area
- Proposed substation expansion area
- Existing transmission line infrastructure
- Property where no access available - State Vegetation Mapping shown

Sandhill Pine Woodland (Endangered BC Act)

- PCT19 - Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains, modified
- PCT21 - Slender Cypress Pine - Sugarwood - Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion, modified

Source: NSWSS, ESRI, Transgrid, WSP

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5.5 GROUNDWATER DEPENDENT ECOSYSTEMS

No high priority GDEs were documented in either of the previous groundwater related water sharing plans that were superseded on 1 July 2020. Publicly available location (GIS) data, including information on high priority GDEs, is currently unavailable for the new water sharing plans that were enacted on 1 July 2020. However, GDE information obtained through the National Groundwater Information System (NGIS) (BOM, 2020b) identified six GDEs with high potential for groundwater interaction within the proposal study area (Table 5.8).

Table 5.8 GDEs with high potential for groundwater interaction within the proposal study area (BOM 2020b)

GDE TYPE	NAME	ASSOCIATED PCT
Terrestrial (aquatic)	Darling River	N/A
Terrestrial (aquatic)	Murray River	N/A
Subterranean (vegetation)	*Eucalyptus camaldulensis*	PCT 11
Subterranean (vegetation)	*Eucalyptus largiforens*	PCT 13 and 15
Subterranean (vegetation)	Grassy Riverine Forest	
Subterranean (vegetation)	Mallee	PCT 170, 171 and 172

Generally, all identified high potential GDEs within the proposal study area are in proximity to the Darling River, Great Darling-Anabranch and Murray River, with larger GDE communities adjacent to the Darling River and Murray River. The following high potential GDEs were also identified through the NGIS:

- two non-connected populations of Mallee (vegetation) that occur northeast of Lake Victoria; one at the edge of the proposal study area and the other within the proposal study area and extending approximately five kilometres to the northwest
- an additional grouping of Mallee and Eucalyptus largiflorens occur proximal to the townships of Buronga and Wentworth, approximately one kilometres from the proposal study area.

One RAMSAR wetland, known as Riverland, is located within SA, about three and a half kilometres southwest of the proposal study area.

5.6 NATIVE VEGETATION AND FAUNA HABITATS

The four main stratified broad fauna habitats recorded within the proposal study area are described below.

5.6.1 RIVERINE

These native woodlands are broadly associated with riverine environments. These are dominated by Black Box and River Red Gums. The vast majority of this fauna habitat stratification unit occurs in association with the Great Darling Anabranch, the Darling River and the Murray River. It is highly modified, mostly consisting of a tree canopy layer with generally a highly disturbed understorey and groundcover, owing to the historical agricultural and grazing use for over 140 years. The association with the permanent or semi-permanent rivers still lends this stratification unit regional importance as it is a habitat that provides water within an arid or semi-arid landscape. Tree hollows occur within older River Red Gums and Black Box and these are an important nesting resource for species such as parrots, microchiropteran bats, arboreal fauna and reptiles.

5.6.2 ARID WOODLAND/SHRUBLANDS

Native woodland and shrublands broadly associated with arid interior areas. This fauna stratification mostly unit occurs in the western part of the proposal study area to the SA/NSW border. It is dominated primarily by mostly whipstick (young) Mallee, with older bull Mallee occurring adjacent to the SA/NSW border. The Mallee is dominated by spinifex or chenopod understorey. Typically, it is highly or partially modified as a result of agricultural and grazing use, which relies on maximum grazing especially in dry times. Due to its disturbed condition, while it still provides habitats for those fauna that primarily rely on tree canopies, those species that require complex shrublayer and groundcovers are less likely to be present. Tree hollows generally do not occur within this fauna stratification unit at a high density, even in the older Mallee areas as Mallee generally needs to be very old to form hollows.

5.6.3 CHENOPOD SHRUBLANDS

This fauna habitat stratification unit occurs in the arid and semi-arid interior parts of the proposal study area. They do not contain a dense or dominant tree canopy but are dominated by dense shrubs such as Black Bluebush, Pearl Bluebush and saltbush. Like the other fauna habitat stratification units, these have generally also been impacted by agriculture and grazing, though the presence of some dense areas of shrublands means that native fauna species still persists throughout this unit.

5.6.4 WETLANDS

The wetland fauna habitat stratification unit is very small and ended up not being impacted by the indicative disturbance area. Only 0.34 hectares occurs within the indicative disturbance area. These are located in lower lying areas near the riverine areas and tend to be dominated by Lignum shrubs and be ephemerally wet in nature. These areas can be important within the arid and semi-arid region by providing a water source and in particularly providing habitat for amphibians in wet times.

5.7 NATIVE VEGETATION MALLEE BIRD ASSESSMENT

Mallee habitats represent unique community forms, where mallee eucalypts are adapted to growing in semi-arid sandy topographies (Australian National Botanic Gardens, 2004). Uniquely, mallee eucalypts are adapted to the harsh conditions defining low rainfall habitats, through a special root structure called a lignotuber (Australian National Botanic Gardens, 2004). They provide a eucalypt canopied structural framework that uniquely fosters a niche assemblage for specialised flora and fauna (including many listed threatened species) over large semi-arid regions. A confirmation of this value includes the proposed listing of the Eastern Mallee Bird Community as Endangered under the EPBC Act, which is still under consideration.

In terms of bird potentials, the highest quality mallee habitats exhibit a number of structural characteristics, which separate them from poorer mallee habitat types, including:

- large patch size with no fragmentation
- long periods without fire
- continuous understorey cover of grasses and/or shrubs
- high understorey plant diversity
- high levels of understorey woodland debris and litter
- old-growth habitat features such as abundant hollows.

Although the transmission line corridor traverses large areas of country dominated by mallee vegetation, the health of associated mallee communities is generally compromised by the lack of the key habitat characteristics which support high quality mallee habitat for mallee dependent fauna. Observed short comings of associated habitats, which constrain its potential to support healthy populations of threatened mallee bird populations occur at all structural levels of the habitat.

Due to the arid nature of lands in which mallee habitats occur they are generally fragile in terms of resilience, particularly during extended dry periods. Therefore, the integrity of their structure and resilience can be easily compromised from impacts that erode their structural form and biodiversity proportions and variation. Due to the low density of resources during hard times, patch size in marginal country needs to be large, to offset the thinning of resources. Fauna that are limited to small home ranges are more susceptible to resource declines. Large areas of habitat or linkages to large areas of habitat are required to allow population to rebuild after stochastic events.

In mallee habitats associated with the proposal disturbance area the continuity of canopy cover is often compromised by fragmentation, which reduces patch size and isolates small patches from extensive areas of high-quality habitats, increasing edge effects, eroding connectivity, introducing weed opportunities and increasing micro-habitat exposure to wind and light. Patch fragmentation, size reduction and isolation are serious hurdles that many small fauna species populations are unable to endure, and different scales of fragmentation affects varying fauna capacities to connect in the landscape.

Understorey degradation from grazing was widespread in lands associated with the proposal disturbance area and was exaggerated by the prevailing extended dry conditions under which surveys were conducted. Grazing appeared to have serious impacts on understorey cover and flora diversity, during the dry, when compared directly with adjacent habitats where grazing was not experienced. The thinning or loss of flora cover appeared to reduce fauna diversity present at many sites, from invertebrates to small and medium sized fauna with limited movement capability. The loss of cover realises an increased risk of predation, reductions in foraging resources, including plants and invertebrates dependent on them, and population resilience.

Old-growth mallee habitat examples were patchy and relatively sparse, with large areas of habitat exhibiting relatively small DBH mallee stems, suggesting fire or clearing in the past. Hollow-bearing mallee trees were infrequent and often associated with degraded understories, suggesting retention for stock shade purposes.

Understorey diversity and structural complexity was occasionally moderate to high, but for the most part sparse or patchy. Triodia (Porcupine Grass, known as spinifex) was patchy and nowhere observed to extensive.

6 THREATENED SPECIES

This chapter address threatened species in accordance with section 6 of the BAM and matters within the indicative disturbance area relating to the BC Act.

In applying the BAM, threatened species are divided into two categories, being:

- ecosystem credit species
- species credit species.

6.1 ECOSYSTEM CREDIT SPECIES

Ecosystem credit species are those that can be predicted by vegetation surrogates and landscape features or are those species for which targeted survey has a low probability of detection. Targeted survey is not required for ecosystem credit species. Ecosystem credit threatened species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the Threatened Biodiversity Data Collection (EES, 2020) as required by subsections 6.1.1.3 and 6.2.1.2 of the BAM.

An overview of the process for determining predicted ecosystem credit species is presented below:

- Step 1: All PCTs, associated vegetation zones and plot data are loaded into the calculator (refer to Chapter 5).
- Step 2: A list of predicted ecosystem credit species is generated from the BAM calculator (refer to section 6.1.1 and Table 6.1).
- Step 3: Justification for inclusion of any additional predicted ecosystem credit species based on the outcome from other database searches, local data sources and likelihood of occurrence assessments (see section 6.1.2, Table 6.2 and Appendix D-1 and Appendix D-2).
- Step 4: Justification for exclusion of any predicted ecosystem credit species identified in the steps above (refer to section 6.1.3, Appendix D-1 and Appendix D-2).
- Step 5: Finalise predicted ecosystem credit species associated with each vegetation zone for each IBRA subregion (refer to Chapter 9 & 12 and Appendix G).

6.1.1 PREDICTED ECOSYSTEM CREDIT SPECIES GENERATED FROM BAM-C

A preliminary list of predicted ecosystem credit species was generated from the BAM-C based on associated vegetation types for each IBRA subregion. This preliminary predicted ecosystem credit species list is presented in Figure 6.1.

Table 6.1 List of BAM-C predicted ecosystem species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Birds							
Artamus cyanopterus	Dusky Woodswallow	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Botaurus poiciloptilus	Australasian Bittern	E	PCT 11, 13 & 17	–	–	✓	✓
Certhionyx variegatus	Pied Honeyeater	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Cinclosoma castanotum	Chestnut Quail-thrush	V	PCT 170, 171 & 172	✓	–	–	–
Circus assimilis	Spotted Harrier	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Daphoenositta chrysoptera	Varied Sittella	V	PCT 11, 13, 15, 21, 58, 170, 171, 172, 221 & 252	✓	–	–	✓
Drymodes brunneopygia	Southern Scrub-robin	V	PCT 171	✓	–	–	–
Epthianura albifrons	White-fronted Chat	V	PCT 17, 63, 154, 166, 216 & 253	✓	✓	✓	✓
Falco hypoleucos	Grey Falcon	E	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	PCT 11, 170, 171 & 172	✓	–	–	✓
Grantiella picta	Painted Honeyeater	V	PCT 15, 21, 58 & 143	✓	–	–	–
Grus rubicunda	Brolga	V	PCT 11, 13, 15, 17, 63 & 166	✓	✓	✓	✓
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	PCT 11, 13, 15, 17, 19, 21, 58, 139, 143, 166, 170, 171 & 216	✓	✓	✓	✓
Hamirostra melanosternon	Black-breasted Buzzard	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Hieraaetus morphnoides	Little Eagle	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Hylacola cautus	Shy Heathwren	V	PCT 170, 171 & 172	✓	–	–	–

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Lathamus discolor	Swift Parrot	E	PCT 11	–	–	–	✓
Leipoa ocellata	Malleefowl	E	PCT 170, 171 & 172	✓	–	–	-
Lichenostomus cratitius	Purple-gaped Honeyeater	V	PCT 11, 13, 170, 171 & 172	✓	–	–	✓
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Lophoictinia isura	Square-tailed Kite	V	PCT 11, 13, 15, 21, 58, 221 & 252	✓	✓	✓	✓
Melanodryas cucullata	Hooded Robin (south-eastern form)	V	PCT 15, 19, 21, 58, 139, 143, 170, 171, 172, 221 & 252	✓	✓	✓	-
Melithreptus gularis	Black-chinned Honeyeater (eastern subspecies)	V	PCT 11	–	–	✓	✓
Neophema splendida	Scarlet-chested Parrot	V	PCT 170, 171 & 172	✓	–	–	–
Ninox connivens	Barking Owl	V	PCT 11, 13 & 15	✓	✓	✓	✓
Oxyura australis	Blue-billed Duck	V	PCT 17	–	–	–	✓
Pachycephala inornata	Gilbert's Whistler	V	PCT 11, 13, 17, 19, 21, 58, 170, 171 & 172	✓	✓	✓	✓
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	PCT 11, 13, 15, 58, 170 & 171	✓	✓	✓	✓
Pomatostomus temporalis	Grey-crowned Babbler (eastern subspecies)	V	PCT 15, 19, 58 & 143	✓	–	–	–
Pyrrholaemus brunneus	Redthroat	V	PCT 154	✓	–	✓	–
Rostratula australis	Australian Painted Snipe	E	PCT 11, 13 & 17	–	–	–	✓
Stagonopleura guttata	Diamond Firetail	V	PCT 11, 13, 19, 58 & 170	✓	–	–	✓
Stictonetta naevosa	Freckled Duck	V	PCT 11, 13 & 17	–	–	✓	✓
Mammals							
Antechinomys laniger	Kultarr	E	PCT 21, 58, 143, 154, 170, 171, 221 & 252	✓	–	–	–
Cercartetus concinnus	Western Pygmy Possum	E	PCT 58, 170, 171, 172 & 221	✓	–	–	–

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Chalinolobus picatus	Little Pied Bat	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	–	✓	✓
Ningaui yvonneae	Southern Ningaui	V	PCT 170, 171 & 172	✓	–	–	–
Nyctophilus corbeni	Corben's Long-eared Bat	V	PCT 21, 58, 139, 170, 171, 172 & 221	✓	✓	✓	-
Pseudomys bolami	Bolam's Mouse	E	PCT 21, 58, 170, 171, 172 & 221	✓	–	–	–
Pseudomys hermannsburgensis	Sandy Inland Mouse	V	PCT 58, 143, 154 & 171	✓	–	–	–
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	PCT 11, 13, 15, 17, 19, 21, 58, 139, 143 & 170	✓	✓	✓	✓
Sminthopsis macroura	Stripe-faced Dunnart	V	PCT 58, 143, 154, 171, 172 & 221	✓	–	–	–
Vespadelus baverstocki	Inland Forest Bat	V	PCT 13, 15, 21, 58, 143, 170, 171, 172 & 221	✓	–	✓	✓
Reptiles							
Aprasia inaurita	Mallee Worm-lizard	E	PCT 170, 171 & 172	✓	–	–	–
Ctenotus brooksi	Wedgesnout Ctenotus	V	PCT 143, 171 & 172	✓	–	–	–
Cyclodomorphus melanops elongatus	Mallee Slender Blue-tongue Lizard	V	PCT 171 & PCT 172	✓	–	–	–
Delma australis	Marble-faced Delma	E	PCT 170, 171 & 172	✓	–	–	–
Echiopsis curta	Bardick	E	PCT 171 & 172	✓	–	–	–
Lerista xanthura	Yellow-tailed Plain Slider	V	PCT 58, 139, 143, 170, 171, 221 & 252	✓	✓	✓	-
Pseudonaja modesta	Ringed Brown Snake	E	PCT 58, 143, 170, 171 & 172	✓	–	–	–
Ramphotyphlops endoterus	Interior Blind Snake	E	PCT 143 & 154	✓	–	–	–
Strophurus elderi	Jewelled Gecko	V	PCT 170, 171 & 172	✓	–	–	–
Tiliqua occipitalis	Western Blue-tongued Lizard	V	PCT 21, 154, 170, 171 & 172	✓	–	–	–

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

6.1.2 JUSTIFICATION FOR INCLUSION OF ANY ADDITIONAL PREDICTED ECOSYSTEM CREDIT SPECIES

In determining the predicted ecosystem credit species list for each IBRA subregion, the following inclusions to the BAM-C preliminary predicted list have been added (refer to Table 6.2).

Table 6.2 Justification for inclusion of any additional predicted ecosystem credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	JUSTIFICATION FOR INCLUSION	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Birds							
Anseranas semipalmata	Magpie Goose	V	Potential habitat occurs within PCT 13, 15	✓	✓	✓	✓
Falco subniger	Black Falcon	V	Potential habitat occurs within PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 153, 154, 166, 170, 171, 172, 216, 221, 252, 253	✓	✓	✓	✓
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	Potential habitat occurs within PCT 11, 13, 19	–	–	–	✓
Mammals							
Chalinolobus picatus	Little Pied Bat	V	Potential habitat occurs within PCT 15, 58, 166	–	✓	–	–
Nyctophilus corbeni	Corben's Long-eared Bat	V	Potential habitat occurs within PCT 13 where hollow-bearing trees occur	–	–	–	✓

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

6.1.3 JUSTIFICATION FOR EXCLUSION OF ANY PREDICTED ECOSYSTEM CREDIT SPECIES

In determining the predicted ecosystem credit species list for each IBRA subregion, the no exclusions to the BAM-C preliminary predicted list have been considered.

6.2 SPECIES CREDIT SPECIES

Species credit species are those species that cannot be confidently predicted to occur based on habitat surrogates and landscape features. These species can also be reliably detected by survey. Species credit species were assessed using information about site context, PCTs and vegetation integrity attributes collected during the field surveys, and data from the Threatened Biodiversity Data Collection (EES, 2020) as required by section 6.3.1.1 of the BAM in conjunction with a habitat assessment.

An overview of the process for determining candidate species credit species is presented below:

- Step 1: All PCTs, associated vegetation zones and plot data are loaded into the BAM-C (refer to Chapter 5).
- Step 2: A list of preliminary candidate species credit species is generated from the BAM-C (refer to Section 6.2.1).
- Step 3: Justification for inclusion of any additional species credit species based on the outcome from other database searches, local data sources and habitat suitability assessments (refer to Section 6.2.1.2, Appendix D-1 and Appendix D-2).
- Step 4: Justification for exclusion of any species credit species identified in the steps above (refer to section 6.2.1.3, Appendix D-1 and Appendix D-2).
- Step 5: Finalise candidate species credit species associated with each vegetation zone for each IBRA subregion (refer to Chapter 9.
- Step 6: Undertake target surveys for candidate threatened species or prepare an expert report or assume presence.
- Step 7: Assessment of candidate threatened species to determine the proposal affected species list (refer to section 6.2.1.4).
- Step 8: Define threatened species impact (individual count or species polygon area count) (refer to Chapter 9, Appendix D-3 and Appendix D-4).
- Step 9: Calculate threatened species impact using BAM-C (see Chapter 12 and Appendix G).

6.2.1 THREATENED FLORA SPECIES

6.2.1.1 CANDIDATE THREATENED FLORA SPECIES CREDIT SPECIES GENERATED FROM BAM-C

A preliminary list of candidate threatened flora species was generated from the BAM-C based on associated vegetation types for each IBRA subregion. This preliminary candidate threatened flora species list is presented in Table 6.3.

Table 6.3 List of preliminary BAM-C candidate threatened flora species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Acacia acanthoclada	Harrow Wattle	E	–	PCT 170, PCT 171 & PCT 172	✓	–	–	–
Acacia carneorum	Purple-wood Wattle	V	–	PCT 21 & PCT 58	✓	–	–	–
Atriplex infrequens	A saltbush	V	–	PCT 17, PCT 153, PCT 166, PCT 170 & PCT 216	✓	–	–	–
Austrostipa metatoris	A spear-grass	V	–	PCT 19 & PCT 170	✓	–	–	✓
Austrostipa nullanulla	A spear-grass	E	Yes	PCT 154 & PCT 253	✓	–	–	–

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Brachyscome papillosa	Mossgiel Daisy	V	–	PCT 15, PCT 154, & PCT 216	✓	–	–	–
Calotis moorei	A burr-daisy	E	Yes	PCT 139, PCT 143, PCT 153, PCT 154 & PCT 170	✓	–	–	–
Casuarina obesa	Swamp She-oak	E	Yes	PCT 11, PCT13 & PCT 15	–	–	–	✓
Cratystylis conocephala	Bluebush Daisy	E	–	PCT 58, PCT 170, PCT 171, PCT 172, PCT 221 & PCT 252	✓	✓	–	✓
Dodonaea stenozyga	Desert Hopbush	CE	Yes	PCT 170, PCT 171 & PCT 172	✓	–	–	–
Eucalyptus leucoxylon subsp. pruinosa	Yellow Gum	V	–	PCT 11, PCT 13, PCT 15 & PCT 19	–	–	–	✓
Kippistia suaedifolia	Fleshy Minuria	E	–	PCT 143, PCT 166, PCT 153, PCT 154 & PCT 253	✓	–	–	–
Lasiopetalum behrii	Pink Velvet Bush	CE	Yes	PCT 170, PCT 171 & PCT 172	✓	–	–	–
Lepidium monoplocoides	Winged Peppercress	E	–	PCT 15, PCT 153, PCT 170, PCT 216	✓	–	✓	–
Leptorhynchos waitzia	Button Immortelle	E	Yes	PCT 63, PCT 153, PCT 166 & PCT 170	✓	–	–	–
Pimelea serpyllifolia subsp. serpyllifolia	Thyme Rice-Flower	E	–	PCT 170, PCT 171 & PCT 172	✓	–	–	–
Pterostylis cobarensis	Greenhood Orchid	V	–	PCT 170 & PCT 171	✓	–	–	–
Santalum murrayanum	Bitter Quandong	E	–	PCT 170, PCT 171 & PCT 172	✓	–	–	–
Solanum karsense	Menindee Nightshade	V	–	PCT 15, PCT 17, PCT 63, PCT 153, PCT 166	✓	–	–	–
Swainsona colutoides	Bladder Senna	E	–	PCT 170, PCT 171 & PCT 172	✓	–	–	–
Swainsona pyrophila	Yellow Swainson-pea	V	–	PCT 170, PCT 171 & PCT 172	✓	–	–	–

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

6.2.1.2 JUSTIFICATION FOR INCLUSION OF ANY ADDITIONAL THREATENED FLORA SPECIES CREDIT SPECIES

In identifying a candidate threatened flora species list for further assessment, the following inclusions to the BAM-C preliminary candidate list have been considered (refer to Table 6.4). Species inclusions were based on database searches and likelihood of occurrence assessments (refer to Appendix D-1).

Table 6.4 Justification for inclusion of any additional threatened flora species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	JUSTIFICATION FOR INCLUSION	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Atriplex infrequens	A saltbush	V	–	Great Darling Anabranch Suitable habitat in the form of PCT 166 Pooncarie – Darling Suitable habitat in the form of PCT 166 Robinvale Plains Suitable habitat in the form of PCT 17 and PCT 216	–	✓	✓	✓
Lepidium monoplocoides	Winged Peppercress	E	–	Robinvale Plains Suitable habitat in the form of PCT 13 and PCT 216.	–	–	–	✓
Leptorhynchos waitzia	Button Immortelle	E	Yes	Great Darling Anabranch Suitable habitat in the form of PCT 166 Pooncarie – Darling Suitable habitat in the form of PCT 63 and PCT 166	–	✓	✓	–
Swainsona murrayana	Slender Darling Pea	V	–	This species has not been recorded within the locality with most records occurring to the east associated with the broader Hay Plain. A single record from 2010 occurs from Nanya Station (around 80 km north of the proposal study area). At Nanya Station, *Swainsona murrayana* was recorded from a gypseous rise approximately 2 m above a saline clay playa, occurring on gypseous clay of Yamba Formation. The plant was ascending through a Bladder Saltbush in a very sparse Bladder Saltbush Shrubland. Gypseous rises have been recorded within the proposal study area within the South Olary Plain IBRA subregion. Targeted surveys of PCT 253 – modified lunette variant will be undertaken based on the occurrence of this species within similar habitat at Nanya Station.	✓	–	–	–

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	JUSTIFICATION FOR INCLUSION	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Swainsona sericea	Silky Swain-pea	V	–	Although no associated vegetation types occur within the proposal study area, this species has been recorded frequently near Red Cliffs mostly within Kings Billabong Park. Field validation of vegetation types within this area indicate Black Box Woodland is the most likely habitat and as such targeted surveys are required for PCT13 within the Robinvale Plains IBRA subregion.	–	–	–	✓

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

6.2.1.3 JUSTIFICATION FOR EXCLUSION OF ANY ADDITIONAL THREATENED FLORA SPECIES CREDIT SPECIES

In refining the candidate threatened flora species list for further assessment, the following exclusions to the BAM-C preliminary candidate list have been considered (refer to Table 6.5). Species exclusions were based on database searches and likelihood of occurrence assessments plus expert review by Dr Ian Sluiter (refer to Appendix D-1).

Table 6.5 Justification for exclusion of any additional threatened flora species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	JUSTIFICATION FOR EXCLUSION	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Brachyscome papillosa	Mossgiel Daisy	V	–	Whilst associated habitat within the proposal study area occurs in the form of PCT 15, PCT 154, & PCT 216 the species is mostly known from areas east of Balranald (~150 km east) and Willandra Lakes (~100 km northeast). The proposal study area does not support large plains of Bladder Saltbush, Leafless Bluebush, grasslands or Grey Box – Cypress Pine woodland complex. Given the lack of records in the locality and lack of optimal habitat this species is not considered a candidate and as such not considered further.	✓	–	–	–
Casuarina obesa	Swamp She-oak	E	Yes	Within NSW this species is only known from a single population at Lake Benanee that occurs to the east of the proposal study area. The indicative disturbance area does not impact shorelines of permanent, ephemeral or relict lakes with associated habitats for this species. Given the lack of records in the locality and lack of optimal habitat this species is not considered a candidate and as such not considered further.	–	–	–	✓

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	JUSTIFICATION FOR EXCLUSION	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Pterostylis cobarensis	Greenhood Orchid	V	–	The proposal study area does not contain preferred habitat in the form of low stony ridges or slopes. Further this species has not been recorded within the locality with the nearest known record being >100 km to the northeast.	✓	–	–	–

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
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6.2.1.4 ASSESSMENT OF CANDIDATE THREATENED FLORA TO DETERMINE AFFECTED SPECIES

A total of 20 candidate threatened flora species were considered to have potential associated habitat within the proposal study area and were the subject of targeted surveys. Of these, five threatened flora species have been recorded. These are:

- *Acacia acanthoclada* (Harrow Wattle) listed as endangered under the BC Act
- *Atriplex infrequens* (A saltbush) listed as vulnerable under the BC Act and EPBC Act
- *Austrostipa nullanulla* (A spear-grass) listed as endangered under the BC Act
- *Dodonaea stenozyga* (Desert Hopbush) listed as critically endangered under the BC Act
- *Santalum murrayanum* (Bitter Quandong) listed as endangered under the BC Act.

A summary of survey results for all candidate threatened flora species, to determine those species that are considered affected by the proposal, are presented in Table 6.6. A discussion of each recorded threatened flora species is also provided below.

Table 6.6 Assessment of candidate threatened flora to determine affected species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Acacia acanthoclada	Harrow Wattle	E	No	PCT 170, PCT 171 & PCT 172	✓	–	–	–	Yes (surveyed)	No A total of 3 individuals were recorded from the proposal study area. All individuals were recorded within the South Olary Plain IBRA subregion. *Acacia acanthoclada* is an area polygon species. Area polygons comprising of a 30-metre buffer to each individual plant was applied in accordance with Section 6.4.1.29 of the BAM. Within the proposal study area *Acacia acanthoclada* has been determined to occupy an area of 0.56 ha (refer to Figure 6.1). Avoidance of all *Acacia acanthoclada* species polygon areas have been achieved through design modifications (refer to section 8.1). Based on avoidance principles, *Acacia acanthoclada* is not considered an affected species.
Acacia carneorum	Purple-wood Wattle	V	No	PCT 21 & PCT 58	✓	–	–	–	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Acacia carneorum.* *Acacia carneorum* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Atriplex infrequens	A saltbush	V	No	PCT 17, PCT 153, PCT 166, PCT 170 & PCT 216	✓	✓	✓	✓	Yes (surveyed)	Yes *Atriplex infrequens* was recorded during targeted surveys within the Robinvale Plain IBRA subregion. No individuals of this species were recorded within the South Olary Plain, Great Darling Anabranch or Pooncarie/darling IBRA subregions. *Atriplex infrequens* is an area polygon species. Within the proposal study area *Atriplex infrequens* has been determined to occupy an area of about 1.55 ha (refer to Figure 6.1). The indicative disturbance area will impact on a small portion of *Atriplex infrequens* species polygon area and as such the species is considered affected and is subject to further assessment in Stage 2 of this BDAR.
Austrostipa metatoris	A spear-grass	V	No	PCT 19 & PCT 170	✓	–	–	✓	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Austrostipa metatoris*. *Austrostipa metatoris* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Austrostipa nullanulla	A spear-grass	E	Yes	PCT 154 & PCT 253	✓	–	–	-	Yes (surveyed)	Yes Possible *Austrostipa nullanulla* individuals and associated habitat have been recorded from the proposal study area. Positive identification of *Austrostipa nullanulla* has not been able to be established due to the lack of fertile flowering material. A species polygon has been applied for *Austrostipa nullanulla* that comprises of a total area within the proposal study area of 73.64 ha (refer to Figure 6.1). The indicative disturbance area would impact on a small portion of *Austrostipa nullanulla* species polygon area and as such the species is considered affected and is subject to further assessment in Stage 2 of this BDAR.
Calotis moorei	A burr-daisy	E	Yes	PCT 139, PCT 143, PCT 153, PCT 154 & PCT 170	✓	–	–	–	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Calotis moorei*. *Calotis moorei* is not considered an affected species.
Cratystylis conocephala	Bluebush Daisy	E	No	PCT 58, PCT 170, PCT 171, PCT 172, PCT 221 & PCT 252	✓	✓	–	✓	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Cratystylis conocephala.* *Cratystylis conocephala* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Dodonaea stenozyga	Desert Hopbush	CE	Yes	PCT 170, PCT 171 & PCT 172	✓	–	–	–	Yes (surveyed)	No A population of 149 individuals of this species was recorded within the proposal study area (refer to Figure 6.1). *Dodonaea stenozyga* is an individual count species. Avoidance through design (i.e. relocation of proposed alignment to the northern side of Renmark Road) has been achievable for this species and the indicative disturbance area will entirely avoid the local population of this species (refer to section 8.1). Based on avoidance principles, *Dodonaea stenozyga* is not considered an affected species.
Eucalyptus leucoxylon subsp. *pruinosa*	Yellow Gum	V	No	PCT 11 & PCT 13, PCT 15 & PCT 19	–	–	–	✓	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Eucalyptus leucoxylon* subsp. *pruinosa.* *Eucalyptus leucoxylon* subsp. *pruinosa* is not considered an affected species.
Kippistia suaedifolia	Fleshy Minuria	E	No	PCT 143, PCT 166, PCT 153, PCT 154 & PCT 253	✓	–	–	–	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Kippistia suaedifolia*. *Kippistia suaedifolia* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Lasiopetalum behrii	Pink Velvet Bush	CE	Yes	PCT 170, PCT 171 & PCT 172	✓	–	–	–	No (surveyed)	No Targeted surveys within the proposal study area did not record any specimens of *Lasiopetalum behrii*. *Lasiopetalum behrii* is not considered an affected species.
Lepidium monoplocoides	Winged Peppercress	E	No	PCT 15, PCT 153, PCT 170, PCT 216	✓	–	✓	✓	No (surveyed)	No Conditions for *Lepidium* flowering and fruit set were good in September 2020. Regular checks of any *Lepidium* spp. found were undertaken. *Lepidium papillosum, L. phlebopetalum,* and *L. fasciculatum* were examined closely. Targeted surveys within the indicative disturbance area did not record any specimens of *Lepidium monoplocoides.* *Lepidium monoplocoides* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Leptorhynchos waitzia	Button Immortelle	E	Yes	PCT 63, PCT 153, PCT 166 & PCT 170	✓	✓	✓	–	No (surveyed)	No During BAM plot surveys of PCT 63, a small button daisy was recorded from Q86. The button daisy was collected to enable further identification to ensure it was not *Leptorhynchos waitzia.* The sample was forwarded to the National Herbarium of NSW – Botanical Information Service for positive verification. The recorded button daisy was identified to be the widely distributed and common *Pycnosorus pleiocephalus* (Soft Billy Button) (pers. comm. Andrew Orme). Additional targeted surveys for this species in September 2020 did not record any specimens of *Leptorhynchos waitzia.* The occurrence of *Pycnosorus pleiocephalus* (Soft Billy Button) throughout PCT 63 during September surveys was also confirmed by Dr Ian Sluiter. *Leptorhynchos waitzia.* is not considered an affected species.
Pimelea serpyllifolia subsp. serpyllifolia	Thyme Rice-Flower	E	No	PCT 170, PCT 171 & PCT 172	✓	–	–	–	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Pimelea serpyllifolia* subsp. *serpyllifolia*. *Pimelea serpyllifolia* subsp. *serpyllifolia* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Santalum murrayanum	Bitter Quandong	E	No	PCT 170, PCT 171 & PCT 172	✓	–	–	–	Yes (surveyed)	Yes A total of 46 individuals of *Santalum murrayanum* were recorded within the proposal study area during targeted surveys (refer to Figure 6.1). The indicative disturbance area will impact on *Santalum murrayanum* and as such the species is considered affected and is subject to further assessment in Stage 2 of this BDAR.
Solanum karsense	Menindee Nightshade	V	No	PCT 15, PCT 17, PCT 63, PCT 153, PCT 166	✓	✓	–	–	No (surveyed)	No Regular checks of any *Solanum* spp. found were undertaken. Targeted surveys within the indicative disturbance area did not record any specimens of *Solanum karsense.* *Solanum karsense* is not considered an affected species.
Swainsona colutoides	Bladder Senna	E	No	PCT 170, PCT 171 & PCT 172	✓	–	–	–	No (surveyed)	No Targeted surveys within the indicative disturbance area did not record any specimens of *Swainsona colutoides*. *Swainsona colutoides* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Swainsona pyrophila	Yellow Swainson-pea	V	No	PCT 170, PCT 171 & PCT 172	✓	–	–	–	No (surveyed)	No Surveys were undertaken after above average rainfall. Much of PCT 172 was in post fire recovery (+2 years). Disturbed edges and areas of recent mallee clearing were targeted. All *Swainsona* spp. located in the field were checked. Only *Swainsona microphylla* and *S. phacoides* were found. Targeted surveys within the indicative disturbance area did not record any specimens of *Swainsona pyrophila*. *Swainsona pyrophila* is not considered an affected species.
Swainsona murrayana	Slender Darling Pea	V	No	PCT 253	✓	–	–	–	No (surveyed)	No Surveys were undertaken after above average rainfall. All *Swainsona* spp. located in the field were checked. Only *Swainsona microphylla* and *S. phacoides* were found. Parallel field traverses within PCT 253 were undertaken on 3 & 8 Sept 2020 (Following above average rainfall). No specimens of *Swainsona murrayana* were recorded. *Swainsona murrayana* is not considered an affected species.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Swainsona sericea	Silky Swain-pea	V	No	PCT 13	–	–	–	✓	No (surveyed)	No Surveys were undertaken after above average rainfall. All *Swainsona* spp. located in the field were checked. Only *Swainsona microphylla* and *S. phacoides* were found. Parallel field traverses within PCT 13 & PCT 19 were undertaken on 2, 4 and 5-8 Sept 2020 (following above average rainfall). No specimens of *Swainsona sericea* were recorded. *Swainsona sericea* is not considered an affected species.

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
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RP – Robinvale Plain

6.2.2 RECORDED THREATENED FLORA SPECIES

ACACIA ACANTHOCLADA (HARROW WATTLE)

Acacia acanthoclada is a threatened shrub listed as endangered under the BC Act. This species is not listed under the EPBC Act. The plant occurs as an erect or spreading shrub ranging from 0.3–1.5 metres in height with branchlets short, rigid and spinescent and flowers globular and golden.

Acacia acanthoclada occurs as two subspecies being *Acacia acanthoclada* subsp. *acanthoclada* which is the only subspecies to occur in NSW and *Acacia acanthoclada* subsp. *glaucescens* which is restricted to Western Australia. Whilst rare in NSW, *Acacia acanthoclada* subsp. *acanthoclada* is more widespread in far northwest Victoria, SA and southern Western Australia.

In NSW, most records of *Acacia acanthoclada* are from the Scotia mallee region and an area north-east of Buronga between Mallee Cliffs and Mungo National Parks although no specimens are protected in these reserves (BioNet 2020). A single (dead) plant has also be previously recoded west of Lake Victoria in far south-western NSW (BioNet 2020).

Within the proposal study area, a total of three individual *Acacia acanthoclada* plants were recorded. All specimens were recorded growing on deep siliceous sands associated with PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion.

Of the three specimens recorded, two were growing together and a single individual was recorded as an isolated occurrence. The two plants recorded growing together were located about 11 kilometres east of the SA border, near the junction of Rufus River Road and Pine Camp Road. These plants were observed growing on the edge of a track, adjacent to the southern side of Renmark Road on 26 November 2019. The property on which these two plants were recorded is currently subject to a Property Vegetation Plan (PVP No. 17PVP00009) and stock proof fencing protects the *Acacia acanthoclada* plants at this location.

Herbarium samples were collected (collected under SL 100630) from both plants and forwarded to the National Herbarium of NSW for positive verification. The herbarium samples were positively determined as *Acacia acanthoclada* on 6 December 2019 under Plant ID BIS 21253. Samples were retained for the herbarium collection.

The additional individual plant of *Acacia acanthoclada* was recorded about 2.2 kilometres west of the PVP property with the plant located to the northern side of Renmark Road on 21 February 2020. The plant was observed growing on the edge of a track adjacent to the southern boundary fence and was not in flower at the time. An inspection of this plant in July 2020, following above average autumn rainfall, observed the specimens in flower.

Based on existing records, these three plants are considered to form the local population *Acacia acanthoclada.*

The unit of measure under BAM-C for *Acacia acanthoclada* is area. Area calculations for species polygons have been established by applying a 30 metre buffer area around the outside of the individual or group of plants as outlined in section 6.4.1.29 of the BAM (refer to Figure 6.1).

The total area of occupancy of *Acacia acanthoclada* within the proposal study area is 0.56 hectares. A summary of *Acacia acanthoclada* species polygon area is provided in Table 6.7.

Table 6.7 *Acacia acanthoclada* species polygon area within the proposal study area and indicative disturbance area

VEGETATION TYPE	PROPOSAL STUDY AREA	INDICATIVE DISTURBANCE AREA
PCT171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion – modified	0.56 ha	0.01 ha
Total	0.56 ha	0.01 ha

Acacia acanthoclada with stock proof fencing under PVP No. 17PVP00009

Acacia acanthoclada on edge of track on the northern side of Renmark Road.

Acacia acanthoclada flowers globular and golden

Acacia acanthoclada with branchlets rigid and spinescent

Acacia acanthoclada flowering in July 2020 following above average autumn rainfall

Photo 6.1 *Acacia acanthoclada* recorded within the proposal study area

ATRIPLEX INFREQUENS (A SALTBUSH)

Atriplex infrequens is a threatened plant species listed as vulnerable under the BC Act. This species is also listed as Vulnerable under the EPBC Act.

Atriplex infrequens is a small spreading to erect perennial saltbush that is distinguished by its small rhombic shaped fruiting bracteoles that are generally less than two millimetres (PlantNET 2020). The species is currently only known from NSW where it is confined to the far north and south western plains regions. Records of *Atriplex infrequens* occur east of Tibooburra, southeast of Brewarrina, near Wilcannia and isolated collections in the Pooncarie region. The southern limit of known distribution of *Atriplex infrequens* is a population that occurs on the southern side of Lake Victoria.

In 2018–2019 a Saving Our Species research action was undertaken to better understand the distribution of *Atriplex infrequens.* The action involved undertaking targeted surveys at known populations across the known distribution of the species. A report card issued on the research outcomes concluded that in the northern area bounded by the locality of Bourke, Wanaaring and Tilpa no plants were recorded. Surveys conducted at the southern limit of distribution at Lake Victoria recorded about 1900 individuals (Saving Our Species 2019).

Within the proposal study area, a new population of *Atriplex infrequens* was recorded from the Trentham Cliff area south of the Sturt Highway. The species was growing in a Lignum Swamp (PCT 17) on grey clays associated with prior flood channels of the Murray River. A population of more than 100 individuals was recorded all of which were restricted to an area of PCT 17 apart from eight individuals that where recorded growing along the edge of an existing access track (refer to Figure 6.1). *Atriplex infrequens* was observed growing with *Duma florulenta* (Lignum) along with other saltbush species such as *Atriplex lindleyi* (Eastern Flat-top Saltbush), *Atriplex pseudocampanulata* (Mealy Saltbush) and *Atriplex holocarpa* (Pop Saltbush).

Atriplex infrequens was initially recorded on 3 May 2020 when undertaking a BAM plot survey of PCT 17 (refer to Q33 in Appendix C-3). Specimens recorded at the time exhibited fruiting bracteoles and were retained in a field plant press for herbarium verification. *Atriplex infrequens* was confirmed by the National Herbarium of NSW under BIS 21400 on 28 July 2020.

Additional plant material was collected for the National Herbarium of NSW on 22 July 2020. At the time of collection, many of the plants had fruiting bracteoles present although most plants appeared to be near the end of a fruiting cycle and perennial die back was evident. *Atriplex infrequens* was not recorded growing in adjoining Black Box Woodland (PCT 13) although *Atriplex semibaccata* was observed growing widespread in the area. Given *Atriplex semibaccata* also has rhombic fruiting bracteoles, sample of this species were also collected for herbarium reference.

The unit of measure under BAM-C for *Atriplex infrequens* is area. Area calculations for species polygons have been established by applying a 30 metre buffer area around the outside of the individual or group of plants as outlined in section 6.4.1.29 of the BAM. The total area of occupancy of *Atriplex infrequens* within the proposal study area is 1.55 hectares (refer to Figure 6.1). A summary of associated vegetation types assigned to *Atriplex infrequens* species polygon area is provided in Table 6.8.

Table 6.8 *Atriplex infrequens* species polygon area within the proposal study area and indicative disturbance area

VEGETATION TYPE	PROPOSAL STUDY AREA	INDICATIVE DISTURBANCE AREA
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (derived)	0.04 ha	0.04 ha
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	0.87 ha	0.18 ha
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified)	0.65 ha	0.04 ha
Total	1.55 ha	0.26 ha

Atriplex infrequens recorded from Q33 in PCT 17

Atriplex infrequens with fruiting bracteoles

Atriplex infrequens fruiting bracteole, size 2 mm and rhomboid in shape

Herbarium samples of *Atriplex infrequens* (right) and *Atriplex semibaccata* (left)

Atriplex infrequens (centre) growing with *Atriplex lindleyi* (Eastern Flat-top Saltbush)

Photo 6.2 *Atriplex infrequens* recorded within the proposal study area

AUSTROSTIPA NULLANULLA (A SPEAR-GRASS)

Austrostipa nullanulla is a threatened grass listed as endangered under the BC Act. This species is not listed under the EPBC Act. *Austrostipa nullanulla* is also listed as a Serious and Irreversible Impact (SAII) species under the BC Act.

In NSW, *Austrostipa nullanulla* is currently only know from Nulla Station where it occurs on a series of gypseous lunette rises that occur on the margins of relict lakes. It is considered more widespread in SA, although is still listed as Vulnerable, whilst a few scattered populations also occurring in north-west Victoria (BioNet 2020).

Austrostipa nullanulla is a small perennial tussock spear grass that grows on gypsum soils. This species is recorded to flower from September to December, mainly following significant rain events (BioNet 2020).

Targeted surveys conducted to date have been undertaken during drought conditions and/or during non-flowering periods and as such reference inspections of existing known populations were carried out prior to surveys. Three known populations, being Bluff Gilchrist, New Nulla Tank and Woomera, were inspected on 18 March 2020. No fertile flowering material was recorded at any of the reference sites during inspections.

Within the proposal study area associated habitat for *Austrostipa nullanulla* is restricted to an area of gypseous lunette rises on the eastern edge of Nulla Station and adjoin lands to the immediate east. This area is associated with the broader Nulla Nulla saline discharge complex as described in Sluiter (2010).

Inspections of gypseous lunette rises (PCT 253) in the proposal study area identified patches of perennial grass tussock nubs that appeared consistent with those observed at the reference sites. No fertile material was observed with all possible *Austrostipa nullanulla* specimens restricted to old perennial nubs or young leaf growth.

Given the underlying gypsum derived geology and similar landscape setting to the reference populations habitat mapping of possible *Austrostipa nullanulla* habitat was undertaken. This involved rapid assessment points at the base of lunette rises and targeted surveys of old perennial nubs or young leaf growth considered likely to be consistent with *Austrostipa nullanulla.*

The unit of measure under BAM-C for *Austrostipa nullanulla* is area. Area calculations for species polygons have been established by applying a 30 metre buffer area around the outside of the individual or group of plants as outlined in section 6.4.1.29 of the BAM. In addition, given surveys have been limited due to seasonality and lack of fertile flowering material, assumed habitat area for *Austrostipa nullanulla* has been assigned to all patches of PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified – lunette). The total area of occupancy of *Austrostipa nullanulla* within the proposal study area has been assumed as 73.64 hectares (refer to Figure 6.1).

A summary of associated vegetation types assigned to *Austrostipa nullanulla* species polygon area is provided in Table 6.9.

Table 6.9 *Austrostipa nullanulla* species polygon area within the proposal study area and indicative disturbance area

VEGETATION TYPE	PROPOSAL STUDY AREA	INDICATIVE DISTURBANCE AREA
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified – boninka)	4.39 ha	0.11 ha
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains (modified – lunette)	69.25 ha	2.07 ha
Total	73.64 ha	2.18 ha

Austrostipa nullanulla at Bluff Gilchrist

Austrostipa nullanulla at Nulla Tank

Austrostipa nullanulla at Woomera

Possible *Austrostipa nullanulla* perennial basal nubs in PCT 253 on a gypseous lunette rise

Possible *Austrostipa nullanulla* growing with rare gypseous species *Elacanthus glaber* and *Roepera compressa*

Possible *Austrostipa nullanulla* new growth sprouting from a perennial basal nub

Possible *Austrostipa nullanulla* new growth following above average autumn rainfall

Photo 6.3 Austrostipa nullanulla recorded within the proposal study area

DODONAEA STENOZYGA (DESERT HOPBUSH)

Dodonaea stenozyga is a threatened shrub listed as critically endangered under the BC Act. This species is considered widespread in southern Australia, from southern WA, through SA and into western Victoria (BioNet 2020) and as such is not listed as threatened under the EPBC Act. *Dodonaea stenozyga* is also listed as SAII species under the BC Act.

Within NSW, *Dodonaea stenozyga* was presumed extinct (with a single record from the Darling River prior to 1859) until the species was recorded from Nanya Station (about 135 kilometres north-north west of Wentworth) in 1998 (BioNet 2020). Since the 1998 record, no additional plants have been positively identified in NSW although a tentative (not confirmed) recording of two individuals occurred from west of Lake Victoria (BioNet 2020).

Dodonaea stenozyga occurs as a rounded shrub 1.5 to two metres high with sticky angular branchlets and paripinnate leaves that are often terminated by a small tooth or lobe. Leaves are one to 3.8 centimetres long and comprise of two to six linear leaflets. The fruit is a four-winged capsule that is often leathery (Royal Botanical Gardens 2020). Habitat for this species has been recorded as semi-arid mallee scrub or open woodland, usually on sandy soils (VicFlora 2020).

Potential habitat for *Dodonaea stenozyga* has been assigned to the following associated plant community types that have been recorded within the study area (BioNet 2020):

- PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones
- PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion
- PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone.

Within the proposal study area, these vegetation types were subject to targeted parallel traverses (refer to Section 3.7) resulting in the location of two discrete areas of occupancy of an unknown *Dodonaea* species that was tentatively assigned to *stenozyga* in the field. Three herbarium samples were collected from representative individuals in the field and were transported in a field plant press for lodging with the National Herbarium of NSW – Botanical information Service for positive species level verification. Positive verification that the recorded specimens were *Dodonaea stenozyga* was issued by the National Herbarium of NSW with the following herbarium registration numbers:

- DS_01 *Dodonaea stenozyga* – conf. A.E. Orme, 18th Dec 2019 – retained - NSW1060158
- DS_02 *Dodonaea stenozyga* – conf. A.E. Orme, 18th Dec 2019 – retained - NSW1060157
- DS_03 *Dodonaea stenozyga* – conf. A.E. Orme, 18th Dec 2019 – retained - NSW1060156.

All individuals of *Dodonaea stenozyga* were recorded from a single property being Land Holding No. 1-002 on the southern side of Renmark Road about seven kilometres east of the SA border (Figure 6.1).

Dodonaea stenozyga was recorded growing in red sandy soil on low dunes associated with PCT 171 Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion. The species was recorded to occur within two discrete areas of occupancy that comprised of 68 GPS waypoints that totalled 149 individual plants (Figure 6.1). The plants exhibited a range of age classes from juvenile to mature with several individuals observed growing to about 1.5 to two metres in height with well-developed woody stems.

No other occurrences of this species were observed within the study area during targeted surveys. Further random meander surveys were completed outside the study area within Land Holding No. 1-002 where an additional two discrete areas of occupancy were recoded (Figure 6.1). These two additional areas had a combined total of 11 individual plants, all of which occurred on red sandy soils on low dunes associated with PCT 171 Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion. A representative herbarium sample was also collected from one of these locations and forwarded to the National Herbarium of New South Wales – Botanical information Service for species identification vouchering.

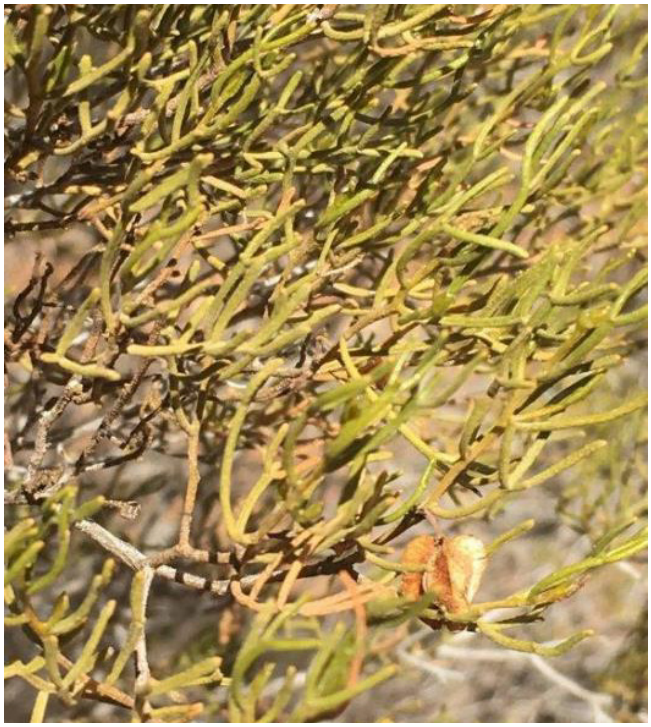
Dodonaea stenozyga is known to be dioecious (having female flowers on one plant and male on another) and given the range of age classes that individuals were observed, it is considered that the population is viable and appears robust. Little is known about pollination vector for this species although is likely to comprise of a wide variety of insects. Seed dispersal mechanism is wind (anemochory) given the four-wing structured fruit. All occurrences of this species within Land Holding No. 1-002 are considered to form a single population that for this report represents the local population.

The recorded individuals of *Dodonaea stenozyga* within and adjacent to the proposal study area represent a significant range extension and a large increase to the total number of known individuals within NSW (pers. comm. A.E. Orme). The unit of measure under BAM-C for *Dodonaea stenozyga* is count of individuals. The total count if individuals within the proposal study area is 149. Due to avoidance measures no individuals are located within the indicative disturbance area.

Large mature *Dodonaea stenozyga* individuals with woody stems

Dodonaea stenozyga rounded shrub habit growing on red sand in PCT 171 (intact)

Dodonaea stenozyga with angular branchlets and four winged fruits



Dodonaea stenozyga paripinnate leaves and four-winged fruit

Photo 6.4 *Dodonaea stenozyga* recorded within the proposal study area

SANTALUM MURRAYANUM (BITTER QUANDONG)

Santalum murrayanum is a threatened flora species listed as endangered under the BC Act. This species is not listed under the EPBC Act.

Santalum murrayanum is a tall shrub or small tree to five metres tall. The growth habit is pendulous with leaves grey-green or silver-green being opposite or sometimes whorled. The bark is smooth when young and becomes dark, hardened and furrowed with age.

The species is widely distributed across Australia occurring from inland southern Western Australia, through SA with the eastern extent being north-western Victoria and south-western New South Wales (BioNet 2020). *Santalum murrayanum* is rare in NSW with most records occurring near the Sturt Highway between Dareton and Balranald. Other more widely distributed records occur between Kyalite and Moulamein in the east, Lake Victoria in the west and in mallee vegetation to the south-east of Menindee (BioNet 2020).

A total of 46 individuals of this species were recorded within the proposal study area or on adjoin lands during targeted surveys. All specimens were recorded from the following vegetation types:

- PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones (modified whip)
- PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion (modified whip)
- PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone (modified whip).

During targeted surveys, regular inspections of *Myoporum platycarpum* subsp. *platycarpum* (Sugarwood) and *Pittosporum angustfolium* (Weeping pittosporum) were undertaken due to the superficial similarities in habit and form between the species observed at a distance.

Of the recorded *Santalum murrayanum* specimens, five were in the western portion of proposal study area on properties west of the Rufus River Road and south of the Renmark Road. The property on which these two plants were recorded is currently subject to a Property Vegetation Plan (PVP No. 17PVP00009) and stock proof fencing protects *Santalum murrayanum* plants at this location. An additional three plants were recorded outside the proposal study area to the south near Old Wentworth Road. These western plants are considered to form part of a single population that include records from Pine Camp Road to the north.

The remaining 41 individuals were recorded east of the Darling River, with four occurring on lands west of the Buronga substation and 37 occurring on the Buronga to Red Cliff section of the proposal study area (refer to Figure 6.1).

Two herbarium samples of *Santalum murrayanum*, one from western section and one from the eastern section, were collected and forwarded to the National Herbarium of NSW. Both samples were confirmed to be *Santalum murrayanum* (Plant ID BIS 21252 and BIS 21306).

The unit of measure under BAM-C for *Santalum murrayanum* is count of individuals. The total count of individuals within the proposal study area is 46 with 18 individuals located within the indicative disturbance area.

Santalum murrayanum with weeping pendulous habit

An individual growing in PCT 171 with *Triodia scariosa*

Leaf and fruit in-situ

Old fallen fruit berries accumulated at the base of a tree

Weeping pendulous habit

A mature specimen with darkened bark

A juvenile specimen with smooth bark

Photo 6.5 *Santalum murrayanum* recorded within the proposal study area

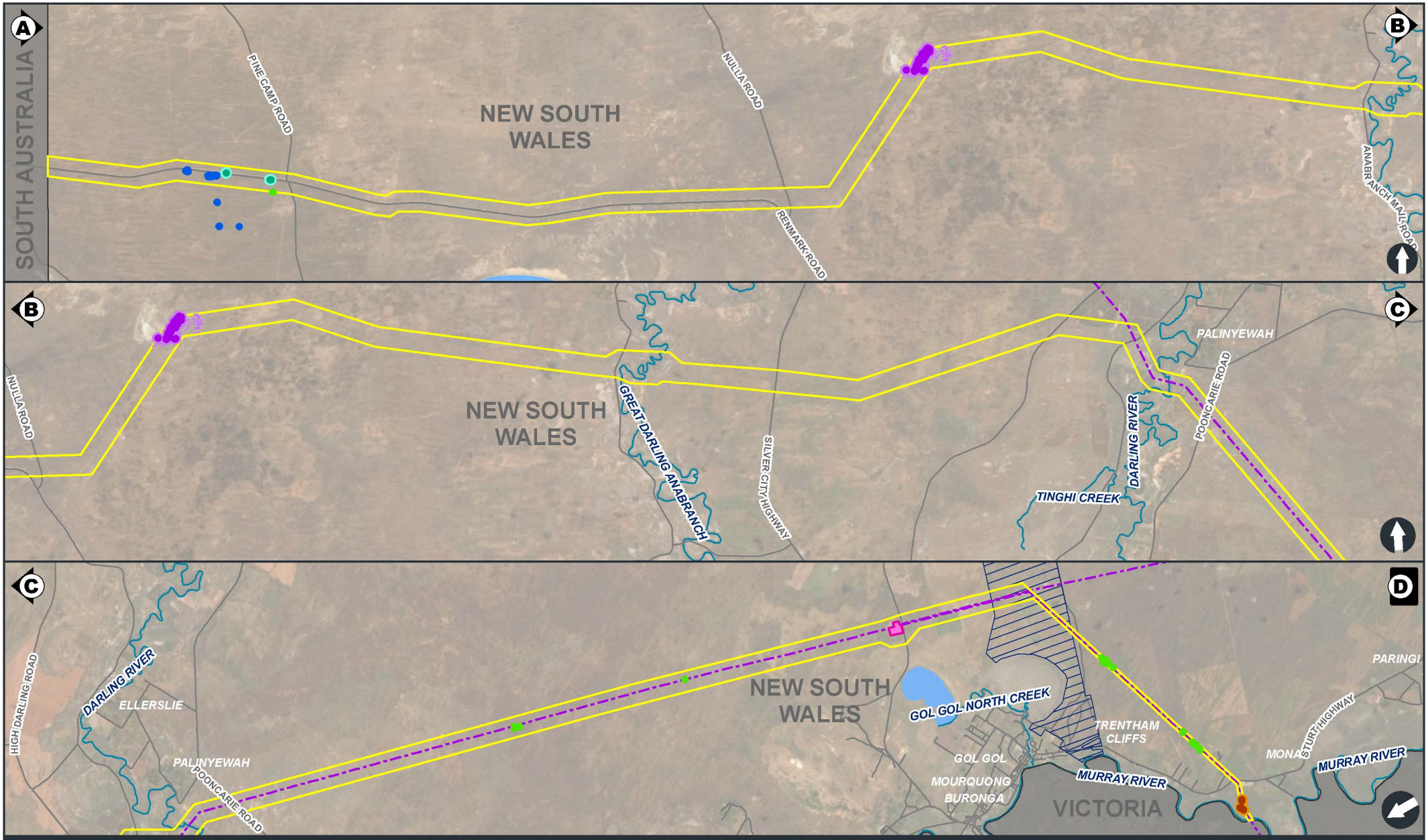


Figure 6.1

Overview of threatened flora species individuals and area polygons

Refer to Appendix D.3 for further detail

- Proposal study area
- Proposed substation expansion area
- Existing transmission line infrastructure
- Property where no access available
- *Acacia acanthoclada* sighting
- *Atriplex infrequens* sighting
- *Austrostipa nullanulla* sighting
- *Dodonaea stenozyga* sighting
- *Santalum murrayanum* sighting
- *Acacia acanthoclada* species polygon
- *Atriplex infrequens* species polygon
- *Austrostipa nullanulla* species polygon

Source: NSWSS, ESRI, Transgrid, WSP

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6.2.3 THREATENED FAUNA SPECIES

6.2.3.1 MALLEE ASSESSMENT

High-quality mallee habitats, support a specialised sub-set of threatened birds, which are dependent upon mallee for survival, including Black-eared Miner, Red-lored Whistler, Malleefowl, Mallee Emu-wren, Striated Grasswren Chestnut Quail-thrush, Western Whipbird, Shy Heathwren, Regent Parrot and Southern Scrub Robin. Mallee habitats also support a wide diversity of Australian avifauna, many of which are common species occurring over a wide range of habitats that extend well beyond mallee habitats.

While the proposal alignment traverses large areas of mallee habitat, those habitats have limited potential for supporting healthy populations of mallee-dependent threatened bird species. Although some areas, particularly near to the SA border, are continuous with extensive tracts of mallee habitat in SA, a long history of clearing, fire and stocking of those habitats, have significantly reduced the suitability of those habitats for threatened avifauna.

Continuity of mallee canopies are reduced, resulting in reducing overall cover, while opening up areas of open habitat with reliable water, more suited to open country birds, which may compete with and/or dilute the gene pool of some mallee-dependent species. Most of the old-growth mallee cohorts are lost, reducing breeding habitats for hollow-dwelling species. Understorey density, structural complexity, biodiversity, age class and continuity has been significantly reduced and/or altered, reducing the potential for species dependent on dense cover and reducing native seed availability for threatened granivorous birds.

Threatened mallee birds are specifically discussed below as while it might appear there is suitable habitat for all of these species, the condition of mallee habitat means that it is not suitable for many of these species.

Species assessed below are:

- Black-eared Miner
- Chestnut Quail-thrush
- Red-lored Whistler
- Mallee Emu-wren
- Western Whipbird
- Striated Grasswren
- Shy Heathwren
- Malleefowl
- Southern Scrub-robin
- Regent Parrot.

BLACK-EARED MINER

This species is listed as Critically Endangered (Species Credit) in NSW under the BC Act and Endangered under the EPBC Act. It was not recorded during the targeted seasonal surveys.

The Black-eared Miner's range is limited to the mallee habitats of eastern SA, north-western Victoria and south-western NSW (Pizzey and Knight, 2012). It is an arid country species of honeyeater that is closely related to the Yellow-throated Miner (*Manorina flavigula*). Although the two species interbreed, producing fertile offspring, Black-eared Miners and *M. flavigula* are both genetically and ecologically distinctive (Baker-Gabb, 2003). Prior to the 1950's, the Black-eared Miner remained insulated from hybridisation with *M. flavigula* within extensive tracts of old-growth mallee habitats where its ability to persist in areas distant from water, kept its gene pools pure from *M. flavigula* influences (Higgins et al., 2001). Nevertheless, the removal of large areas of high-quality mallee habitats since the 1950's, through agriculture and fire, has eroded habitat separations between the two species over much of its range (Baker-Gabb, 2003). Currently, Black-eared Miners only persist without dilution from *M. flavigula* genes, where large tracts of old-growth mallee persist in large reserved areas (Higgins et al., 2001). In the 2003 recovery plan (Baker-Gabb, 2003), 95 per cent of the distribution of the Black-eared Miner was reported as occurring in the SA Bookmark Biosphere Reserve (Baker-Gabb, 2003). At the time of the National Recovery Plan publication (Baker-Gabb, 2003) the only records within NSW were five

hybrid communities observed in the Scotia Mallee region in 1997 and 1999. Victorian Black-eared Miner records are currently unknown. There were birds that persisted in some of the larger reserves for a period after they were isolated by clearing, but that appears to have been a buffered delay, before *M. flavigula* populations diluted the Black-eared Miner gene pool, due to insufficient core habitat extent to protect their population from *M. flavigula* gene swamping (Baker-Gabb, 2003).

Key habitat components for Black-eared Miner to persist in mallee is their dependence on extensive stands of old-growth mallee that have not been burnt for 40 years. *M. flavigula* populations are dependent on permanent water and all individuals occur within two kilometres of permanent dams (Baker-Gabb, 2003). The most genetically intact Black-eared Miners occur in areas that are at least five kilometres from permanent water (Baker-Gabb, 2003).

All mallee habitats associated with the indicative disturbance area are compromised as potential Black-eared Miner habitat by habitat attributes, which favour the persistence of Yellow-throated Miners (*M. flavigula*). The most suitable habitats in the alignment are those occurring in the west, however, the habitat has low incidences of old-growth components, there are permanent dams, and all observed miners, approaching Black-eared Miner markings, had white rumps, which is a key character for identifying Yellow-throated Miners from the dark rumped Black-eared Miners (Higgins et al., 2001). If Black-eared Miners persist in habitats associated with the indicative disturbance area, it may only occur as a genetic influence within the more dominant Yellow-throated Miner gene pool.

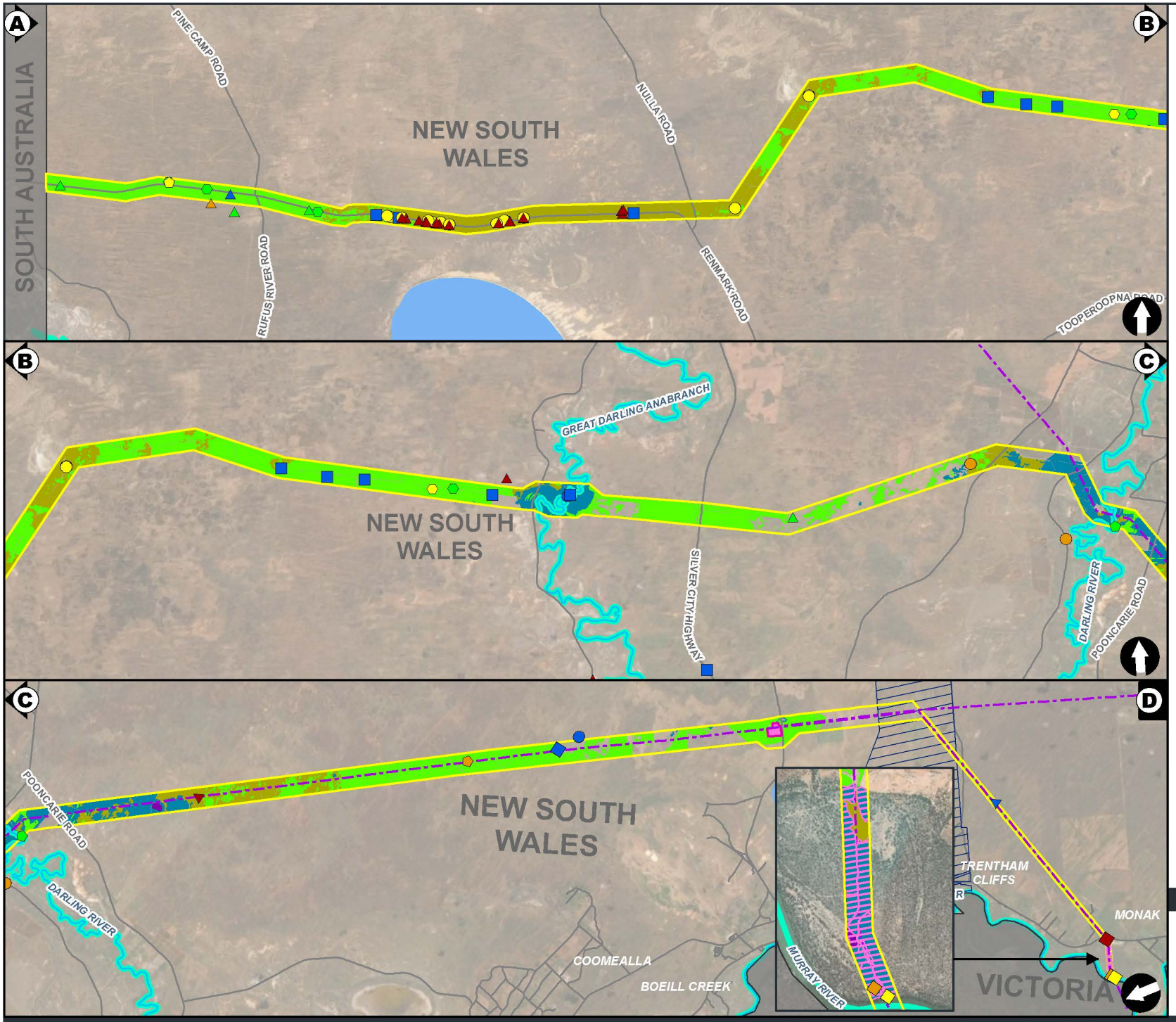
The following table (Table 6.10) presents the locations of dams occurring in the western mallee sections of the indicative disturbance area.

Table 6.10 Known watering locations associated with Western Mallee associated with the proposal

LOCATION	STATUS	LAT	LONG	COMMENTS
Lake Victoria – NSW	A	133.996245	141.244106	Permanent water storage – buffer
Murray River – NSW	A	N/A	N/A	Permanent water storage – buffer
Salt Creek – NSW	A	N/A	N/A	Permanent water storage – buffer
Pine Camp – NSW	A	-33.891401	141.188056	Cluster of three permanent dams
Pine Camp – NSW	A	-33.890610	141.184295	Cluster of two permanent dams
Pine Camp – NSW	A	-33.878117	141.170429	One permanent dam
Pine Camp – NSW	A	-33.863050	141.159691	Cluster of four permanent dams
Pine Camp – NSW	A	-33.844169	141.173349	One permanent dam
Pine Camp – NSW	A	-33.840071	141.176465	One permanent dam
Pine Camp – NSW	A	-33.837523	141.172035	One permanent dam
Pine Camp – NSW	A	-33.840269	141.191161	Cluster of four permanent dams
Pine Camp – NSW	A	-33.834433	141.198218	One permanent dam
Pine Camp – NSW	A	-33.824528	141.199006	One permanent dam
Pine Camp – NSW	A	-33.802599	141.163982	Cluster of three permanent dams
Pine Camp – NSW	A	-33.807898	141.143862	Cluster of two permanent dams
Pine Camp – Brown's Tank – NSW	A	-33.778219	141.122194	One permanent dam
Pine Camp – NSW	A	-33.814434	141.084385	Cluster of four permanent dams
Pine Camp – NSW	A	-33.817484	141.088454	One permanent dam
Pine Camp – NSW	A	-33.813339	141.038774	Cluster of two permanent dams

LOCATION	STATUS	LAT	LONG	COMMENTS
Pine Camp – NSW	A	-33.840343	141.036084	One permanent dam
Pine Camp – NSW	A	-33.873038	141.102426	One permanent dam
Rufus – NSW	C	-33.886145	114.158010	One ephemeral waterhole
Rufus – NSW	B	-33.886273	114.171591	One semi-permanent waterhole
Rufus – NSW	A	-33.902134	114.042715	Cluster of two permanent dams
Rufus – NSW – Edsons Number Two Tank	A	-33.914418	141.113770	One permanent dam
Rufus – NSW – Bucket Tank	B	-33.941567	141.095444	One semi-permanent dam
Rufus – NSW	B	-33.919200	141.080947	One semi-permanent dam
Rufus – NSW	A	-33.882699	141.036324	Cluster of two permanent dams
Rufus – NSW – Salt Creek Billabong	A	-33.966677	141.036324	Permanent Billabong
Rufus – NSW	B	-33.906071	141.009933	Cluster of two semi-permanent dams
Rufus – NSW	B	-33.903114	141.174391	One semi-permanent waterhole
Rufus – NSW	B	-33.909105	141.180382	One semi-permanent waterhole
Chowilla – SA	B	-33.805420	140.994258	One semi-permanent waterhole
Chowilla – SA – Box Tree Waterhole	B	-33.833741	140.947509	One semi-permanent waterhole
Chowilla – SA	A	-33.805420	140.994258	One permanent dam
Chowilla – SA	A	-33.799000	140.968678	One permanent dam
Chowilla – SA	C	-33.887440	140.995609	One ephemeral dam
Chowilla – SA	C	-33.885115	140.979059	One ephemeral dam
Chowilla Regional Reserve, Lake Littra – SA	AA	-33.934291	141.001165	Lake – Environmental Water – Buffer
Chowilla – SA	B	-33.732760	140.865772	Semi-permanent waterhole
Chowilla – SA – Butcher Dam	B	-33.734625	140.846094	Cluster of two semi-permanent dams
Calperum Station – SA	B	-33.766226	140.848310	Semi-permanent waterhole
Calperum Station – SA	B	-33.807802	141.849579	Cluster of two semi-permanent dams
Chowilla Reg. Res. Coombool Swamp – SA	AA	-33.889501	140.900897	Lake – Environmental Water – Buffer

Two kilometre and five kilometre buffers have been drawn around each of the dams in Figure 6.2 to show areas where the presence of water is likely to be favouring Yellow-throated Miners or representing opportunities for Black-eared Miners. Known records of both species have also been mapped for reference.



Proposal study area
Proposed substation expansion area
Minor road
Waterbody
Property where no access available

Threatened fauna identified during survey

- Black-breasted Buzzard
- Bolam's Mouse
- Chestnut Quail-thrush
- Corben's Long-eared Bat
- Dusky Woodswallow
- Greater Sand Plover
- Grey-crowned Babbler
- Hooded Robin
- Inland Forest Bat
- Little Eagle
- Little Pied Bat
- Major Mitchell's Cockatoo
- Malleefowl mound
- Pectoral Sandpiper
- Rainbow Bee-eater
- Red-necked Stint
- Redthroat
- Regent Parrot
- Sharp-tailed Sandpiper
- Southern Ningaui
- Spinifex Slender Blue-tongue
- Superb Parrot
- White-bellied Sea-Eagle
- White-fronted Chat

Fauna strata within the proposal study area

- Arid woodlands/shrublands
- Chenopod shrublands
- Riverine
- Wetland
- Fish habitat
- Regent Parrot (eastern subspecies) species polygon

0 5 10 15 km

Figure 6.2

Overview of threatened fauna species individuals fauna stratification and area polygons

Refer to Appendix D.4 for further detail

Source: NSWSS, ESRI, Transgrid, WSP

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CHESTNUT QUAIL-THRUSH

This species is listed as Vulnerable (Ecosystem Credit) in NSW under the BC Act and not listed under the EPBC Act. A single species of threatened mallee-dependent bird species, the Chestnut Quail-thrush, was observed in the alignment during the 2019/2020 survey periods. The Chestnut Quail-thrush is a medium-sized bird, which spends much of its time foraging on the ground for invertebrates and prefers canopy cover and open shrubby habitats containing ground layers with suitable foraging niches. Although its habitat preferences extend to a range of woodland types in the semi-arid zone (Higgins and Peter, 2002), within the alignment's habitats it was only encountered within mallee on sandy substrates, although it likely uses associated Black Oak stands. The observed individual was a female carrying invertebrate prey in the bill, suggesting the feeding of dependent young in the vicinity of the sighting. The species nests at ground level at the base of a mallee tree, shrub, fallen branch or grass tuft (Pizzey and Knight, 2012), so is not dependent on old-growth trees for breeding purposes. They can tolerate more open understories provided there is sufficient overhead cover from mallee or shrub canopies and understory complexity/litter for foraging. The observation site was in the Pinnington Property within a couple of kilometres of the SA border and was dominated by young age cohort mallee growing on a low dune topography.

Photo 6.6 Female Chestnut Quail-thrush *(Cinclosoma castanotus)* carrying food in mallee habitat exhibiting moderate levels of understory debris within the indicative disturbance area

RED-LORED WHISTLER

This species is listed as Critically Endangered (Species Credit) in NSW under the BC Act and Vulnerable under the EPBC Act. It was not recorded during the targeted seasonal surveys.

The Red-lored Whistler has a patchy distribution across mallee regions from the northern Eyre Peninsula, to central-eastern SA, north-west Victoria and central-western NSW (Department of Environment, 2016a). The species occurs in mallee habitats dominated by heathy understories as well as those with spinifex dominated understorey strata. Red-lored Whistler spinifex territories average 100 hectares, and heathy territories, 20 hectares (Department of Environment, 2016a). The species requires high quality habitat and is absent from large areas of mallee habitat, particularly where grazing is present, with habitat noted as unsuitable within six kilometres of cattle drinking bores (Department of Environment, 2016a). It recolonises different mallee and heathy habitats at different post-fire periods, broom bush three to 30 years, and in the Big Desert (Victoria) mallee-heath 63 per cent of records were in areas 21 to 40 years post fire (Department of Environment, 2016a). It has been reported to be absent from areas not containing spinifex, a ground cover grass within which it has been known to occasionally build is nests (Department of Environment, 2016a). It appears that there are some circumstances where habitat would be used as early as three years post-fire, but most studies report that the most utilised habitats are those with long periods since fire and where grazing pressure is absent (Department of Environment, 2016a).

In NSW the species persists in a limited distribution area in central-western NSW within the Round Hill/Nombinnie/ Yathong reserve complex. There is also potential habitat associated with the Tarawari/Scotia mallee areas, although confirming records appear to be absent from this area. There are no known populations occurring within the localities

associated with the study area and surveys conducted specifically for this species found no individuals occurring in south-western NSW.

The Red-lored Whistler is considered very unlikely to occur within habitats associated with the proposal study area, due to the lack of, or predicted, records from the surrounding regions, and the degraded condition of associated mallee habitats as a consequence of clearing, burning and a long history of grazing. This species was not recorded during the 2019/2020 survey program, despite targeted surveys for this species and habitat assessments concluded that habitat was not of sufficient quality to support its presence.

MALLEE EMU-WREN

This species is not listed in NSW under the BC Act as it is known to be absent and Endangered under the EPBC Act. It was not recorded during the targeted seasonal surveys.

The Mallee Emu-wren occurs in spinifex mallee and is a cryptic species with secretive habits. Its distribution until recently, occurred through the south-eastern SA mallee reserves into the eastern mallee reserves of Victoria (Department of Environment, 2016a). Currently the SA populations have been decimated by fire and it is only known to persist in Victorian Mallee reserves. There are no records for this species in NSW mallee habitats (Department of Environment, 2016a).

Mallee habitats associated with the indicative disturbance area have patches of spinifex mallee, the spinifex (*Triodia sp.*) of which, are poorly developed, in terms of extent and size, and occur within the mallee as relatively small isolated patches. Spinifex within the alignment appeared to be stunted as a consequence of extended dry periods and were reduced in extent from previous clearing and the effects of sustained grazing.

The Mallee Emu-wren was not observed in mallee habitats associated with the indicative disturbance area. The absence of the species from the indicative disturbance area habitats appeared to be a consequence of the low quality of habitat, in terms of its low structural diversity and poor cover of high-quality spinifex, the reduced quality of which is not due to the sustained dry conditions. To determine if dry conditions were affecting the potential to locate this species, a check on known habitat for this species in the Victorian mallee was undertaken, and a pair was observed in high quality spinifex mallee habitat. The site where the birds were observed was characterised by a relatively open, but continuous, mallee canopy cover with a continuous cover of spinifex and good levels of woodland debris.

Due to the lack of records for this species in NSW, the poor condition of the most likely habitats for Mallee Emu-wren within the indicative disturbance area, and the relative ease in finding birds in high quality known habitats, it is considered unlikely that the Mallee Emu-wren occurs within the indicative disturbance area or associated habitats for which survey access was available.

Photo 6.7 Male Mallee Emu-wren observed at a high-quality Victorian spinifex mallee reference site, during the period (24/10/2019) surveys were conducted in spinifex mallee associated with the indicative disturbance area

Photo 6.8 High quality mallee habitat not subject to grazing and fragmentation pressures where Striated Grasswrens (and Malleefowl) have been previously observed in the Victorian mallee and where Mallee Emu-wren was observed during the proposal survey period to determine if habitat condition was likely to prevent detection of birds during onsite surveys

WESTERN WHIPBIRD

The eastern subspecies of the Western Whipbird is a mallee and shrubland bird that does not occur in the NSW mallee habitats. It currently occurs in SA only, with some habitat potential in central western Victorian reserves.

STRIATED GRASSWREN

This species is listed as Vulnerable (Species Credit) in NSW under the BC Act and not listed under the EPBC Act. It was not recorded during the targeted seasonal surveys.

The Striated Grasswren belongs to a group of endemic wren-like birds occurring in arid and semi-arid regions of Australia. The Striated Grasswren (*Amytornis striatus striatus*) generally occurs in habitats with groundcover strata dominated by spinifex (*Triodia* sp.) in association with mallee habitats on sandy soils, although they have been known to extend beyond the borders of such habitat into other vegetation types (Higgins et al., 2001). They prefer habitats where large old (25 to 40 years) spinifex clumps occur, but have been recorded moving back into burnt plant communities as early as six to eight years post-fire (Office for Environment & Heritage, 2020). Striated Grasswrens are a cryptic species that is often difficult to detect and are usually encountered in pairs or family groups. The call is high-pitched, usually very quiet and with a thin quality, which adds to the difficulty of their detection. Their primary food is invertebrates and seeds and their nest is a significant dome of intertwined grasses, including spinifex, and bark, located in the top of a spinifex clump (Higgins et al., 2001).

This species currently appears to be in decline, in both Victoria and SA, and its NSW distribution is limited to Yathong National Park. The extensive adjacent mallee habitats in SA may also support a NSW population in mallee habitats in the Scotia/Tarawari region (Office for Environment & Heritage, 2020). There are no known records for Striated Grasswren in the vicinity of the proposal study area in NSW (Higgins et al., 2001) (Office for Environment & Heritage, 2020).

The Striated Grasswren prefers extensive patches of very large spinifex plants and will also use smaller occurrences of spinifex where it is continuous, extensive and not subject to degradation from clearing, grazing and fire (Office for Environment & Heritage, 2020, Garnett and Crowley, 2000).

Spinifex occurrences within mallee sand dune habitats associated with the proposal disturbance area are limited to discontinuous patches of small spinifex plants in mallee habitats subject to degradation from clearing, grazing and fire, which offer insufficient cover and foraging habitat for Striated Grasswrens. The habitats are depauperate of significant structural diversity, which is otherwise represented by extensive healthy patches of spinifex and woodland debris that occurs in undisturbed habitats favoured by this species.

SHY HEATHWREN

This species is listed as Vulnerable (Ecosystem Credit) in NSW under the BC Act and not listed under the EPBC Act. It was not recorded during the targeted seasonal surveys.

In NSW the Shy Heathwren is a small bird favouring understorey strata with moderate to dense cover in mallee shrublands and heathlands (Higgins and Peter, 2002). Their current NSW distribution encompasses the separated distributions of two subspecies; *H. c. macrorhyncha* extending patchily south from the Cobar region to the Riverina where suitable habitats exist in native vegetation remnants, including rocky hilltops; and subspecies *H. c. cauta*, which extends from the mallee habitats of SA and Victoria patchily into south-western NSW, wherever mallee habitats have sufficient understorey cover to suit their habitat preferences (Menkhorst et al., 2019) (Office for Environment & Heritage, 2020, Garnett and Crowley, 2000).

Mallee habitats surveyed within the alignment, where access was available, were for the most part open with a low incidence of shrubby understorey strata and so rendered unsuitable for this species. All mallee associated with the alignment east of Nulla Road was unsuitable for Shy Heathwren due to the lack of shrubby understorey strata. Mallee habitats in the western sections of the alignment, and extending to the SA border, were for the most part devoid of high-density shrub strata. In the western most mallee areas there were patches of shrubby strata in the western end of the Pinnington property and shrubby habitat areas within the adjacent Robertson property, although access to Robertson's habitats was not possible during the majority of periods when surveys could be undertaken. The shrubby habitats surveyed in this section of the alignment did not have sufficient density or extent to support Shy Heathwren, even though

call playback was undertaken throughout the habitat to elicit a response from potential individuals. It is possible that mallee habitats in the more northern sections of the Robertson property could support Shy Heathwren, but the lack of access to areas outside the indicative disturbance area could neither confirm or refute habitat suitability.

Due to the possibility that an absence of Shy Heathwrens, in the proposal disturbance area habitats, was temporary, due to the prevailing extended dry conditions, a reference site in high-quality Victorian shrubby mallee was visited under the same climatic conditions. A pair of heathwrens quickly responded to playback calls (see image below), strongly suggesting that this species is absent from, or very sparsely distributed within, shrubby areas within the indicative disturbance area. Nevertheless, it is considered very likely that there are no Shy Heathwrens in indicative disturbance area habitats, due to the absence of more common shrubby understorey birds. At the representative site, where Shy Heathwrens were present, Inland Thornbills were immediately noticeable. Inland Thornbill is a common inland species that inhabits shrubby habitats, but it was not present in shrubby habitats associated with the NSW mallee habitats through which the proposal would traverse.

Photo 6.9 Shy Heathwren (left) and Inland Thornbill (right) observed in high-quality shrubby mallee habitat outside of the proposal study area, during the same period surveys were conducted (24/10/2019) in low quality shrubby habitats within the proposal study area

Photo 6.10 High quality shrubby mallee habitats in control sites outside the proposal study area where Inland Thornbill, Shy Heathwren and Southern Scrub Robins were present

MALLEEFOWL

This species is listed as Endangered (Ecosystem Credit) in NSW under the BC Act and Vulnerable under the EPBC Act. It was not observed during the targeted seasonal surveys, though two old unused mounds were recorded.

While the Malleefowl occurs patchily in all Australian mainland states, except for Queensland (Benshemesh, 2007), for the purposes of this assessment, its regional distribution encompasses semi-arid habitats extending across inland areas of south-eastern South Australia, north-western Victoria and south-western NSW (Menkhorst et al., 2019). It prefers shrubby woodlands dominated by mallee eucalypts and acacias where understorey strata are diverse and remain intact from damage by fire and grazing pressures (Benshemesh, 2007). A thorough understanding of their habitat requirements remains largely unknown (Benshemesh, 2007). Nevertheless there is a dependence on sandy substrates and leaf litter for constructing suitable incubating nest mounds for breeding purposes, and the birds occur in higher densities where higher rainfall, greater soil fertility and greater shrub diversity exist (Benshemesh, 2007). There are some correlations of bird density to shrub diversity, particularly in reference to leguminous shrubs and herbs, and a strong indication that sheep grazing severely impacts bird densities, with grazed areas only supporting one tenth the density of ungrazed areas (Benshemesh, 2007). While understory diversity appears to be important for Malleefowl, higher canopy densities have a positive influence on increases in breeding occurrences (Benshemesh, 2007). Mallee areas underlain by sandy substrates and subject to Triodia sp. grass distributions were found to be much more preferred by Malleefowl that chenopod dominated mallee, which occurs on clay substrates (Benshemesh, 2007). The preference for mallee habitats places the birds at great risk of habitat loss from fire events, as mallee woodlands are recognised as extremely flammable habitats with serious fire events extending across hundreds of thousands of hectares and occurring at average return rates of 20 years. Almost ironically, such fire events often occur after periods of good rainfall which increases understorey litter levels elevating woodland fuel levels (Benshemesh, 2007). While fire often encourages higher densities of suitable foraging plants, such as leguminous shrubs like acacias, such habitats are less productive than might be expected after 30 years post fire than areas 40 years post fire (Benshemesh, 2007).

In light of the range of deficiencies reported to constrain Malleefowl distribution and breeding frequency, assessment of mallee habitats associated with the proposal study area, found that Triodia sp. dominated mallee, found in PCT171 and PCT172, were the most preferred habitats onsite, but occurred intermittently between areas dominated by chenopod understoreys, such as occurs in PCT170.

Assessments found that those areas where PCT171/172 is associated with the alignment are largely under private land ownership and exhibit understorey diversity deficiencies brought about by a long history of grazing, clearing and fire histories.

While the most likely habitats for Malleefowl within the alignment exhibit significant deficiencies directly related to low carrying capacities, two unused Malleefowl nests were observed within the alignment in two different areas, suggesting that Malleefowl are likely extant within the habitats associated with the alignment, although very likely at very low densities and requiring very large areas of habitat to encompass their annual requirements for suitable foraging and breeding purposes.

The left image below occurs in the western mallee close to the South Australian border, the right image shows a disused mound on the link to Red Cliffs (but north of the Sturt Highway).

Photo 6.11 Two unused Malleefowl mounds observed within the proposal study area, both occurring in Plant Community Type (PCT) 171

SOUTHERN SCRUB ROBIN

This species is listed as Vulnerable (Ecosystem Credit) in NSW under the BC Act and not listed under the EPBC Act. It was not observed during the targeted seasonal surveys.

The Southern Scrub Robin is a terrestrial bird occurring in semi-arid environments where it spends much of its time on the ground, favouring habitats with a good density of understorey cover (Higgins and Peter, 2002). The species appears to avoid areas without sufficient shrub cover occurring in very low densities within fire affected habitat, until sufficient age restores understorey cover. Birds have been observed as not returning to some habitats for some nine years after fire (Higgins and Peter, 2002). Although preferring dense shrubland habitats, the species is loud, relatively vocal and readily responds to calls in its territory.

Therefore, it is relatively easy to find in suitable habitat, and was easily observed in dense shrubby habitats in high quality mallee at control sites, during the period targeted bird surveys were conducted within the project's mallee habitats. They were observed to provide inadequate cover for the Southern Scrub Robin, due to the thinning of understorey shrubby strata from a sustained history of grazing, clearing and fire.

Photo 6.12 Southern Scrub Robin occurring in high quality mallee habitat with dense shrub layers at a control site (24/10/2019) outside of the proposal study area

REGENT PARROT

This species is listed as Endangered (Species Credit) in NSW under the BC Act and Vulnerable under the EPBC Act. It was not observed during the targeted seasonal surveys. A single pair was observed at the eastern extremity of the proposal study area, in riparian habitat near the Murray River crossing.

The range of the eastern Regent Parrot is restricted to a single population occurring within semi-arid catchment areas of the lower Murray Darling basin in south-eastern Australia, and extending across inland areas of south-eastern South Australia, north-western Victoria and south-western NSW (Menkhorst et al., 2019). During the last 100 years the eastern subspecies has decline in both abundance and distribution (Baker-Gabb and Hurley, 2011). Favoured breeding habitats. The species is dependent on the relatively close juxtaposition of key habitat requirements, being; tall mature riparian forest for breeding and roosting sites (mallee used for roosting in the non-breeding season in some areas), suitable mallee and/or cereal crop foraging areas, and corridors of vegetation for movements between key habitat types (Baker-Gabb and Hurley, 2011).

The current distribution encompasses the proposal study area, although the most likely Murray River associated breeding areas (Baker-Gabb and Hurley, 2011) do not extend to west of Red Cliffs.

The open areas of chenopod plains occurring west of Buronga, and extending almost to the NSW border with South Australia, represents a barrier to the woodland habitat continuity that the species prefers for movements through the landscape (Baker-Gabb and Hurley, 2011).

A pair of birds were observed flying through open riparian woodland near the alignment's Murray River crossing to Red Cliffs, but no birds were observed throughout the more westerly areas of the proposal study area, which is likely due to the movement/foraging-habitat issues associated with the very open landscapes surrounding Lake Victoria and the Murray floodplain throughout those areas of the region.

No individuals were observed in the western mallee areas of the proposal study area, despite a considerable observational presence of ecologists throughout those habitats over the period from June 2019 to September 2020.

Surveys conducted in 2008 for Regent Parrot's use of the Darling River corridor, in the Pooncarie area, for breeding purposes, found Regent Parrots to be absent from those areas (Baker-Gabb and Hurley, 2011).

Apart from the potential for birds to be reliant on Black Box woodland adjacent to the Murray and some limited potential for use of eastern mallee habitats in the Trentham Cliffs area, it is considered unlikely that local distributions of the eastern subsp. of the Regent Parrot extend across habitats west of the Darling River in potential habitat areas associated with the proposal study area.

In regard to the observed condition of easterly habitat areas, in which surveys have been conducted over the 2019/2020 period, ongoing clearing of significantly large areas of mallee habitat in the Trentham Cliffs-Buronga areas have seriously removed extensive mallee foraging and connective habitat for Regent Parrots, which is likely to place significant constraints on their access to mallee habitats north of the Murray, which are associated with the proposal study area east of the Darling.

6.2.3.2 CANDIDATE THREATENED FAUNA SPECIES CREDIT SPECIES GENERATED FROM BAM-C

A preliminary list of candidate threatened fauna species was generated from the BAM-C based on associated vegetation types for each IBRA subregion. This preliminary candidate threatened fauna species list is presented in Table 6.11.

Table 6.11 List of BAM-C candidate threatened fauna species credit species

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Amphibians								
Litoria raniformis	Southern Bell Frog	E	N	PCT's 11, 13, 17 Lakes, swamps and rivers	–	–	–	✓
Neobatrachus pictus	Painted Burrowing Frog	E	N	PCT's 11, 15, 58, 153, 154, 170, 171, 221, 252 Floodplain – grasslands and swamps	✓	✓	✓	–
Birds								
Amytornis striatus	Striated Grasswren	V	Y	PCT171, PCT172 Spinifex Mallee	✓	–	–	–
Ardeotis australis	Australian Bustard	E	N	PCT's 15, 58, 221, 252 Chenopod and grassy plains	✓	–	–	–
Burhinus grallarius	Bush Stone-curlew	V	N	PCT's 11, 13, 15, 21, 58, 252 Grassy woodland	✓	✓	✓	✓
Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	CE	Y	PCT 15 Grassland and Grassy woodlands	✓	–	–	–
Hamirostra melanosternon	Black-breasted Buzzard	V	N	PCT's 11, 13, 15, 17, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 Semi-arid zone – open country	✓	✓	✓	✓
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	N	PCT's 11, 13, 15, 17, 19, 21, 58, 139, 143, 166, 170, 171, 216 Riparian forest – inland lakes and rivers	✓	✓	✓	✓
Hieraaetus morphnoides	Little Eagle	V	N	PCT's 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252, 253 Woodlands with associated grassland	✓	✓	✓	✓
Lathamus discolor	Swift Parrot	E	Y	PCT's 11 Winter foraging resources – Riparian and lake-side habitats	–	–	–	✓
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	N	PCT's 11, 13, 15, 19, 21, 58, 63, 139, 143, 153, 154, 166, 170, 171, 172, 221, 252, 253 Callitris and mallee – arid riverine	✓	✓	✓	✓

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Lophoictinia isura	Square-tailed Kite	V	N	PCT's 11, 13, 15, 21, 58, 221, 252 Woodlands – Mallee, floodplain and riverine	✓	✓	✓	✓
Manorina melanotis	Black-eared Miner	CE	Y	PCT's 170, 171, 172 Mallee	✓	–	–	–
Pachycephala rufogularis	Red-lored Whistler	CE	Y	PCT's 171, 172 Mallee	✓	–	–	–
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	N	PCT's 11, 13, 15, 58, 170, 171 Mallee, floodplain and riparian	✓	✓	✓	✓
Ninox connivens	Barking Owl	V	N	PCT's 11, 13, 15 Not mallee – woodlands and riparian	✓	✓	✓	✓
Mammals								
Lasiorhinus latifrons	Southern Hairy-nosed Wombat	E	N	PCT's 58, 153, 154, 170, 171, 172 Suitable semi-arid to arid grassy woodlands with suitable burrowing substrates	✓	✓	–	–
Pseudomys desertor	Desert Mouse	CE	Y	PCT's 171, 172 Spinifex mallee	✓	–	–	–
Reptiles								
Lucasium stenodactylum	Crowned Gecko	V	N	PCT's 143, 153, 154, 170, 221 Sand hill habitats	✓	–	–	–

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

6.2.3.3 JUSTIFICATION FOR INCLUSION OF ANY ADDITIONAL THREATENED FAUNA SPECIES CREDIT SPECIES

In identifying a candidate threatened fauna species list for further assessment, no additional threatened fauna species credit species are required to be included.

6.2.3.4 JUSTIFICATION FOR EXCLUSION OF ANY ADDITIONAL THREATENED FAUNA SPECIES CREDIT SPECIES

The southern distribution limit of the Squatter Pigeon tenuously extends across the Queensland into northern NSW, but the species is now very rare in that locality. The species distribution does not extend over the NSW border in the most reliable records databases. The closest record to the proposal study area is some 790 kilometres to the north. Due to the lack of records within intervening lands and its highly threatened status in southern Queensland, it is considered very unlikely that an individual would reach the proposal study area by accident, and for these reasons it can be justified for exclusion from further consideration as a species credit species. (refer to Table 6.12).

Table 6.12 Justification for exclusion of any additional threatened fauna species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	SAII	JUSTIFICATION FOR EXCLUSION	IBRA SUBREGIONS			
					SOP	GDA	PD	RP
Birds								
Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	CE	Y	This species is well outside its known distribution. There are no records for this species within the locality or bioregions.	✓	–	–	–

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

6.2.3.5 ASSESSMENT OF CANDIDATE THREATENED FAUNA TO DETERMINE AFFECTED SPECIES

The BAM Calculator identified 18 candidate threatened fauna species that may occur on site. Of these, one species has been excluded as the proposal study area does not provide habitat or microhabitats that this species depend on and as such did not require targeted surveys to be undertaken (Table 6.12).

Targeted threatened fauna surveys have been undertaken in accordance with methods outlined in Section 3.8 to determine presence or absence of candidate threatened fauna species in accordance with Section 6 of the BAM. Details of survey effort for each candidate species in outlined in Appendix A-3 with a summary of survey results for all candidate threatened fauna species, to determine those species that are considered affected by the proposal, are presented in Table 6.13.

Table 6.13 Assessment of candidate threatened flora to determine affected species

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Amphibians										
Litoria raniformis	Southern Bell Frog	E	N	PCT's 11, 13, 17 Lakes, swamps and rivers	–	–	–	✓	No (lack of suitable habitat)	No. This species was not recorded.
Neobatrachus pictus	Painted Burrowing Frog	E	N	PCT's 11, 15, 58, 153, 154, 170, 171, 221, 252 Floodplain – grasslands and swamps	✓	✓	✓	–	No (surveyed)	No. This species was not recorded.
Birds										
Amytornis striatus	Striated Grasswren	V	Y	PCT171, PCT172 Spinifex Mallee	✓	–	–	–	No (surveyed)	No. This species was not recorded.
Ardeotis australis	Australian Bustard	E	N	PCT's 15, 58, 221, 252 Chenopod and grassy plains	✓	–	–	–	No (surveyed)	No. This species was not recorded.
Burhinus grallarius	Bush Stone-curlew	V	N	PCT's 11, 13, 15, 21, 58, 252 Grassy woodland	✓	✓	✓	✓	No (surveyed)	No. This species was not recorded.
Hamirostra melanosternon	Black-breasted Buzzard	V	N	PCT's 10, 11, 13, 15, 16, 17, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 Semi-arid zone – open country	✓	✓	✓	✓	Yes (surveyed) Recorded near the Low Darling Road, High Darling Road and Chowilla Regional Reserve.	No. Not recorded breeding or nesting so therefore classified as a predicted ecosystem credit species.

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	N	PCT's 10, 11, 13, 15, 16, 17, 19, 21, 58, 139, 143, 166, 170, 171, 216 Riparian forest – inland lakes and rivers	✓	✓	✓	✓	Yes (surveyed) Recorded at the Red Cliffs section in the east and on the Rufus plains and Rufus weir in the west of the indicative disturbance area.	No. Not recorded breeding or nesting so therefore classified as a predicted ecosystem credit species.
Hieraaetus morphnoides	Little Eagle	V	N	PCT's 10, 11, 13, 15, 16, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252, 253 Woodlands with associated grassland	✓	✓	✓	✓	Yes (surveyed) Observed singularly. Two records in mallee east of the SA border. Once west of the Anabranch associated with mallee habitats. Once along the Low Darling Road associated with floodplain woodlands.	No. Not recorded breeding or nesting so therefore classified as a predicted ecosystem credit species.
Lathamus discolor	Swift Parrot	E	Y	PCT's 10, 11 Winter foraging resources – Riparian and lake-side habitats	–	–	–	✓	No (surveyed)	No. This species was not recorded.

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	N	PCT's 10, 11, 13, 15, 16, 19, 21, 58, 63, 139, 143, 153, 154, 166, 170, 171, 172, 221, 252, 253 Callitris and mallee – arid riverine	✓	✓	✓	✓	Yes (surveyed) Mostly in pairs. Observed in open mallee habitats on Rufus River Road west of Lake Victoria 2019/2019. Observed three times in mallee west of the Anabranch. Recorded twice in Black Box woodland at the Anabranch (30+). Recorded twice in roadside locations along the Silver City Highway. Recorded along Renmark Road in Cypress Pine associated with mallee habitats. Recorded in mallee habitats west of the Buronga substation	No. Not recorded breeding or nesting so therefore classified as a predicted ecosystem credit species.
Lophoictinia isura	Square-tailed Kite	V	N	PCT's 10, 11, 13, 15, 16, 21, 58, 221, 252 Woodlands – Mallee, floodplain and riverine	✓	✓	✓	✓	Yes (surveyed) Recorded flying above mallee habitats where the Red Cliffs deviation leaves the main powerline easement	No. Not recorded breeding or nesting so therefore classified as a predicted ecosystem credit species.

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Manorina melanotis	Black-eared Miner	CE	Y	PCT's 170, 171, 172 Mallee	✓	–	–	–	No (surveyed)	No. This species was not recorded.
Pachycephala rufogularis	Red-lored Whistler	CE	Y	PCT's 171, 172 Mallee	✓	–	–	–	No (surveyed)	No. This species was not recorded.
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	N	PCT's 10, 11, 13, 15, 16, 58, 170, 171 Mallee, floodplain and riparian	✓	✓	✓	✓	Yes (surveyed)	Yes. A pair observed within the proposal study area flying through riverine woodland on the Robinvale Plain IBRA subregion. Not observed in South Olary Plain, great darling Anabranch or Pooncarie – Darling IBRA subregion. The species is considered affected by the proposal for the Robinvale Plain IBRA subregion with associated habitat recorded for PCT 11 and PCT 13.
Ninox connivens	Barking Owl	V	N	PCT's 10, 11, 13, 15, 16 Not mallee – woodlands and riparian	✓	✓	✓	✓	No (surveyed)	No. This species was not recorded.

SPECIES NAME	COMMON NAME	BC ACT[1]	SAII	NATIVE VEGETATION TYPE(S)	IBRA SUBREGIONS				SPECIES PRESENCE	AFFECTED?
					SOP	GDA	PD	RP		
Mammals										
Lasiorhinus latifrons	Southern Hairy-nosed Wombat	E	N	PCT's 58, 153, 154, 170, 171, 172 Suitable semi-arid to arid grassy woodlands with suitable burrowing substrates	✓	✓	–	–	No (surveyed)	No. This species was not recorded.
Pseudomys desertor	Desert Mouse	CE	Y	PCT's 171, 172 Spinifex mallee	✓	–	–	–	No (surveyed)	No. This species was not recorded.
Reptiles										
Lucasium stenodactylum	Crowned Gecko	V	N	PCT's 143, 153, 154, 170, 221 Sand hill habitats	✓	–	–	–	No (surveyed)	No. This species was not recorded.

(1) Threat status under the BC Act: V = vulnerable, E = endangered, CE = critically endangered

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

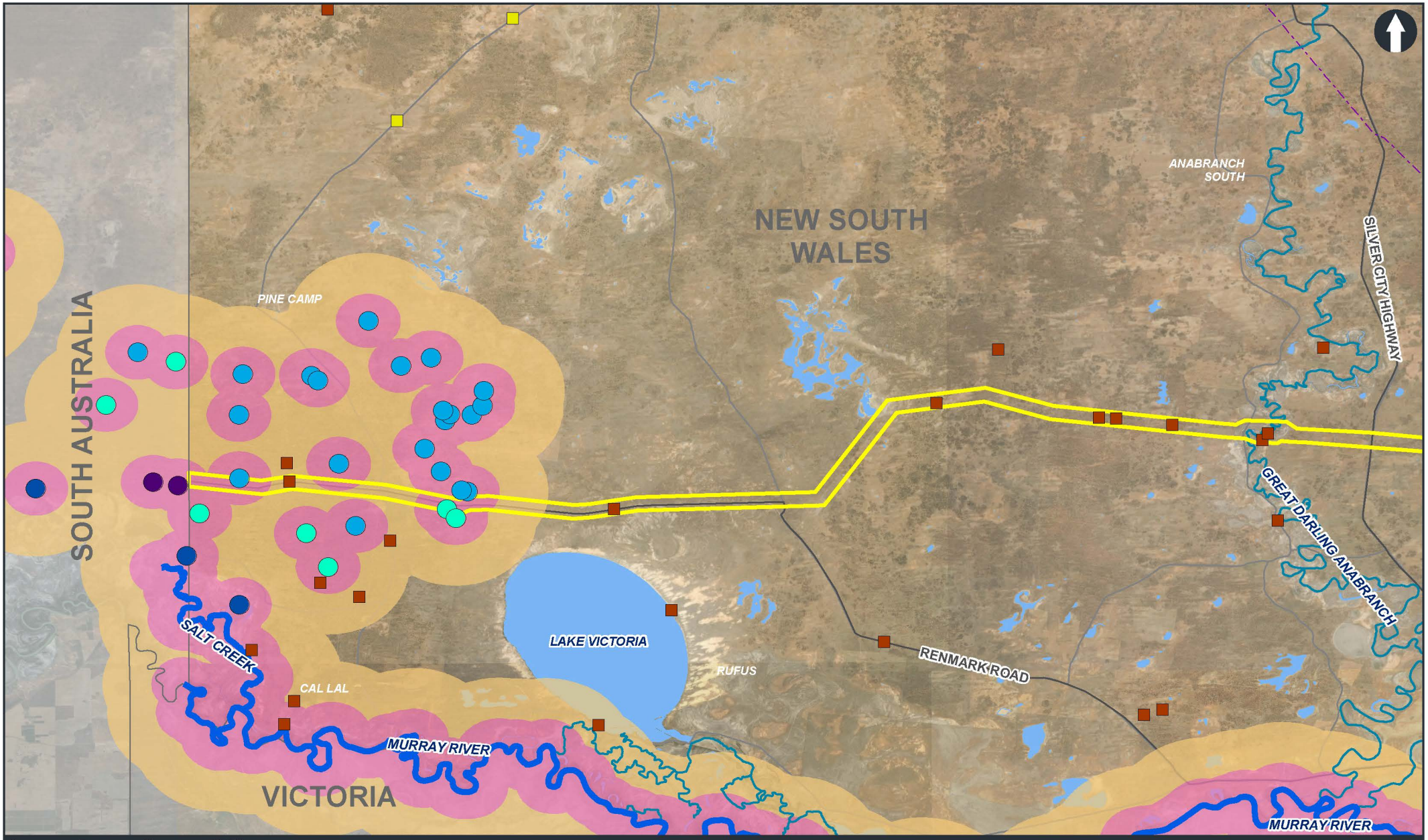

Figure 6.3

Black-eared Miner analysis

6.3 RECORDED THREATENED FAUNA SPECIES

A number of threatened fauna species were observed directly or captured during surveys across the proposal study area or in adjacent lands. Refer to Figure 6.2 for recorded locations of these species. All except the Regent Parrot are ecosystem credit species and do not require individual assessment.

6.3.1 SPECIES CREDIT SPECIES

REGENT PARROT

The eastern subspecies of the Regent Parrot (*Polytelis anthopeplus monarchoides*) is listed as Endangered under the NSW BC Act and Vulnerable under the Commonwealth EPBC Act. Regent Parrots were only observed once in association with the indicative disturbance area during the October 2019 – September 2020 survey period. A single pair were observed flying through Black Box woodland in floodplain topography near the indicative disturbance area crossing of the Murray River at Trentham Cliffs. Where this species is abundant it is relatively easily observed, and during the survey period relatively good numbers of Regent Parrots were observed further east when travelling to and from the indicative disturbance area through areas where the species is more abundant. The birds require good connectivity of woodland habitats between riverine roosting/breeding habitats and mallee foraging habitats, which is not present in extensive areas west of the Darling River and is increasingly difficult in habitats associated with the eastern sections of the indicative disturbance area, due to the continuation of large-scale clearing of mallee habitats.

6.3.2 ECOSYSTEM CREDIT SPECIES

6.3.2.1 THREATENED REPTILES

SPINIFEX SLENDER BLUE-TONGUE LIZARD

The Spinifex Slender Blue-tongued Lizard (*Cyclodomorphis melanops elongatus*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. A single individual was observed while constructing a pitfall fence in spinifex grassed dunes to the west of the Great Darling Anabranch. The lizard was buried in undisturbed sand with no indication of a surface entrance to an underground tunnel. When uncovered the lizard quickly escaped into an adjacent spinifex clump. While spinifex patches associated with the habitat were not extensive or continuous throughout the habitat, occasional patches were of sufficient size and maturity to support small animals such as the Spinifex Slender Blue-tongue Lizard. This species was not otherwise captured during the survey period, which is likely due to its resistance to capture through standard trapping methods. It is expected to occur throughout the indicative disturbance area within PCT171 where spinifex patches offer sufficient extent and cover for it to persist through extended dry periods.

6.3.2.2 THREATENED BIRDS

BLACK-BREASTED BUZZARD

The Black-breasted Buzzard (*Hamirostra melanosternon*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. Four individual Black-breasted Buzzards were observed during the October 2019 to September 2020 fauna survey period. Observations were all made within short distances from floodplain habitats. An immature bird was observed at Chowilla Regional Reserve, adjacent to the NSW border, an adult and sub-adult were observed separately, near to the development crossing of the Darling River and a fourth bird (sub-adult) was observed along the Rufus River Road, to the south of the indicative disturbance area south of Lake Victoria. It is likely that Black-breasted Buzzards are resident throughout the region and move widely for foraging. Taller trees, such as those associated with flood plain woodlands, are likely to represent nesting opportunities locally.

Sub-adult Black-breasted Buzzard Low Darling Road

Distant adult Black-breasted Buzzard High Darling Road

Photo 6.13 Black-breasted Buzzard

CHESTNUT QUAIL-THRUSH

The Chestnut Quail-thrush (*Cinclosoma castanotum*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. The Chestnut Quail-thrush is discussed in more detail above in Section 6.2.3.1. Two observations of Chestnut Quail-thrush were made during the October 2019 to September 2020 surveys, the single female pictured in Photo 6.14 with food for dependent young in October 2019 and a family group of five (5) birds in the same general area in September 2020. This species prefers canopied arid woodlands and within the indicative disturbance area, is likely to be confined to stands of PCT170, PCT171 and PCT172 where the understorey strata offer cover and sufficient micro-habitat features for foraging and nest sites.

Female Chestnut Quail-thrush western mallee

Female Chestnut Quail-thrush western mallee

Photo 6.14 Chestnut Quail-thrush

GREATER SAND PLOVER

The Greater Sand Plover (*Cinclosoma castanotum*) is listed as Vulnerable under the NSW BC Act and the Commonwealth EPBC Act. A single Greater Sand Plover was observed foraging with other migratory shorebirds in Coombool Swamp within the Chowilla Regional Reserve in South Australia adjacent to the NSW border. There are no other records for this species within the region, which is likely due to the low number of survey works undertaken locally and the tendency of this species to prefer estuarine habitats occurring in coastal area. Another relatively rare migratory bird, the Pectoral Sandpiper was observed at the same location in November 2019. The Pectoral Sandpiper (*Calidris melanotos*) is not listed as a threatened species but is listed as Migratory species under the EPBC Act.

Greater Sand Plover Chowilla Regional Reserve October 2019

Pectoral Sandpiper Chowilla Regional Reserve November 2019

Photo 6.15 Greater Sand Plover and Pectoral Sandpiper

HOODED ROBIN

The Hooded Robin (South-eastern Form) (*Melanodryas cucullata cucullata*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. The Hooded Robin was observed at five locations within the indicative disturbance area. At two sites in the western mallee adult birds were attending to juvenile fledglings, and a third pair were observed mating. A fourth western mallee observation was within the eastern boundary between mallee and chenopod habitats. The fifth observation was east of the Silver City Highway in Black Oak woodland. Woodland habitats occurring within the indicative disturbance area that retain relatively intact understorey strata provide suitable habitat for this species.

Juvenile Hooded Robin Western Mallee section of the indicative disturbance area

Photo 6.16 Hooded Robin

LITTLE EAGLE

The Little Eagle (*Hieraaetus morphnoides*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. The Little Eagle was observed on five occasions during the October 2019 to September 2020 survey period. Three of those observations were in the western mallee areas of the proposal study area and are most likely the same individual/s suggesting this area is part of an occupied territory. Other two individuals were observed east of the Greater Darling Anabranch and near the Low Darling Road. It is considered very likely that the indicative disturbance area falls within the home ranges of a number of individuals.

Little Eagle Low Darling Road

Little Eagle Western Mallee at the common viewing distance

Photo 6.17 Little Eagle

MAJOR MITCHELL'S COCKATOO

The Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. Major Mitchell's Cockatoos were encountered occasionally throughout arid woodland/shrubland and Black Box habitats associated with the proposal study area. Although they were generally sparsely distributed across the region, more than a pair of birds was encountered on two occasions, with a group of five birds observed in the western mallee and a group of thirty observed at the Greater Darling Anabranch. Birds were observed using cypress pine fruit and paddy melons for forage on more than one occasion.

Major Mitchell's Cockatoo feeding on Cypress Pine fruit.

Major Mitchell's Cockatoo were observed eating paddy melons in road-side locations.

Photo 6.18 Major Mitchells Cockatoo

MALLEEFOWL MOUNDS

The Malleefowl (*Leipoa ocellata*) is listed as Endangered under the NSW BC Act and Vulnerable under the Commonwealth EPBC Act. Malleefowl were not observed within the proposal study area or other habitats within the region during the 2019 – 2020 survey period. It is a cryptic species and despite its size is very difficult to pick up within the dappled light and sombre tones of mallee woodlands. During the survey period two (2) disused Malleefowl nest mounds were discovered within the indicative disturbance area . One mound was observed in the western mallee habitat, the second in mallee at Trentham Cliffs in the section of the indicative disturbance area that diverts south from the existing indicative disturbance area toward the Murray River crossing to Red Cliffs. It is considered likely that Malleefowl occur within mallee woodland habitats associated with the proposal study area, but in low densities, as the quality of understorey strata is not sufficient to support a thriving population.

Disused Malleefowl mound western mallee Rufus

Disused Malleefowl mound Trentham Cliffs

Photo 6.19 Malleefowl mounds

REDTHROAT

The Redthroat (*Polytelis anthopeplus monarchoides*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. Redthroats are a small passerine with sombre plumage, the only colour being the rufous-buff throat of the male, from which the name is derived. Within the proposal study area habitats, Redthroats were found to inhabit open chenopod habitats away from wooded habitats. Redthroats were recorded at nine sites within the proposal study area, with one site within earshot of four calling males. The birds were not continuously distributed throughout chenopod habitat but were relatively common where the density and quality of chenopod shrubs were high. Redthroats were found to accept a lower density of shrubs in areas where the plants were large and thickly foliaged but avoided areas where the shrubs were small, although relatively continuous. Large areas of chenopod shrublands associated with the proposal study area were characterised by plants in poor condition and exhibiting a loss of foliage cover. The poor condition of many plants in some areas, was likely due to extended dry periods experienced throughout the region and appeared to limit the distribution of Redthroats in localised areas. It is considered possible that recovery of such habitats during favourable seasons, may increase the Redthroat's area of occupancy.

Male Redthroat chenopod habitat, Rufus

Large chenopod shrubs are favoured by Redthroat where the shrub density is low to moderate

Photo 6.20 Redthroat

SQUARE-TAILED KITE

The Square-tailed Kite (*Lophoictinia isura*) is listed as Vulnerable under the NSW BC Act and not listed under the Commonwealth EPBC Act. The distribution of the Square-tailed Kite extends through coastal areas into inland areas, with the proposal study area falling at the limits of its recorded distribution. A single bird was observed circling over mallee woodland in the eastern mallee area over two consecutive formal bird survey sites, suggesting the bird was foraging and not just passing through the habitat.

Square-tailed Kite eastern mallee Trentham Cliffs

Habitat where the photo to the left was taken

Photo 6.21 Square-tailed Kite

WHITE-BELLIED SEA-EAGLE

The White-bellied Sea-Eagle (*Haliaeetus leucogaster*) is listed as Vulnerable under the NSW BC Act and listed as a Marine species under the Commonwealth EPBC Act. Marine species are subject to assessment as MNES under the EPBC Act, within Commonwealth Marine areas, such areas are not associated with the indicative disturbance area or surrounding areas. White-bellied Sea-Eagles were observed on a number of occasions in the wider landscape of the proposal study area in association with the Murray River floodplain, but only observed within the proposal study area at one location near its crossing of the Murray River. The individual observed was flying through the location high above the indicative disturbance area . Wedge-tailed Eagles have established nesting sites at the Murray Crossing location and may defend their territory from the presence of other large raptors.

Immature White-bellied Sea-Eagle on the Murray flood plain to the south of the indicative disturbance area

Photo 6.22 White-bellied Sea-Eagle

WHITE-FRONTED CHAT

The White-fronted Chat (*Epthianura albifrons*) is listed as Vulnerable under the NSW BC Act and is not listed under the Commonwealth EPBC Act. White-fronted Chats were very sparsely encountered within the proposal study area during the 2019 and early 2020 survey periods. The low numbers during that survey period appears to be due to the extended dry period in which the surveys were conducted, as this species was abundant after rains improved the local vegetation condition. The birds were observed in open chenopod and grassland habitats in the western and central (east of the Darling River) sections of the proposal study area.

Female White-fronted Chat

Male White-fronted Chat

Photo 6.23 White-fronted Chats

6.3.2.3 THREATENED MAMMALS

BOLAM'S MOUSE

Bolam's Mouse (*Pseudomys bolami*) is listed as Vulnerable under the NSW BC Act and is not listed under the Commonwealth EPBC Act. Bolam's Mouse was captured in a pitfall trap in chenopod understorey vegetation within Black Box riverine habitats in the proposal study area nearby to the Murray River crossing.

Black Box riverine woodland with chenopod understorey, where Bolam's Mouse was captured, Trentham Cliffs

Photo 6.24 Pitfall traps where Bolam's Mouse was captured

SOUTHERN NINGAUI

The Southern Ningaui (*Ningaui yvonnae*) is listed as Vulnerable under the NSW BC Act and is not listed under the Commonwealth EPBC Act. The Southern Ningaui occurs in spinifex dominated understorey habitats and a single individual was captured in a pitfall trap within spinifex mallee (PCT171) in the western mallee.

Southern Ningaui in western mallee Rufus

PCT171 spinifex mallee Southern Ningau capture site

Photo 6.25 Southern Ningaui

INLAND FOREST BAT

The Inland Forest Bat (*Vespedelus baverstocki*) is listed as Vulnerable under the NSW BC Act and is not listed under the Commonwealth EPBC Act. The Inland Forest Bat was captured at two locations in chenopod mallee (PCT170) east of Pooncarie Road.

Inland Forest Bat captured in chenopod mallee east of Pooncarie Road

Photo 6.26 Inland Forest Bat

LITTLE PIED BAT

The Little Pied Bat (*Chalinolobus pictus*) is listed as Vulnerable under the NSW BC Act and is not listed under the Commonwealth EPBC Act. A single Little Pied Bat was captured at two locations in habitats associated with the proposal study area. One in River Red Gum forest associated with the Darling River, the other in chenopod mallee east of the Pooncarie Road.

Little Pied Bat Darling River indicative disturbance area crossing

Photo 6.27 Little Pied Bat

CORBEN'S LONG-EARED BAT

Corben's Long-eared Bat (*Nyctophilus corbeni*) is listed as Vulnerable under the NSW BC Act and listed as Vulnerable under the Commonwealth EPBC Act. Three Corben's Long-eared Bat individuals were capture during harp trapping surveys in chenopod mallee habitat, east of Pooncarie Road.

Corben's Long-eared Bat harp trap captured in chenopod mallee habitat

Photo 6.28 Corben's Long-eared Bat

6.4 PRESCRIBED IMPACTS

This section identifies prescribed biodiversity impacts which may be difficult to quantify, replace or offset, making avoiding and minimising impacts critical in accordance with section 8.2 of the BAM. Prescribed biodiversity impacts relevant to the proposal have been identified in Table 6.14.

Table 6.14 Prescribed biodiversity impacts relevant to the proposal

PRESCRIBED BIODIVERSITY IMPACTS	PRESENT	RELEVANCE TO THE PROPOSAL	THREATENED SPECIES OR COMMUNITY USING OR DEPENDENT ON FEATURE	SECTION OF THE BAR WHERE PRESCRIBED IMPACT IS ADDRESSED
(a) impacts of development 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	Yes	(i) no karst, caves, crevices or cliffs considered to be relevant to prescribed impacts are present. However, one area of geological significance relating to biodiversity within the proposal study area are the gypsum soils associated with lunette rises that were observed in a restricted area on the eastern edge of Nulla Station and adjoin lands. These soils are preferentially favoured by rare gypsum obligate species such as *Austrostipa nullanulla* (Endangered) and the highly restricted *Elacanthus glaber* and *Roepera compressa*. Refer to Figure 6.1 for the location of this feature, which is equivalent to the area polygon for *Austrostipa nullanulla*. The approach to these areas is addressed in Stage 2 of the BDAR. (ii) no rocks considered to be relevant to prescribed impacts are present. (iii) no human made structures considered to be relevant to prescribed impacts are present. (iv) no non-native vegetation considered to be relevant to prescribed impacts is present.	*Austrostipa nullanulla*	Sections 8.2 and 9.3 of Stage 2 assessment of this BDAR
(b) impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Yes	The proposal has the potential to impact on connectivity for habitat of threatened species that facilitates movement across species' ranges. The nature of the potential impacts to connectivity primarily relate to impacts to aerial species such as birds or bats through interaction with the proposed towers or associated lines. Terrestrial movement (either on the ground and/or below the upper stratum of vegetation) is unlikely to be substantially altered given the majority of native vegetation under 2 m would be retained within the easement of the proposal.	— Raptors — Brolga — Major Mitchell's Cockatoo — Regent Parrot — Migratory shorebirds — Waterfowl — Microbats	Sections 8.2 and 9.3 of Stage 2 assessment of this BDAR

PRESCRIBED BIODIVERSITY IMPACTS	PRESENT	RELEVANCE TO THE PROPOSAL	THREATENED SPECIES OR COMMUNITY USING OR DEPENDENT ON FEATURE	SECTION OF THE BAR WHERE PRESCRIBED IMPACT IS ADDRESSED
(c) impacts of development on movement of threatened species that maintains their life cycle	Yes	The proposal has the potential to impact on movement of threatened species that maintains their life cycle. The nature of the potential impacts to connectivity primarily relate to impacts to aerial species such as birds or bats through interaction with the proposed towers or associated lines. Terrestrial movement (either on the ground and/or below the upper stratum of vegetation) is unlikely to be substantially altered given the majority of native vegetation under 2 m would be retained within the easement of the proposal (disturbance area B).	— Raptors — Brolga — Major Mitchell's Cockatoo — Regent Parrot — Migratory shorebirds — Waterfowl — Microbats	Sections 8.2 and 9.3 of Stage 2 assessment of this BDAR
(d) impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	Yes	The proposal crosses significant waterways including Great Darling Anabranch, Darling River and the Murray River. However any substantial impacts to water quality to these and other water bodies are not expected to occur. All construction and operation impacts will be managed to ensure ground disturbance is minimised and managed and direct impacts to the waterbodies themselves and related hydrological processes are not expected to occur.	— Amphibians — Terrestrial Species — Aerial species — Aquatic Species	Sections 8.2 and 9.3 of Stage 2 assessment of this BDAR
(e) impacts of wind turbine strikes on protected animals	No	Not applicable		
(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community	Yes	The proposal is likely to generate additional vehicular movements, particularly during construction but also during operation. It is located adjoining to or crosses regional roads such as Renmark Road, Silver City Highway and the Sturt Highway.	— Amphibians — Terrestrial Species	Sections 8.2 and 9.3 of Stage 2 assessment of this BDAR
other	No	No other likely prescribed impacts are considered likely to be relevant.	N/A	N/A

Further consideration and assessment of the identified potential prescribed impacts is provided in Stage 2 of this BDAR.

6.5 THREATENED AQUATIC SPECIES

6.5.1 FM ACT LISTED THREATENED SPECIES

Within the proposal study area threatened aquatic habitat occurs in the form of fresh and saline wetlands, rivers and creeks that contain mapped key fish habitats (Strahler 4/5th Order streams) and other open water bodies such as agricultural dams, irrigation canals, road table drains and low depressions that periodical pond water.

Areas of mapped key fish habitat have been considered to provide moderate likelihood of occurrence for six threatened species listed under the FM Act (refer to Appendix D-2 for further detail). These species are:

- Darling River Snail (*Notopala sublineata*) listed as critically endangered under the FM Act
- Eel-tailed Catfish (*Tandanus tandanus*) listed as endangered under the FM Act
- Hanley's River Snail (*Notopala hanleyi*) listed as critically endangered under the FM Act
- Murray Crayfish (*Euastacus armatus*) listed as vulnerable under the FM Act
- Murray Hardyhead (*Craterocephalus fluviatilis*) listed as critically endangered under the FM Act
- Silver Perch (*Bidyanus bidyanus*) listed as vulnerable under the FM Act.

Further assessment of these threatened aquatic species is provided in Stage 2 of this report.

6.5.2 FM ACT LISTED ENDANGERED ECOLOGICAL COMMUNITIES

The following Endangered ecological communities listed under the FM Act have potential to occur within the proposal study area:

- Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River Lowland
- Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Murray River Lowland.

A brief overview of each endangered ecological community and its relevance to the proposal study area is provided below.

6.5.2.1 AQUATIC ECOLOGICAL COMMUNITY IN THE NATURAL DRAINAGE SYSTEM OF THE LOWLAND CATCHMENT OF THE DARLING RIVER LOWLAND

The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River (Lowland Catchment of the Darling River) is listed as an Endangered ecological community under the FM Act.

The Lowland Catchment of the Darling River ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams, and associated lagoons, billabongs, lakes, flow diversions to anabranches, and the floodplains of the Darling River including Menindee Lakes and the Barwon River. Specifically, these areas include the main Barwon–Darling channel from Mungindi (QLD–NSW border) to the confluence with the Murray River, the arid zone intermittent intersections streams (Warrego, Culgoa, and Narran Rivers), Border Rivers (Macintyre, Severn and Dumaresq Rivers), and regulated tributaries of the Gwydir, Namoi, Macquarie, Castlereagh, and Bogan Rivers (NSW Fisheries Scientific Committee 2003a).

Riparian native vegetation recorded within the proposal study area is considered to comprise of the following native vegetation types:

- PCT11 – 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) (modified)
- PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (modified).

Lowland Catchment of the Darling River ecological community is considered affected by the proposal based on clearing of riparian vegetation. Further assessment of impacts on this ecological community, including an assessment of significance in accordance with Section 221ZV of the FM Act, is addressed in Section 9.8 of Stage 2 of this report.

6.5.2.2 AQUATIC ECOLOGICAL COMMUNITY IN THE NATURAL DRAINAGE SYSTEM OF THE LOWLAND CATCHMENT OF THE MURRAY RIVER LOWLAND

The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Murray River (Lowland Catchment of the Murray River) is listed as an Endangered ecological community under the FM Act.

The lowland catchment of the Murray River ecological community includes all native fish and aquatic invertebrates within all natural creeks, rivers, and associated lagoons, billabongs and lakes of the regulated portions of the Murray River (also known as the River Murray) downstream of Hume Weir, the Murrumbidgee River downstream of Burrinjuck Dam, the Tumut River downstream of Blowering Dam and all their tributaries anabranches and effluents including Billabong Creek, Yanco Creek, Colombo Creek, and their tributaries, the Edward River and the Wakool River and their tributaries, anabranches and effluents, Frenchmans Creek, the Rufus River and Lake Victoria (NSW Fisheries Scientific Committee 2003b).

Riparian native vegetation recorded within the proposal study area is considered to comprise of the following native vegetation types:

- PCT11 – 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) (modified)
- PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) (derived).

Lowland Catchment of the Murray River ecological community is considered affected by the proposal based on clearing of riparian vegetation. Assessment of impacts on this ecological community, including an assessment of significance in accordance with Section 221ZV of the FM Act, are addressed in Section 9.8 of Stage 2 of this report.

7 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Matters of National Environmental Significance (MNES), listed under the EPBC Act, are addressed in this section. The following biodiversity MNES protected under the EPBC Act were considered for their relevance to the proposal:

- listed threatened species and communities (sections 18 and 18A)
- listed migratory species (sections 20 and 20A)
- wetlands of international importance (sections 16 and 17B).

This BDAR provides an assessment of all EPBC Act listed threatened species and communities that may be impacted. In undertaking this assessment all matters listed in Appendix A of the SEARs have been considered, including all EPBC Act listed threatened species and communities and migratory species likely to be impacted by the action. This list of species and communities for assessment has also been supplemented and refined with database searches (i.e. BioNet, BAM-C, PMST, and NSW Fisheries databases) to provide a thorough assessment.

7.1 THREATENED SPECIES AND COMMUNITIES

7.1.1 THREATENED ECOLOGICAL COMMUNITIES

Based on broad scale state vegetation mapping and database searches a total of two candidate threatened ecological communities listed under the EPBC Act were considered likely to occur. These are:

- Buloke (*Allocasuarina luehmannii*) Woodlands of the Riverina and Murray-Darling Depression Bioregions
- Coolibah (*Eucalyptus coolabah*) – Black Box (*Eucalyptus largiflorens*) Woodlands of the Darling Riverine Plains and the Brigalow Belt of South Bioregion.

These threatened ecological communities were also identified as potential candidates within the proposal study area in the Preliminary Biodiversity Assessment report (WSP 2020a), the EPBC Act referral documentation (WSP 2020b) and Appendix A of the SEARs issued for the proposal.

Neither of these, or any other threatened ecological communities listed under the EPBC Act, were recorded within the proposal study area during the detailed native vegetation sampling and mapping work. The PCTs found within the proposal study area do not correspond to any EPBC Act listed threatened ecological communities. Section 3.6 and 3.7 of this BDAR outlines the survey methods used. An overview of the PCTs found within the proposal study area is provided in Section 5.2 and a detailed description of each PCT is provided in Appendix C-2. Detailed vegetation integrity plot data for each PCT and associated vegetation zone is presented in Appendix C-3.

7.1.2 THREATENED FLORA

Appendix A of the SEARs outlines an initial list of EPBC Act listed threatened flora species likely to be impacted by the action. Combined with database searches (BioNet, BAM-C and PMST), there is predicted habitat or identified known habitat within the proposal study area for 12 threatened flora species listed under the EPBC Act (refer to Appendix D-1). Of these, five have been identified to have a moderate likelihood of occurrence and were the subject of targeted surveys. The results of targeted surveys for the five identified EPBC Act threatened flora species are presented in Table 7.1.

Appendix D-1 provides a description of the habitat requirements for each EPBC Act listed species, and the reasoning for inclusion or exclusion of EPBC Act listed species in this assessment. One EPBC Act listed threatened flora species outlined in the SEARs, *Brachyscome papillosa* (Mossigel Daisy), was excluded due to the habitat being considerably degraded and no records of the species from within 100 kilometres of the proposal study area (refer to Section 6.2.1.3 and Appendix D-1 for further detail).

Details of the scope, timing and methodology of the targeted surveys used for EPBC Act listed threatened flora species and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements is provided in Chapter 3).

The potential impacts to EPBC Act listed threatened flora species were identified in accordance with the BAM and are outlined in Chapter 9. For threatened flora species 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) which are provided in Appendix E-1. Avoidance and proposed mitigation measures are outlined in Chapters 8 and 11. The residual adverse impacts likely to occur to EPBC Act listed threatened flora species after avoidance and mitigation have been calculated in accordance with the BAM (in the form of biodiversity credits) and are presented in Chapter 10 and Appendix G.

Table 7.1 Listed EPBC Act threatened flora species considered for assessment

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	ASSESSMENT
Atriplex infrequens	A saltbush	V	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species. The targeted surveys undertaken have recorded this species in May and July 2020 from PCT 17 (refer to Section 6.2.1). *Atriplex infrequens* is considered affected by the proposal.
Austrostipa metatoris	A spear-grass	V	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species. This species was subject to targeted surveys that focus on PCT 19 and PCT 170 habitats. No individuals of *Austrostipa metatoris* have been recorded during targeted surveys and the occurrence of this species within the indicative disturbance area is considered unlikely.
Lepidium monoplocoides	Winged Peppercress	E	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species. Associated habitat occurs in the form of PCT 15 and PCT 216. No individuals of *Lepidium monoplocoides* have been recorded during targeted surveys and the occurrence of this species within the indicative disturbance area is considered unlikely.
Solanum karsense	Menindee Nightshade	V	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species. Associated habitat occurs in the form of PCT 15, PCT 17, PCT 63 and PCT 166. No individuals of *Solanum karsense* have been recorded during targeted surveys and the occurrence of this species within the indicative disturbance area is considered unlikely.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	ASSESSMENT
Swainsona murrayana	Slender Darling Pea	V	Not identified as a matter likely to be impacted in the SEARs. However, this species may occur in PCT 253 in the South Olary Plain IBRA subregion.	Candidate species credit species. Associated habitat occurs in the form of PCT 253. A single record of this species from 2010 was made on Nanya Station (~80 km north of the proposal study area). At Nanya Station, *Swainsona murrayana* was recorded from a gypseous rise approximately 2 m above a saline clay playa, occurring on gypseous clay of Yamba Formation containing a very sparse Bladder Saltbush Shrubland. No individuals of *Swainsona murrayana* have been recorded during targeted surveys and the occurrence of this species within the indicative disturbance area is considered unlikely.

(1) Threat status under the EPBC Act: V = vulnerable, E = endangered

7.1.3 THREATENED FAUNA

Six EPBC Act listed threatened fauna species are known to occur or are considered likely to occur within the proposal study area due to the large extent and high quality of the habitats. Appendix A of the SEARs outlines the original list of EPBC Act listed threatened fauna species likely to be impacted by the action. Combined with database searches (BioNet, BAM-C and PMST), there is predicted habitat or identified known habitat within the proposal study area for 17 threatened fauna species listed under the EPBC Act (refer to Appendix D-2). This includes four extinct mammal species. Of these 37 EPBC Act listed species, 17 have been identified to have a moderate likelihood of occurrence or higher and were the subject of targeted surveys. The 17 identified EPBC Act threatened fauna species are the species which are likely to be impacted by the action and for which further investigation has been undertaken and are outlined in Table 7.2.

Appendix D-2 provides a description of the habitat requirements for each EPBC Act listed species, and the reasoning for inclusion and exclusion of EPBC Act listed species in this assessment. Some fauna species outlined in the SEARs, for example Mallee Emu-wren and Plains-wanderer, were excluded from the assessment based on the absence of suitable habitat, the habitat being considerably degraded, or absence of the species from surveys (refer to Section 6.2.3.1 and Appendix D-2 for further detail). Other species including the Curlew Sandpiper, Red Knot, Northern Siberian Bar-tailed Godwit, and Bar-tailed Godwit (baueri) were excluded from assessment as candidate species credit species as there is no 'mapped important habitats' for these species that would be impacted. The Northern Siberian Bar-tailed Godwit was removed from the assessment entirely as this species is restricted to the northwest of Australia and is not known to inhabit the proposal study area (any birds would be vagrants).

Details of the scope, timing and methodology of the targeted surveys used for EPBC Act listed threatened fauna species and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements is provided in Section 3.8.

The potential impacts to EPBC Act listed threatened fauna species were identified in accordance with the BAM and are outlined in Chapter 9. For threatened fauna species 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) which are provided in Appendix E-1. Avoidance and proposed mitigation measures are outlined in Chapter 7. The residual adverse impacts likely to occur to EPBC Act listed threatened fauna species after avoidance and mitigation have been calculated in accordance with the BAM (in the form of biodiversity credits) and are presented in Chapter 12 and Appendix G.

The Silver Perch, Murray Hardyhead and Murray Cod have been assumed to occur within suitable waterway habitats within the study area due to mapped habitat, waterway classification for fish passage, and/or Key Fish Habitat mapping. However, the waterways would be spanned by the transmission lines, structures would not be built within the riparian zone, and appropriate buffers would be placed around the structures so that indirect impacts do not occur. Impact to these species is considered unlikely. There would be trimming of canopy trees where the power lines cross the waterways, but this is unlikely to result in any erosion or sedimentation. Further details on predicted impacts to aquatic ecology and watercourses are provided in Chapter 9.

Table 7.2 Listed EPBC Act threatened fauna species considered for assessment

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	ASSESSMENT
Amphibians				
Litoria raniformis	Southern Bell Frog	V	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species. Predicted habitat occurs within PCT 11, PCT 13, and PCT 17 in the Robinvale Plains IBRA Subregion. No suitable waterbodies were present with the indicative disturbance area and its presence is considered unlikely, however assessment has been completed as records do generally occur along the Murray River.
Birds				
Botaurus poiciloptilus	Australasian Bittern	E	Identified in the SEARs as a matter requiring further consideration	Predicted ecosystem credit species. Habitat is present within PCT 11 in the Pooncarie-Darling IBRA Subregion. Habitat is present in PCT 11, PCT 13 and PCT 17 in the Robinvale Plains IBRA Subregion. No suitable waterbodies were present with the indicative disturbance area, however assessment has been completed as a precaution.
Calidris canutus	Red Knot	E	Identified in the BioNet search	Mainly restricted to coastal environments. Rare occurrences cannot be discounted.
Falco hypoleucos	Grey Falcon	V	Identified by the BAM-C.	Predicted ecosystem credit species. Habitat is present within PCT 11 in the Pooncarie-Darling IBRA Subregion. Habitat is present in PCT 15, 19, 21, 58, 143, 153, 154, 170, 171, 172, 221, 252, 253 in the South Olary Plain IBRA Subregion, PCT 15, 19, 58, 166 in the Great Darling Anabranch IBRA Subregion, PCT 11, 15, 21, 63, 139, 154, 166 in the Pooncarie-Darling IBRA Subregion, and PCT 11, 13, 17, 19 and 216 in the Robinvale Plains IBRA Subregion. Rare occurrences cannot be discounted. No individuals have been recorded during targeted surveys and the occurrence of this species within the indicative disturbance area is considered unlikely.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	ASSESSMENT
Geophaps scripta scripta	Squatter Pigeon (Southern Subspecies)	V	Identified by the BAM-C. They are very rare in the southern parts of their range, but suitable habitat is present.	Candidate species credit species. Considered unlikely to occur due to the indicative disturbance area being located outside of this species known distribution.
Grantiella picta	Painted Honeyeater	V	Identified in the PMST, BioNet and BAM-C searches. Habitat occurs with study area and similar habitat is associated with records in SA although there are no records locally.	Predicted ecosystem credit species. Habitat is present within PCT 15, 21, 58, 143 in the South Olary Plain IBRA Subregion. No individuals have been recorded during targeted surveys.
Hirundapus caudacutus	White-throated Needletail	V	Identified in the BioNet search. Although local records are sparse, due to wide ranging habitats may occur in aerial habitats over the study area on a seasonal basis.	Mainly restricted to coastal environments. Rare occurrences in the air cannot be discounted.
Lathamus discolor	Swift Parrot	CE	Identified in the SEARs as a matter requiring further consideration	Predicted ecosystem credit species. Suitable habitat occurs within PCT 11 in the Robinvale Plains IBRA Subregion. No individuals have been recorded during targeted surveys.
Leipoa ocellata	Malleefowl	V	Identified in the SEARs as a matter requiring further consideration	Predicted ecosystem credit species. Suitable habitat occurs within PCT 170, PCT 171, and PCT 172 in the South Olary Plain IBRA Subregion. Two old Malleefowl mounds were recorded within the proposal study area during the surveys.
Limosa lapponica baueri	Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit	V	Identified in the PMST search. May occur intermittently around salt-lakes and wetlands.	Predicted ecosystem credit species. Mainly restricted to coastal environments. Rare occurrences cannot be discounted.
Manorina melanotis	Black-eared Miner	E	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species. Potential habitat occurs within PCT 170, PCT 171, and PCT 172 in the South Olary Plain IBRA Subregion. No individuals have been recorded during targeted surveys.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	ASSESSMENT
Pachycephala rufogularis	Red-lored Whistler	V	Identified in the SEARs as a matter requiring further consideration	Predicted ecosystem credit species. Predicted habitat occurs within PCT 171 and PCT 172 in the South Olary Plain IBRA Subregion. No individuals have been recorded during targeted surveys.
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	V	Identified in the SEARs as a matter requiring further consideration	Candidate species credit species (breeding habitat) and Predicted ecosystem credit species. Predicted habitat occurs within PCT 15, PCT 58, PCT 170, and PCT 171 in the South Olary Plain IBRA Subregion. Predicted habitat occurs within PCT 15 and PCT 58 in the Great Darling Anabranch IBRA Subregion. Predicted habitat occurs within PCT 11 and PCT 15 in the Pooncarie Darling IBRA Subregion. Predicted habitat occurs within PCT 11 and PCT 13 in the Robinvale Plains IBRA Subregion. Two birds recorded flying through next to Murray River. Considered only likely to occur in Red Cliffs section of indicative disturbance area (Robinvale Plains IBRA Subregion).
Fish				
Bidyanus bidyanus	Silver Perch	CE	Identified in the PMST search.	The proposal study area traverses Local Government Areas that contain mapped key fish habitats (Strahler 4/5 Order streams) and DPI mapped habitat for this species. Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered likely to be low.
Craterocephalus fluviatilis	Murray Hardyhead	E	Identified in the PMST search.	The proposal study area traverses Local Government Areas that contain mapped key fish habitats (Strahler 4/5 Order streams). Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered likely to be low.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	ASSESSMENT
Maccullochella peelii	Murray Cod	V	Identified in the PMST search.	The proposal study area traverses Local Government Areas that contain mapped key fish habitats (Strahler 4/5 Order streams). Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered likely to be low.
Mammals				
Nyctophilus corbeni (syn. N. timoriensis)	South-eastern Long-eared Bat (Corben's Long-eared Bat & Greater Long-eared Bat)	V	Identified in the SEARs as a matter requiring further consideration	Predicted ecosystem credit species. Predicted habitat occurs within PCT 21, PCT 58, PCT 170, PCT 171 and PCT 221 in the South Olary Plain IBRA Subregion. Predicted habitat occurs within PCT 58 in the Great Darling Anabranch IBRA Subregion. Predicted habitat occurs within PCT 21 and PCT 139 in the Pooncarie Darling IBRA Subregion. Predicted habitat occurs within PCT 11 in the Robinvale Plains IBRA Subregion. Recorded within PCT170 during the surveys.

(1) Threat status under the EPBC Act: V = vulnerable, E = endangered, CE = critically endangered

7.1.4 OFFSETS FOR EPBC ACT LISTED SPECIES

Any offsets proposed for impacts to EPBC Act listed threatened species will be done in accordance with the NSW BOS, the NSW Assessment Bilateral Agreement – Amending Agreement No. 1, and NSW BC Regulation. Further details on required offsets is provided in Chapter 12.

7.2 MIGRATORY SPECIES

Migratory species that were recorded consisted of the following:

- White-bellied Sea-Eagle
- Rainbow Bee-eater
- Great Egret.

And those that were recorded outside of the proposal study area in local or regional wetlands were:

- Sharp-tailed Sandpiper (Chowilla regional reserve in SA)
- Pectoral Sandpiper (Chowilla regional reserve in SA)
- Red-necked Stint (Chowilla regional reserve in SA)
- Greater Sand Plover (Chowilla regional reserve in SA)
- Black-winged Stilt (Chowilla regional reserve in SA)
- Caspian Tern (Recorded in local riparian and wetland habitats)
- Red-necked Avocet (Chowilla regional reserve in SA).

Potential impacts on migratory species are assessed in Chapter 9 of this BDAR.

7.3 WETLANDS OF NATIONAL AND INTERNATIONAL IMPORTANCE

Wetlands are important habitat for a diverse range of animals including waterbirds, amphibians, invertebrates and fish species as well as aquatic and water loving plants such as sedges and rushes. Tree species such as River Red Gum also rely on these environments. Wetlands are important provide strategic refuge during drought and frequently support threatened species. Most of the migratory bird species listed under international convention agreements with Australia may be found in these wetlands.

7.3.1 NATIONALLY IMPORTANT WETLANDS

There were seven nationally important wetlands returned from the PMST. None of these nationally important wetlands occur within NSW. The proposed mitigation measures would ensure that no indirect downstream impacts would occur. Impacts on water quality, water bodies and hydrological processes are discussed in Chapter 9.

7.3.2 WETLANDS OF INTERNATIONAL IMPORTANCE (RAMSAR WETLANDS)

Three RAMSAR wetlands or Wetlands of International importance were identified by database searches:

- Banrock station wetland complex, located 40–50 kilometres downstream of the proposal study area
- Riverland – in Chowchilla Game Reserve, located about three kilometres to the south-west of the SA/NSW state border at western end of the proposal study area, located in SA
- The Coorong, and Lakes Alexandra and Albert Wetland, located 150–200 kilometres downstream of the proposal study area.

The Riverland Ramsar site would be the only wetland of international importance in the locality. It is located within about three and a half kilometres of the proposal however it would not be directly or indirectly impacted. The proposal mitigation measures would ensure that no indirect downstream impacts would occur. Impacts on water quality, water bodies and hydrological processes are discussed in Section 9.8.

7.4 COMMONWEALTH SEAR'S REQUIREMENTS

Appendix A of the Secretary's Environmental Assessment Requirements for Project EnergyConnect (NSW – Western Section) (EPBC 2020/8673) cross-reference the *Guidelines for preparing assessment documentation relevant to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) for proposals being assessed under the NSW Assessment Bilateral.*

Appendix E-3 of this BDAR provides a table to cross-reference the Commonwealth requirements in the SEARs for the purposes of this BDAR.

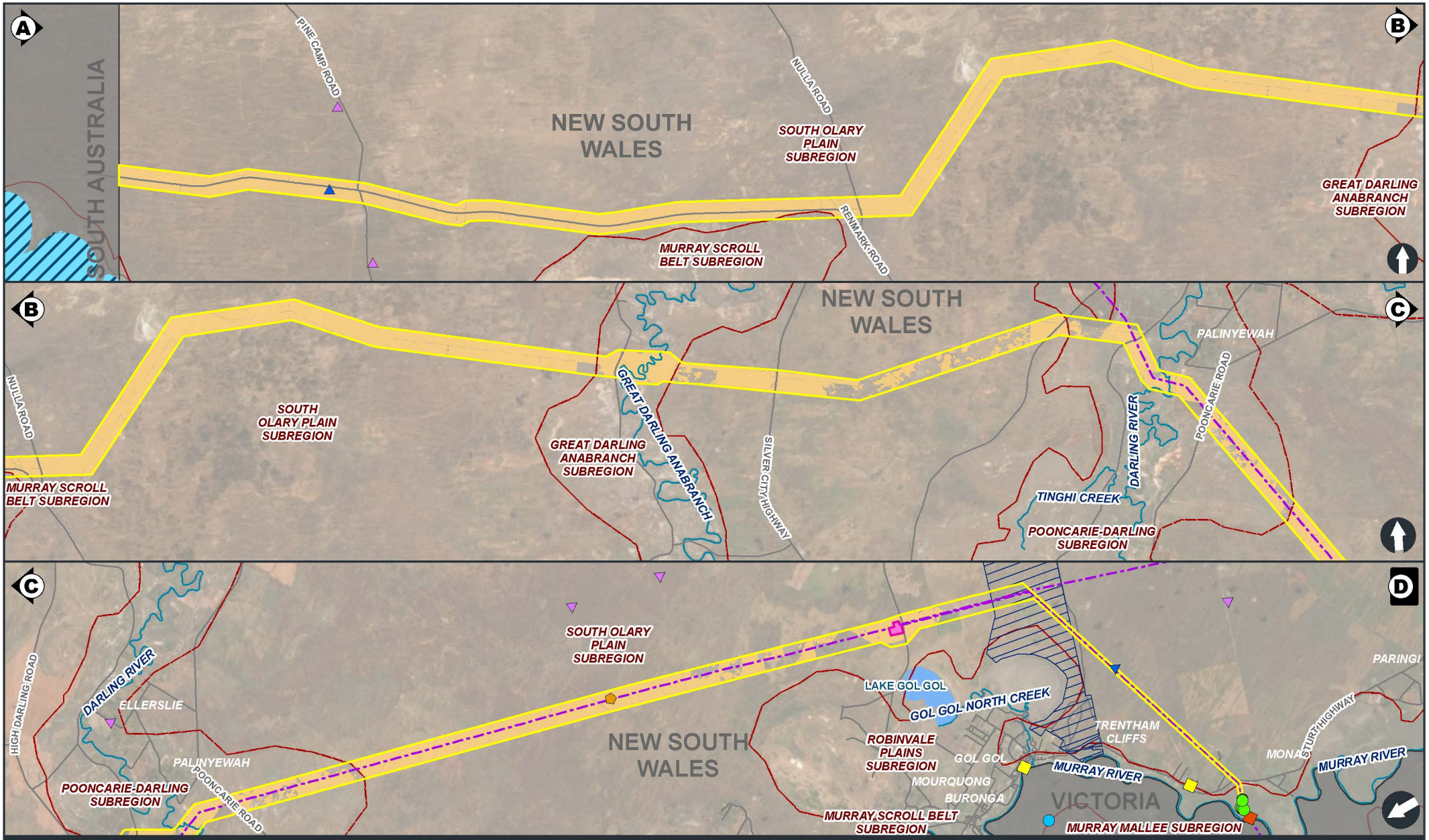

Figure 7.1

Overview of matters of national environmental significance

Refer to Appendix D.2 and D.3 for further detail

- Proposal study area
- Proposed substation expansion area
- Existing transmission line infrastructure
- Ramsar wetland
- MNES habitat for target species
- Property where no access available - State Vegetation Mapping shown

Threatened flora (WSP)
- Atriplex infrequens

Threatened fauna (WSP)
- Regent Parrot
- Malleefowl mound
- Corben's Long-eared Bat

Threatened fauna (Bionet)
- Corben's Long-eared Bat
- Grey Falcon
- Malleefowl
- Painted Honeyeater
- Regent Parrot (eastern subspecies)

Source: NSWSS, ESRI, Transgrid, WSP

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STAGE 2 – IMPACT ASSESSMENT

8 AVOID AND MINIMISE IMPACTS

The following provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the proposal. This information is provided to directly address Section 8 of the BAM.

8.1 AVOID AND MINIMISE IMPACTS ON NATIVE VEGETATION AND HABITAT

This section addresses the proposal location and design decisions surrounding the avoidance and minimisation of impact to native vegetation and habitat. The location, route and design of the proposal has been an adaptive process informed by desktop research and field survey findings.

8.1.1 LOCATION

The proposal involves the construction and operation of a new high voltage interconnector between NSW and SA, with an added connection to north-west Victoria. Complete avoidance of impacts to biodiversity values is not practicable, but impacts have been minimised as outlined below.

Avoidance and minimisation of impacts have been considered during proposal design development, including the strategic options assessment and identification and refinement of the proposal process. Details about the proposal design development are summarised in Chapter 3 of the EIS.

A biodiversity constraints assessment was undertaken through the proposal design development phase. This involved the preparation of a preliminary biodiversity assessment based on desktop assessment and field surveys (WSP 2020). Biodiversity values identified as known, predicted or likely to occur within the proposal study area were assigned to a three-tier biodiversity constraint hierarchy. This hierarchy was developed to assist with addressing the principle of avoid and minimise to inform route selection as required under Section 8 of the BAM. Biodiversity constraints hierarchy were based on the following criteria:

Tier 1 biodiversity constraint – areas to avoid

Tier 1 biodiversity constraints were areas of very high environmental sensitivity, with environmental approvals considered unlikely or unachievable. Tier 1 constraints were:

- Ramsar Wetlands
- World Heritage Areas.

Tier 2 biodiversity constraint – areas to be avoided if reasonable, or minimise impact

Tier 2 biodiversity constraints were areas of high environmental sensitivity, with environmental approvals considered complex and require additional triggers for biodiversity offsets and demonstration of avoid and minimising impacts on such biodiversity values. Tier 2 biodiversity constraints were:

- National Parks, ecological conservation areas (including flora reserves, state conservation areas, Biodiversity Stewardship Sites, Biobanks; wilderness protection areas)
- threatened ecological communities listed under the EPBC Act
- threatened ecological communities listed under the BC Act as SAII entities
- other important wetlands and water sources for migratory birds protected by international agreements.

Tier 3 biodiversity constraint – areas to avoid to minimise impact

Tier 3 biodiversity constraints were areas of high environmental sensitivity, with environmental approvals considered complex and uncertain. Avoiding and minimising impact recommended as biodiversity offsets will apply to unavoidable impacts that in some cases would require significant, expensive and perhaps unattainable offsets obligations. Tier 3 biodiversity constraints were:

- threatened species (flora/fauna) – other non-SAII threatened species listed under the BC Act and EPBC Act
- large, contiguous/intact areas of moderate or better-quality woodland vegetation (only patch sizes of > 5 hectares) (only within three kilometres of existing alignment)
- threatened ecological communities listed under the BC Act (non-SAII)
- key fish habitat (most permanent and semi-permanent freshwater habitats including Strahler 4/5 order streams)
- riparian corridors (Strahler 4/6 order streams) that require a 40 metre riparian buffer on these features as outlined under Table 14 of the BAM.

The strategic option assessment involved avoid, minimise and mitigate measures that included assigning the biodiversity constraints hierarchy to the following outcomes:

- Tier 1 constraints: areas where the transmission line cannot be located (no-go)
- Tier 2 constraints: areas that are to be avoided wherever possible (avoid)
- Tier 3 constraints: areas where impacts should be minimised and mitigated (minimise).

Following the strategic options assessment, the preferred corridor identification and refinement was influenced by several factors including further analysis of biodiversity constraints. Biodiversity constraints that have influenced the proposal identification, together with how the proposal has been refined to avoid/minimise potential biodiversity impacts include:

- positioning of transmission line corridor (which contains the indicative disturbance area) to co-locate where possible with existing infrastructure (i.e. Renmark Road and existing Broken Hill to Buronga 220kV electrical infrastructure)
- relocation of transmission line corridor from southern side of Renmark Road to the northern side to avoid impacts on the critically endangered threatened flora species *Dodonaea stenozyga* and the endangered flora species *Acacia acanthoclada*
- relocation of the transmission line corridor south at Nulla Station to avoid high biodiversity value areas that contain a population of the endangered flora species *Austrostipa nullanulla*
- positioning of the transmission line corridor to co-locate with the existing Broken Hill to Buronga 220kV electrical infrastructure to avoid impacts on individuals of the endangered flora species *Leptorhynchos watzia* and vulnerable flora species *Atriplex infrequens*.

In accordance with section 8.1.1 of the BAM, efforts to avoid and minimise direct impact on native vegetation and habitat during proposal location are further addressed in Table 8.1.

Table 8.1 Efforts to avoid and minimise direct impacts on native vegetation and habitat during proposal location

MEASURES TO AVOID AND MINIMISE IMPACT	PROPOSAL LOCATION
(a) locating the project in areas where there are no biodiversity values	The proposal has been located where possible to utilise category 1 – exempt lands.
(b) locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	Much of the proposal study area has been identified to contain native vegetation. Areas of existing and permanent disturbance (e.g. existing roads and tracks, utility easements, fence lines, cadastral boundaries, degraded grazing lands) were considered to provide opportunities for locating the proposal in areas that have a lower vegetation integrity. These opportunities included: — the existing TransGrid X2 220kV transmission line running north west from the Buronga Substation towards Broken Hill — the existing Buronga 220kV substation — the Renmark-Wentworth Road towards the western extent of the corridor — various minor roads, tracks, fence lines and cadastral boundaries trending east/west through the corridor alignment — the existing TransGrid X5/3 220kV transmission line running south west from the Buronga Substation towards Red Cliffs. These existing features offered various opportunities for the co-location of transmission infrastructure (i.e. from the point where the existing TransGrid X2 220kV line crosses Low Darling Road near the suburb of Ellerslie) and offered some reduction in the extent of impacts arising from transmission line construction and operational maintenance.
(c) locating the project in areas that avoid habitat for species that have a high biodiversity risk weighting or native vegetation that is a critically endangered ecological community (CEEC) or an endangered ecological community (EEC)	The transmission line corridor was refined to avoid impacts on the critically endangered threatened flora species *Dodonaea stenozyga*. Targeted surveys for this species identified a population of 149 individuals growing on the southern side of Renmark Road. This occurrence represents the largest known population of this species within NSW. The locating of the transmission line corridor to the northern side of Renmark Road at this location avoids impacts to this high biodiversity risk species. The transmission line corridor was also refined to avoid and minimise impacts on a known population of the endangered threatened flora species *Austrostipa nullanulla*. A large population of *Austrostipa nullanulla* occurs on gypseous rises within Nulla Station and adjoining properties. Several of these occurrences within Nulla Station are protected under conservation agreements. The proposal disturbance area was positioned south of these areas to enable complete avoidance of all conservation areas. Further refinement based on detailed habitat assessment will enable further micro siting of transmission line towers and positioning access tracks to further avoid and minimise impacts on this species during the detailed design phase.

MEASURES TO AVOID AND MINIMISE IMPACT	PROPOSAL LOCATION
(d) locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained.	Given the length and linear nature of the proposal, is was not possible to locate the alignment in manner that would not intersect large patches of native vegetation or intersect riparian linkages associated with the Great Darling Anabranch, Darling River and Murray River riverine corridors. Due to the nature of the proposal being mostly aerial spans between transmission towers, ground disturbances are primarily limited to tower pads, break and winch sites and access tracks. The restricted nature of these works and retention large areas of native vegetation below two metres would ensure connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat to be maintained.
Proposal location considerations	
(a) an analysis of alternative modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology	The proposal is a fixed linear infrastructure asset that is being designed with the latest technologies and methods that would take into consideration further avoidance and minimisation of impacts on biodiversity values during the detailed design phase.
(b) an analysis of alternative routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route (c) an analysis of alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location (d) an analysis of alternative sites within a property on which the project is proposed that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site.	The corridor selection assessment methodology for the proposal considered a 'hierarchy of constraints' which were developed to inform the proposal study area and the transmission line corridor and allow for route narrowing and eventual selection of a detailed design alignment for the proposed transmission line. The overall methodology for the corridor selection process included consideration of a corridor that: — was selected to minimise environmental and social impacts and maximise the use of previously disturbed areas wherever possible, including: — avoiding areas of environmental sensitivity where obtaining planning approvals and access are were considered unlikely — maximising distances to dwellings, inhabited areas and other sensitive land uses — preferencing areas of existing disturbance (e.g. transmission line or utility easements, roads, tracks, fence lines and cadastral boundaries) and targeting narrow width crossing points of waterways and flood out areas (and their associated riparian habitats e.g. around the Darling River and Great Darling Anabranch) — enabled the use of current and available technology for transmission line construction — enabled the transmission line to be accessed and maintained safely — was broadly acceptable to landholders and key stakeholders, balancing the various environmental and social aspects with engineering requirements.

8.1.2 DESIGN

This section addresses section 8.1.2 of the BAM.

Table 8.2 Efforts to avoid and minimise direct impacts on native vegetation and habitat during proposal design

MEASURES TO AVOID AND MINIMISE IMPACT	PROPOSAL DESIGN
(a) reducing the clearing footprint of the proposal	Avoid/minimise clearing of vegetation and associated threatened flora or fauna habitats where possible, particularly in key habitat areas e.g. dense old growth Mallee, large tracts of Mallee, large old trees with hollows, riverine/wetland/salt lake features and active roost sites etc. This would be achieved through micro siting transmission line towers and positioning access tracks during the detailed design phase.
(b) locating ancillary facilities in areas where there are no biodiversity values	The placement of ancillary facilities including main construction compounds and accommodation camps where possible have utilised and would utilise category 1 – exempt lands.
(c) locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	The placement of ancillary facilities including main construction compounds and accommodation camps where possible have utilised low vegetation integrity score (less than 17) native vegetation patches such as derived condition vegetation zones.
(d) locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	The placement of ancillary facilities including main construction compounds and accommodation camps have avoided areas of high biodiversity value including threatened ecological communities (PCT 19 and PCT 21), vegetation with high densities of hollows (PCT 170 'bull' and PCT 171 'bull') and threatened flora populations.
(e) providing structures to enable species and genetic material to move across barriers or hostile gaps	Bird diverters would be installed on transmission lines within 1 km of wetland / riverine habitats to reduce impacts on threatened aerial species from collision and allow safe passage within these areas.
(f) making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	Mitigation measures for the proposal (refer to Chapter 11 Management and mitigation measures) provide a commitment to minimise or where possible avoid impacts to threatened flora and fauna species, and ecological communities during detailed design and during the micro siting of design elements.

8.2 AVOID AND MINIMISE PRESCRIBED BIODIVERSITY IMPACTS

8.2.1 LOCATION

In accordance with section 8.2.2 of the BAM, efforts to avoid and minimise prescribed biodiversity impacts have been addressed in Table 8.3 below.

Table 8.3 Efforts to avoid and minimise impacts on prescribed biodiversity during proposal planning and location

PRESCRIBED BIODIVERSITY IMPACTS	PROPOSAL PLANNING
Proposal location	
(a) locating the envelope of surface works to avoid direct impacts on the habitat features	The approach outlined in Section 8.1 has ensured that: — impacts to gypsum soils and *Austrostipa nullanulla* have been avoided and minimised — impacts to habitat connectivity and species movement have been avoided and minimised — impacts to water-related values have been avoided and minimised — impacts of vehicle strikes have been avoided and minimised.
(b) locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features, e.g. locating longwall panels away from geological features of significance or water dependent plant communities and their supporting aquifers	The approach outlined in Section 8.1 has ensured that: — impacts to gypsum soils and *Austrostipa nullanulla* have been avoided and minimised — impacts to habitat connectivity and species movement have been avoided and minimised — impacts to water-related values have been avoided and minimised — impacts of vehicle strikes have been avoided and minimised. Subsurface works are expected to be comparatively minor.
(c) locating the proposal to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or local movement pathways	The approach outlined in Section 8.1 has ensured that: — impacts to gypsum soils and *Austrostipa nullanulla* have been avoided and minimised — impacts to habitat connectivity and species movement have been avoided and minimised — impacts to water-related values have been avoided and minimised — impacts of vehicle strikes have been avoided and minimised. Connectivity would not be severed as a result of the proposal. It may be impacted to some degree for particularly aerial species however such impacts are not expected to be likely to be significant.

PRESCRIBED BIODIVERSITY IMPACTS	PROPOSAL PLANNING
(d) optimising proposal layout to minimise interactions with threatened species and ecological communities, e.g. designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies	The approach outlined in Section 8.1 has ensured that: — impacts to gypsum soils and *Austrostipa nullanulla* have been avoided and minimised — impacts to habitat connectivity and species movement have been avoided and minimised — impacts to water-related values have been avoided and minimised — impacts of vehicle strikes have been avoided and minimised.
(e) locating the proposal to avoid direct impacts on water bodies.	The approach outlined in Section 8.1 has ensured that: — impacts to water-related values have been avoided and minimised. No waterbodies will be directly impacted.
Proposal location considerations	
(a) an analysis of alternative modes or technologies that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed mode or technology	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(b) an analysis of alternative routes that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed route	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(c) an analysis of alternative locations that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed location	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(d) an analysis of alternative sites within a property on which the proposal is proposed that would avoid or minimise prescribed biodiversity impacts and justification for selecting the proposed site.	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.

8.2.2 DESIGN

Designing a proposal to avoid and minimise prescribed biodiversity impacts is addressed in this section in accordance with section 8.2.3 of the BAM. Efforts to avoid and minimise impacts to prescribed biodiversity through proposal design have been addressed in Table 8.4.

Table 8.4 Efforts to avoid and minimise impacts on prescribed biodiversity during proposal design

MEASURES TO AVOID AND MINIMISE IMPACT	PROPOSAL DESIGN
(a) engineering solutions, e.g. proven techniques to minimise fracturing of bedrock underlying features of geological significance, water dependent communities and their supporting aquifers, proven engineering solutions to restore connectivity and favoured movement pathways	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(b) design of proposal elements to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbines to dissuade perching and minimise the diameter of the rotor swept area, designing fencing to prevent animal entry to transport corridors	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(c) design of the proposal to maintain environmental processes critical to the formation and persistence of habitat features not associated with native vegetation	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(d) design of the proposal to maintain hydrological processes that sustain threatened species and TECs	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.
(e) design of the proposal to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	Refer to Section 8.1 and to the EIS. There are no alternatives to the proposal and the proposal has already been designed in the most sympathetic way possible.

9 ASSESSMENT OF CONSTRUCTION IMPACTS

9.1 ASSESSMENT OF DIRECT IMPACTS UNABLE TO BE AVOIDED

Assessment of direct impacts unable to be avoided has been carried out in accordance with Section 9.1 of the BAM.

In assessing construction impacts an indicative disturbance area (as defined in Table 9.1) has been used. It is also noted that for this report, the indicative disturbance area has the same meaning as 'development site' as defined in the BAM.

It should be noted that this approach is likely to be a worst-case scenario assessment given an indicative impacts approach based on a potentially larger footprint than could eventuate and that detailed design would prioritise avoidance and/or impact minimisation.

Table 9.1 Indicative disturbance area definition for biodiversity construction impact assessment purpose

TERM	DEFINITION
Indicative disturbance area	Refers to the area that would be directly impacted by both construction and operation of the proposal including all proposal infrastructure elements (including the proposed proposal disturbance area, substation site works and other ancillary works i.e. the permanent works footprint) as well as locations for currently proposed construction elements such as construction compounds, access tracks and site access points, laydown and staging areas, concrete batching plants, brake/winch sites, site offices and accommodation camps.
Disturbance area A	Refers to an area around transmission towers and between transmission towers, as well as main construction compounds, accommodation camps and substation works in which vegetation would be removed during construction and subject to ongoing maintenance during operation (i.e. removal to ground level) for operational and safety requirements (including bushfire). This zone is a subset to the indicative disturbance area.
Disturbance area B	Refers to an area between transmission towers in which trimming would only be required to meet the vegetation clearance heights, which would not require disturbance at ground level. However, where trees within this area would or have the potential to exceed vegetation clearance heights, these trees would be removed and may result in temporary ground disturbance. Vegetation clearance heights are set by TransGrid for operational and safety requirements, including bushfire risk management. This zone is a subset to the indicative disturbance area.

It should be noted that detailed design for the proposal has not been completed and as a result the indicative disturbance area is indicative only to enable assessment of the likely quantum and type of impacts of the proposal.

Figure 9.1 provides an illustration of the components of the indicative disturbance area. Figure 9.2 provides the indicative impact areas used for calculations within the indicative disturbance area.

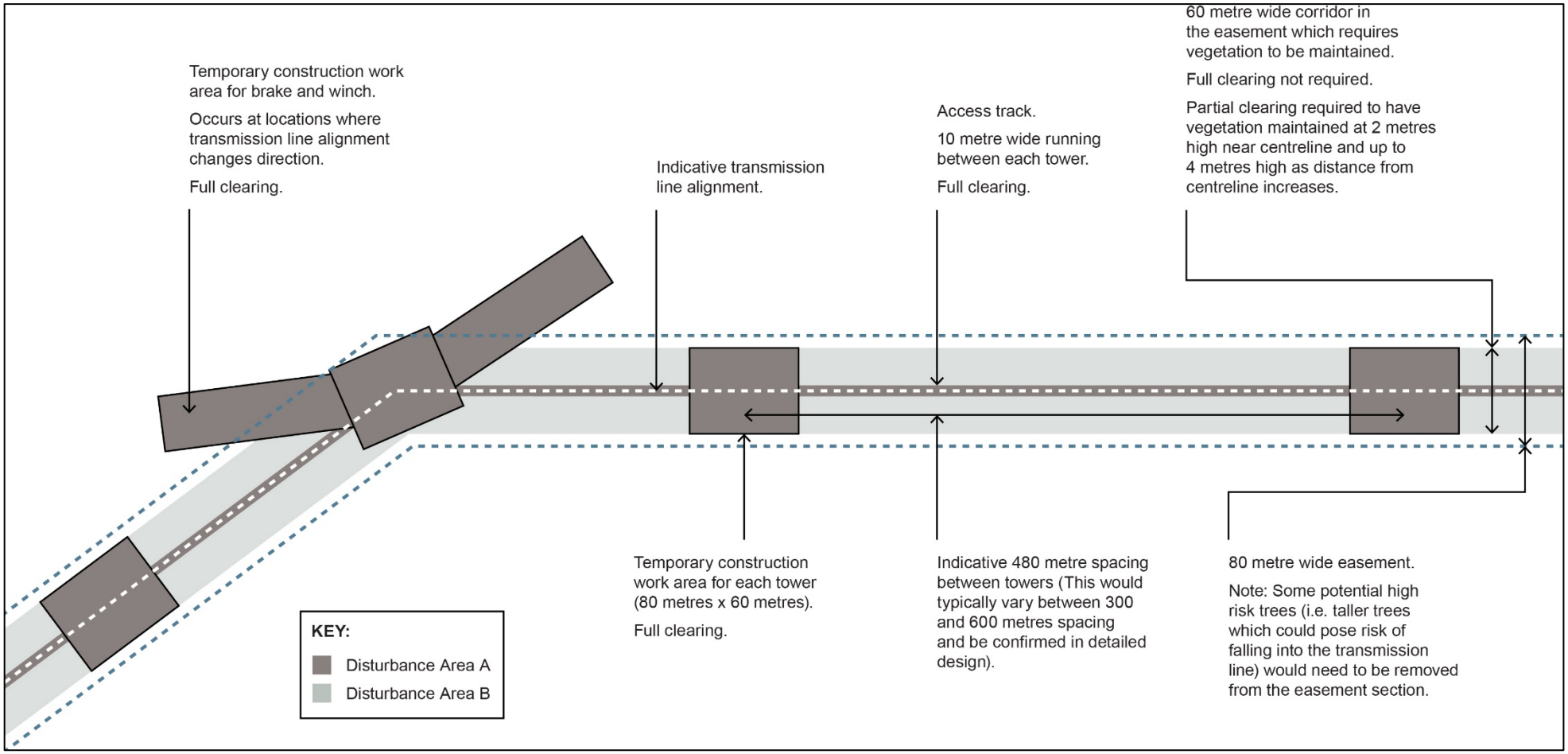

Figure 9.1 Illustration of the components of the indicative disturbance area

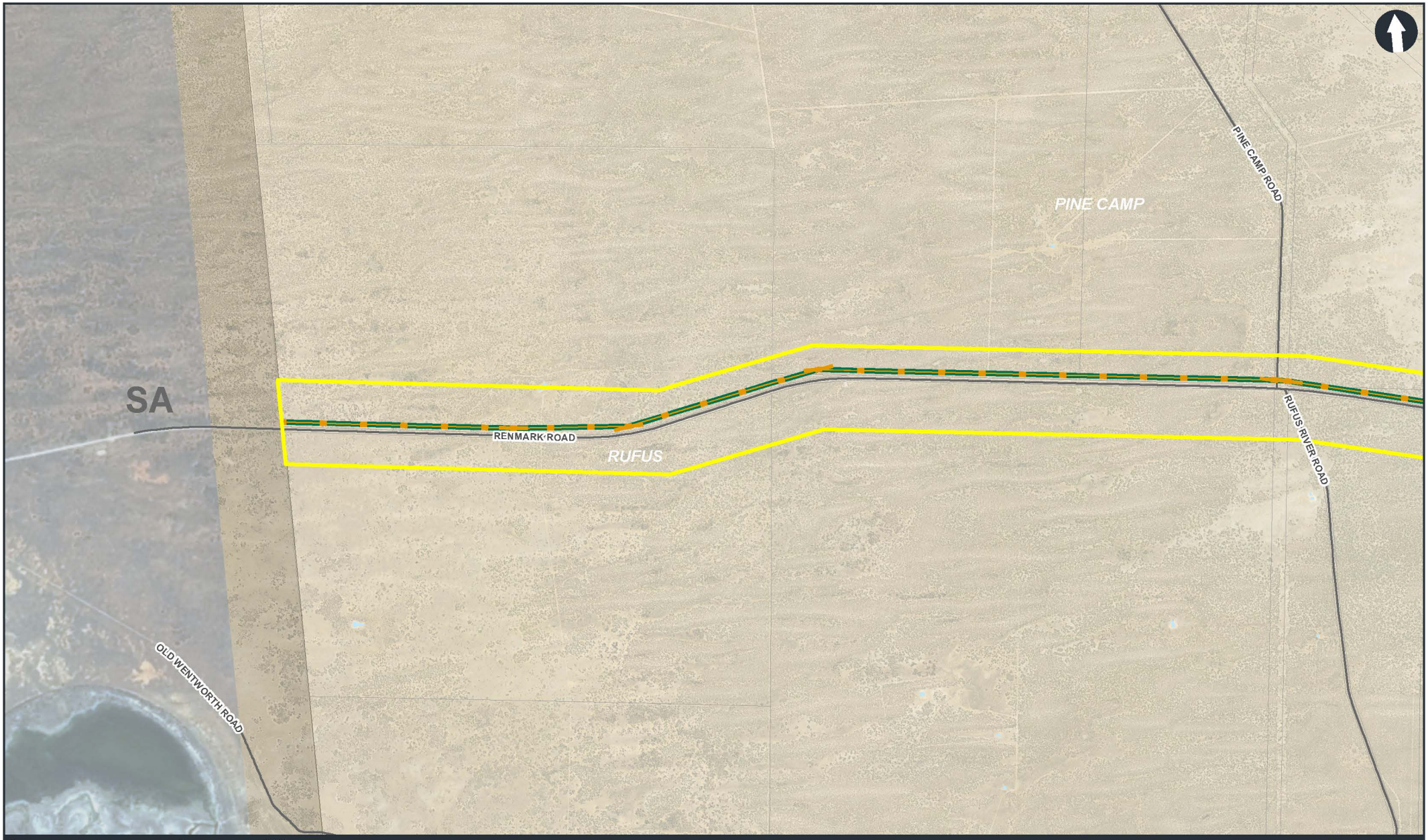

Figure 9.2a

Proposal disturbance area including construction and operational impacts

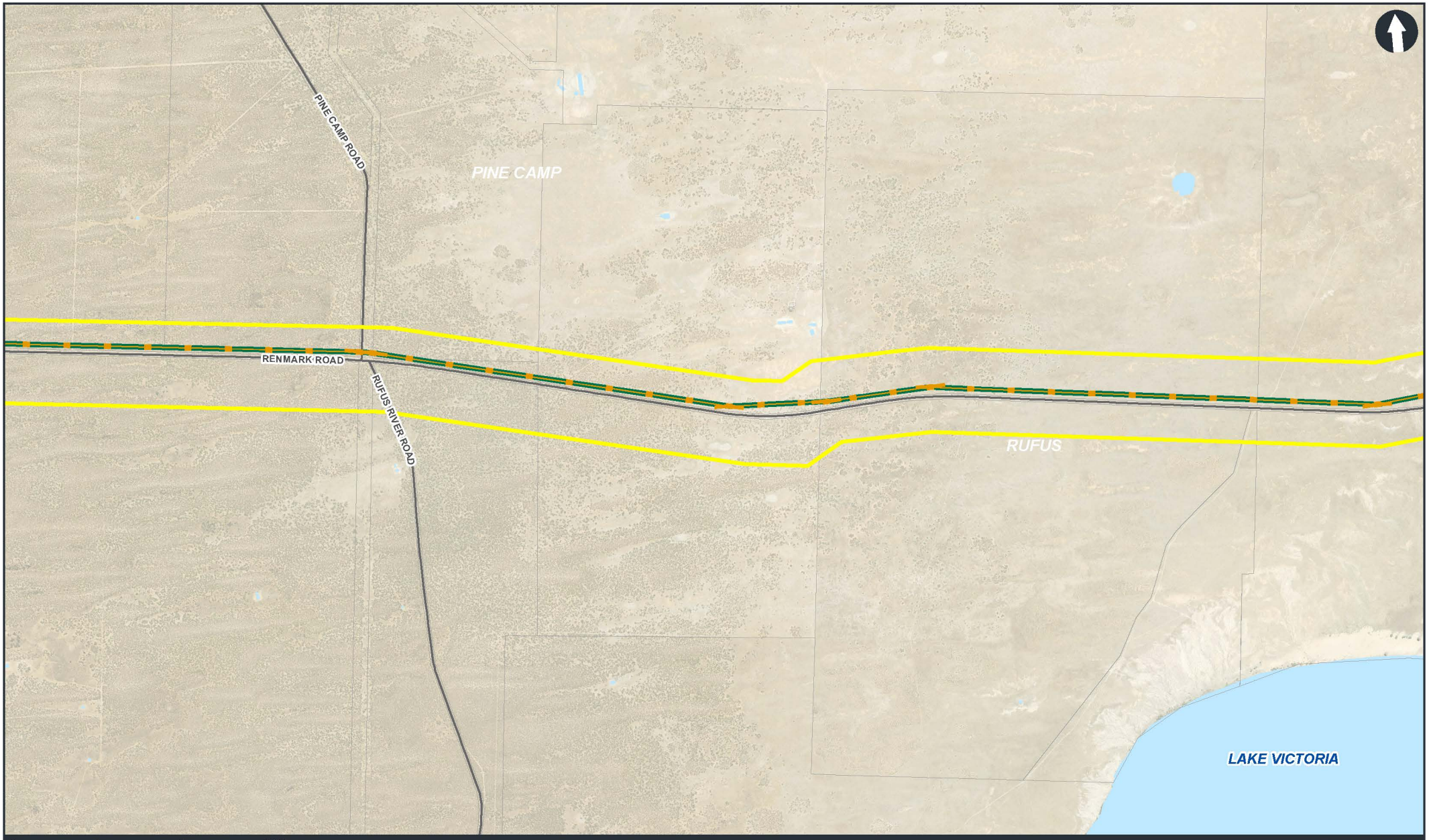

Figure 9.2b

Proposal disturbance area including construction and operational impacts

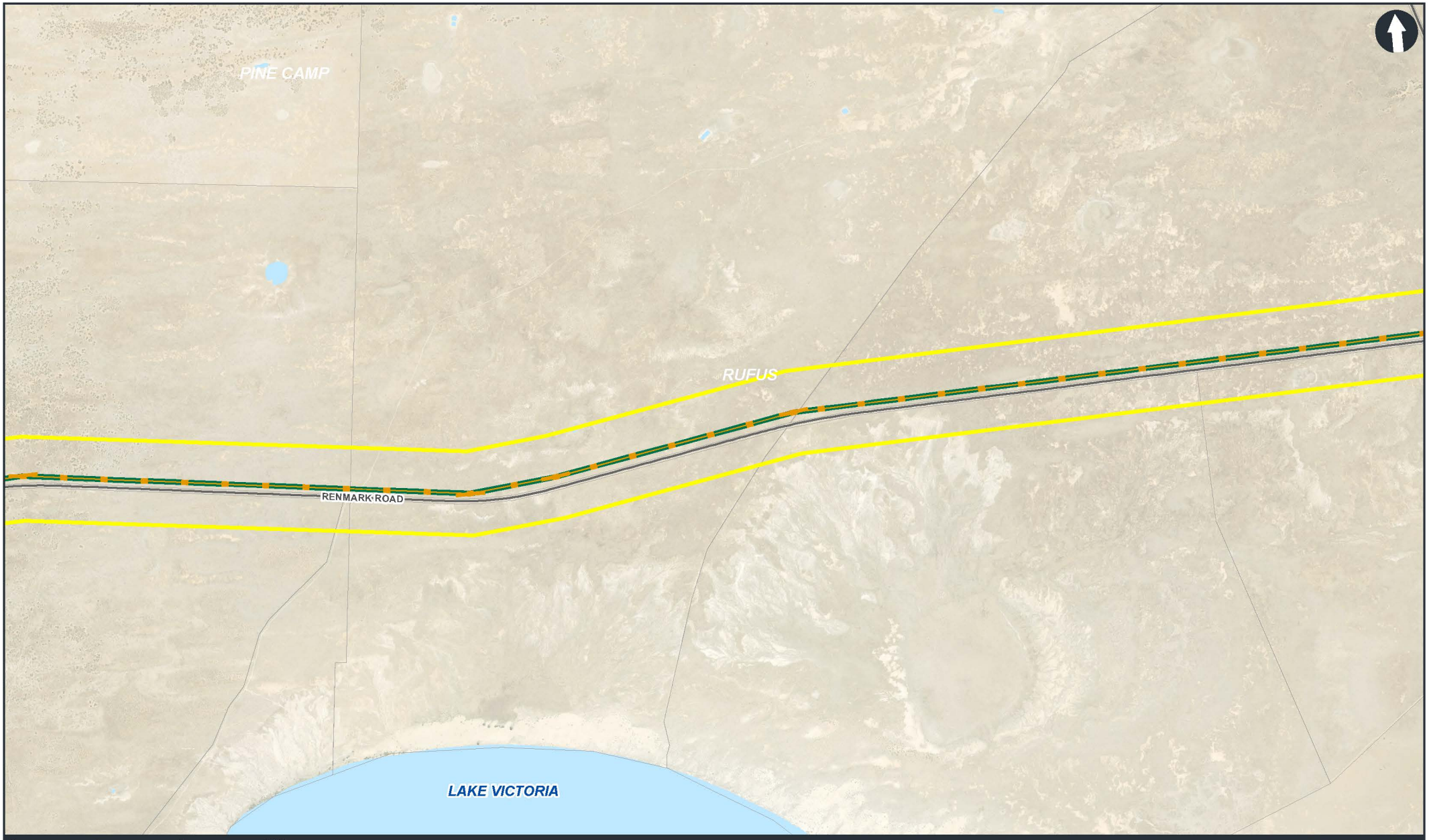

Figure 9.2c

Proposal disturbance area including construction and operational impacts

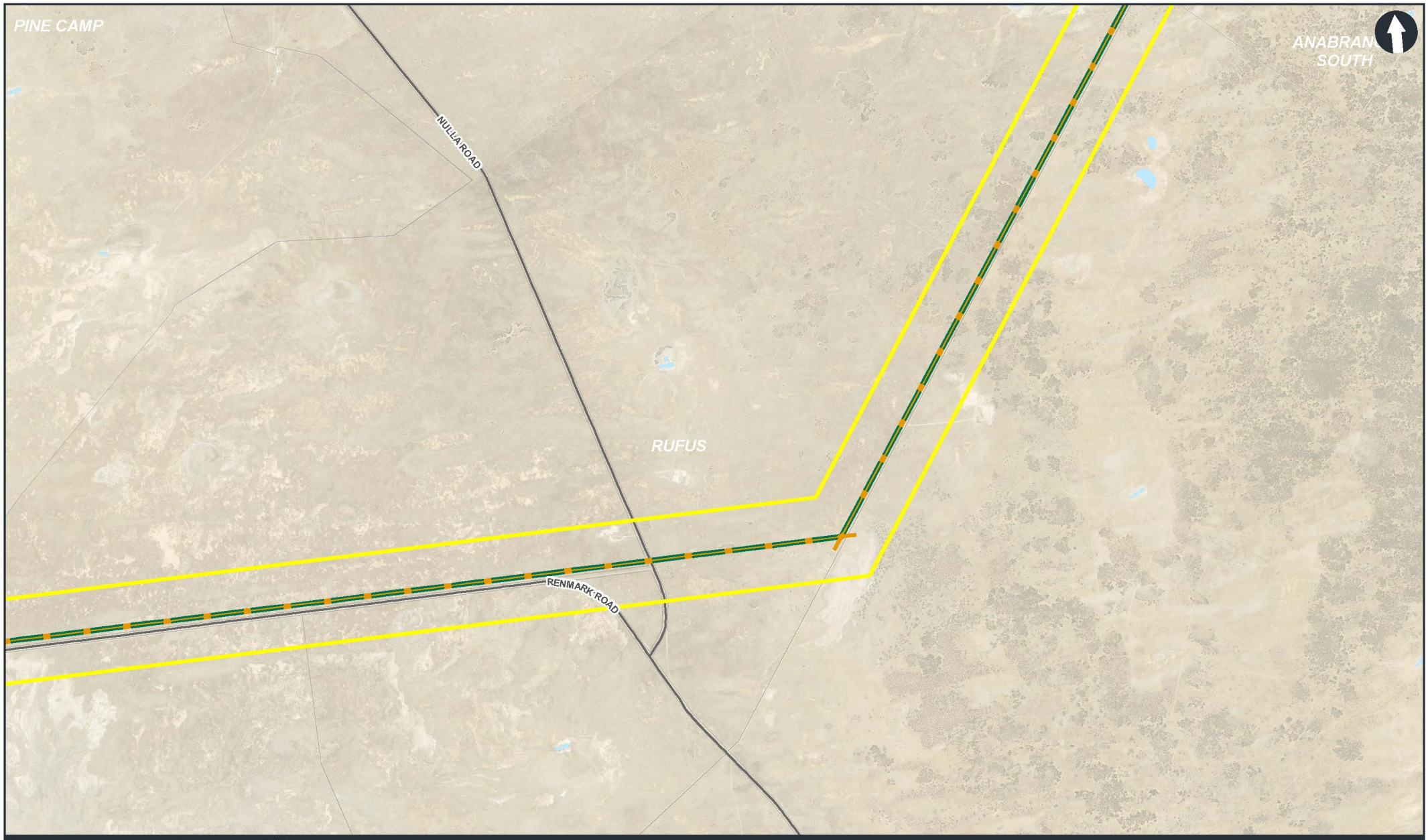

Figure 9.2d

Proposal disturbance area including construction and operational impacts

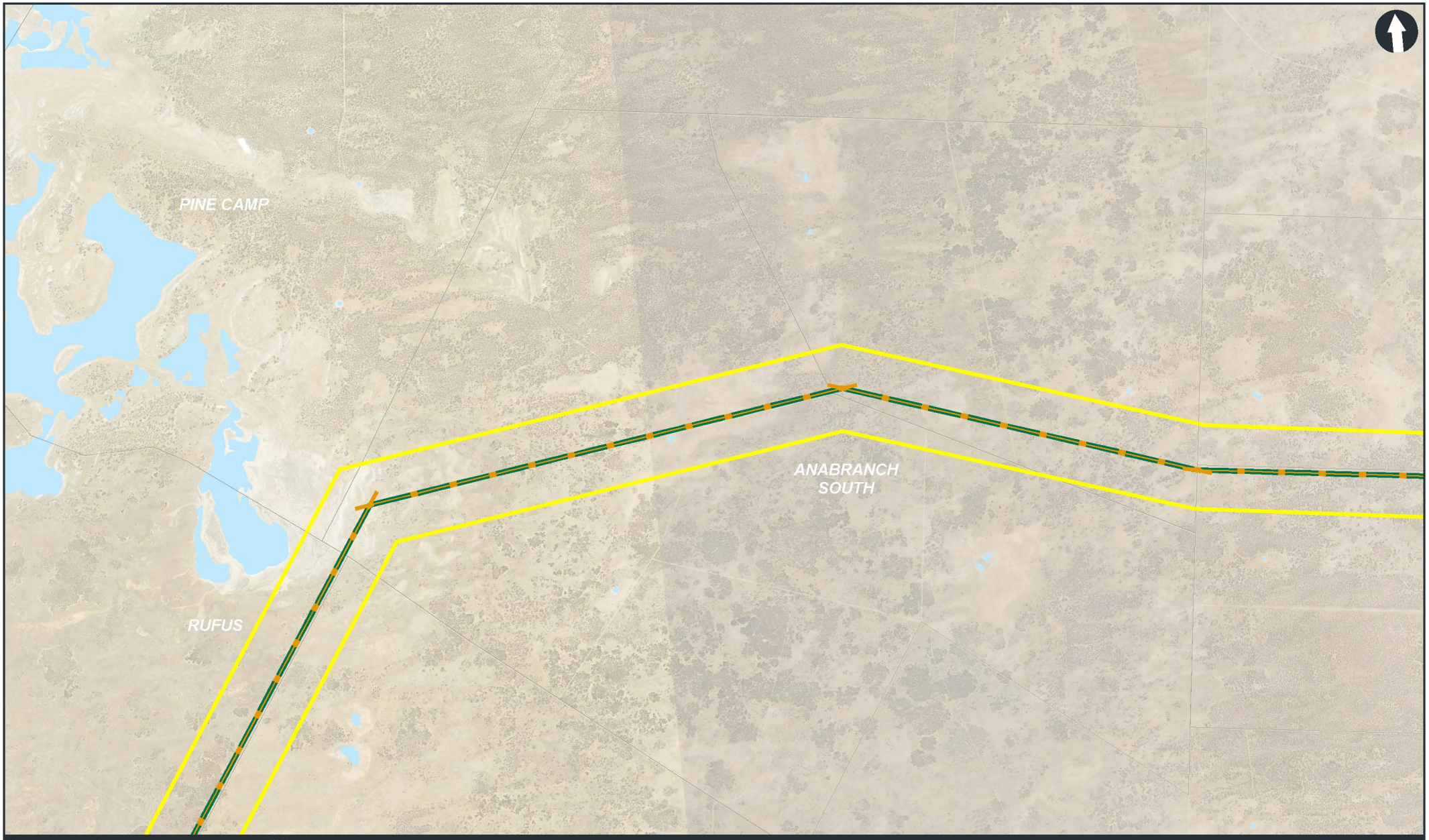

Figure 9.2e

Proposal disturbance area including construction and operational impacts

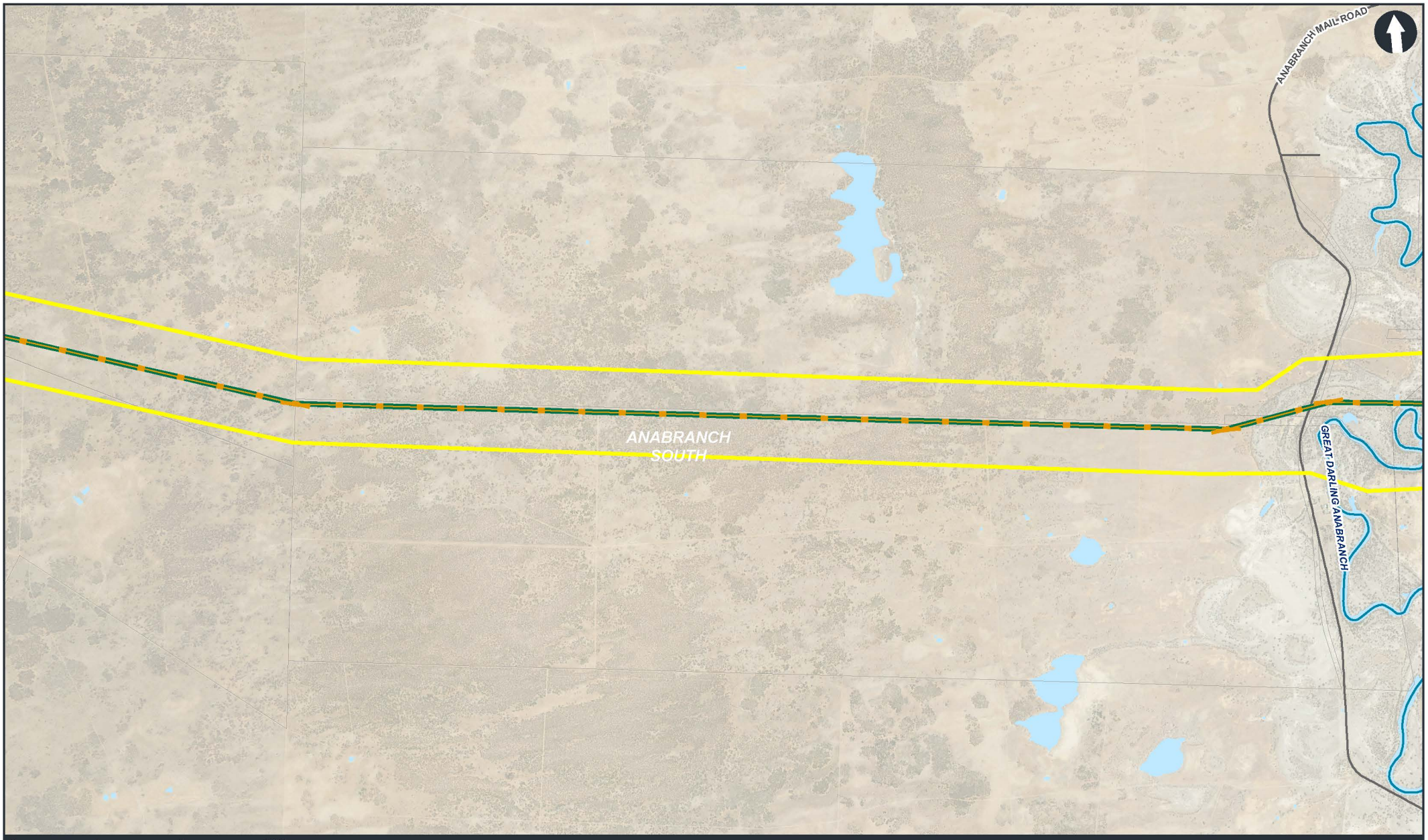

Figure 9.2f

Proposal disturbance area including construction and operational impacts

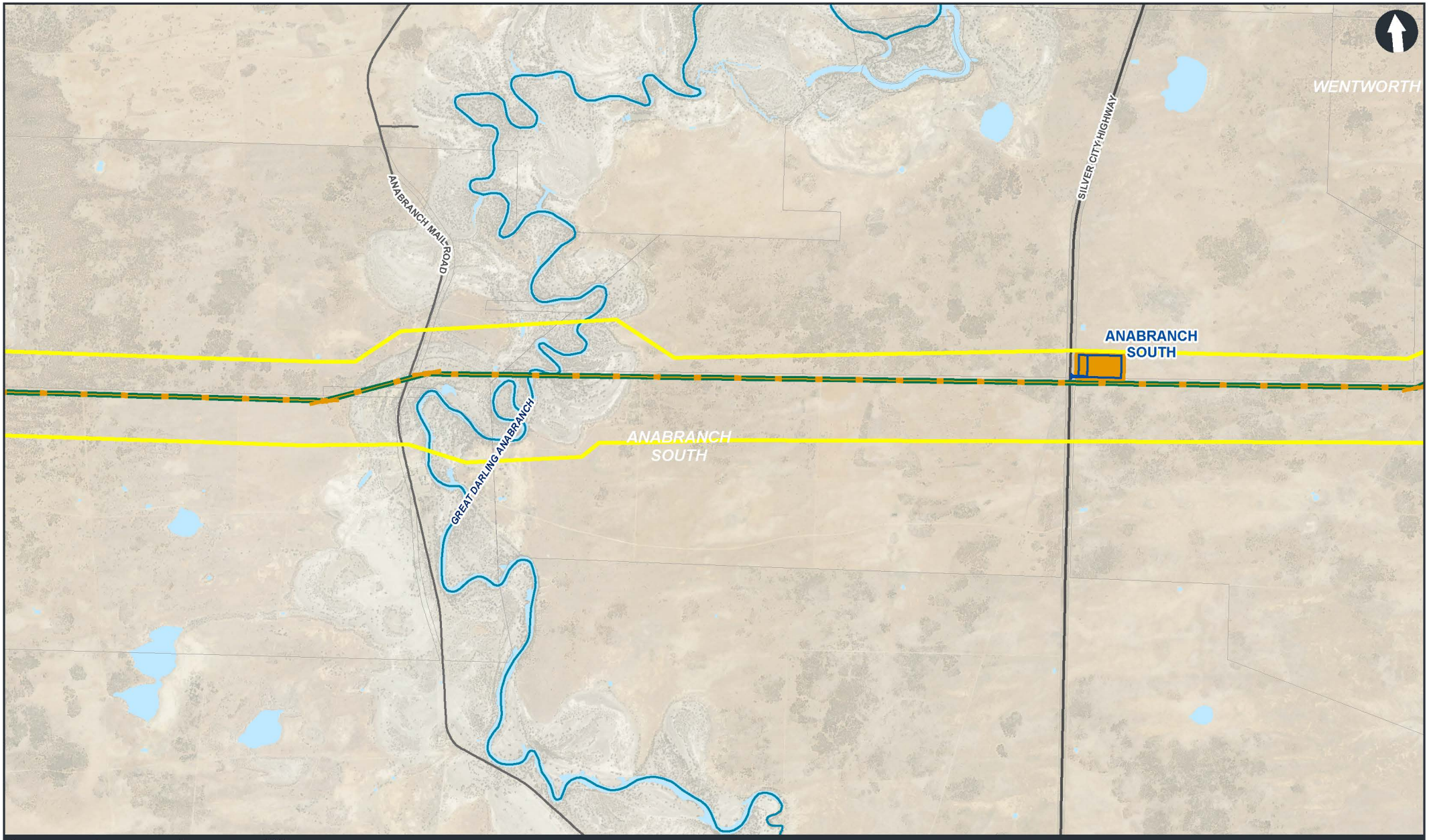

Figure 9.2g

Proposal disturbance area including construction and operational impacts

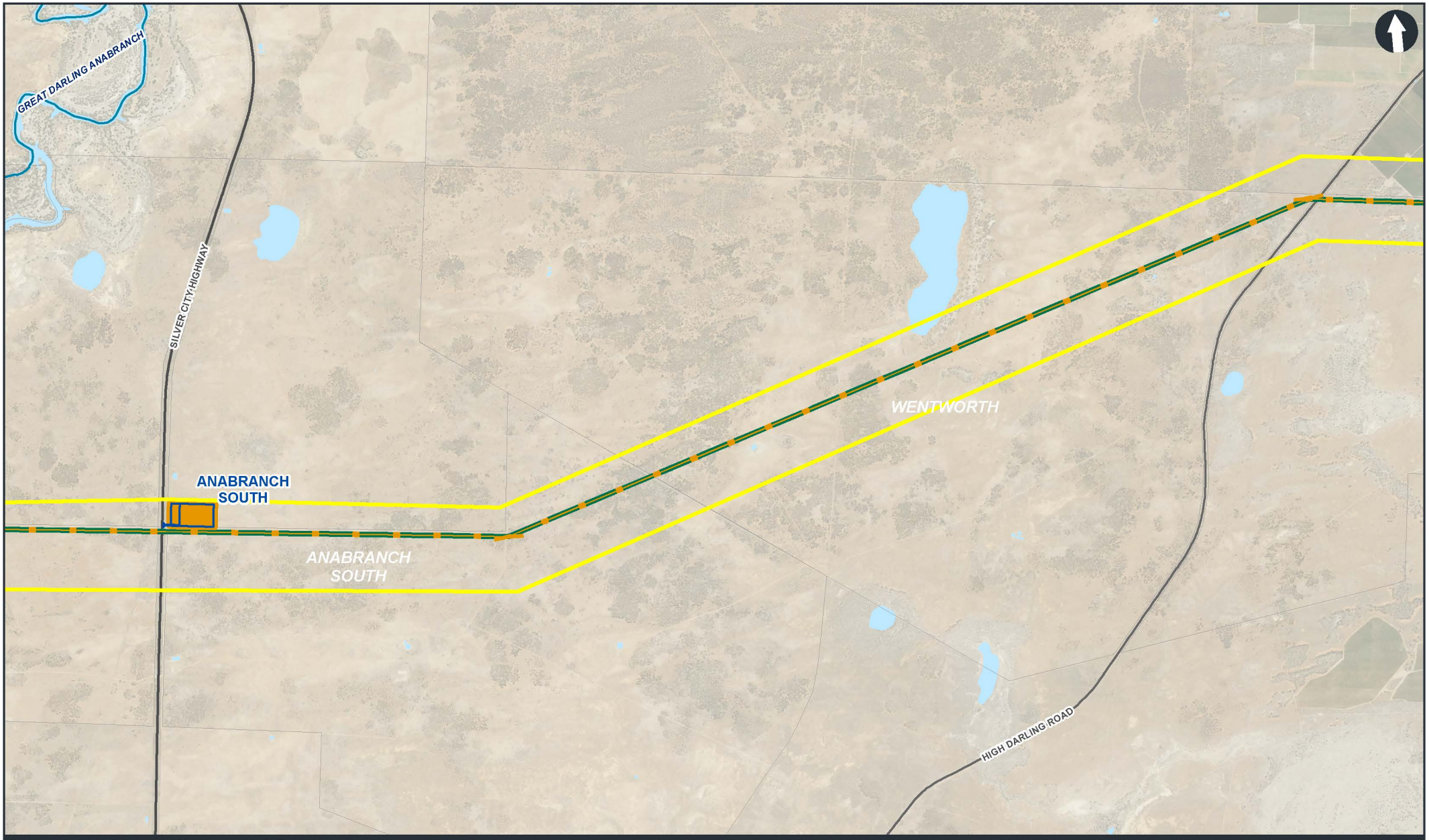

Figure 9.2h

Proposal disturbance area including construction and operational impacts

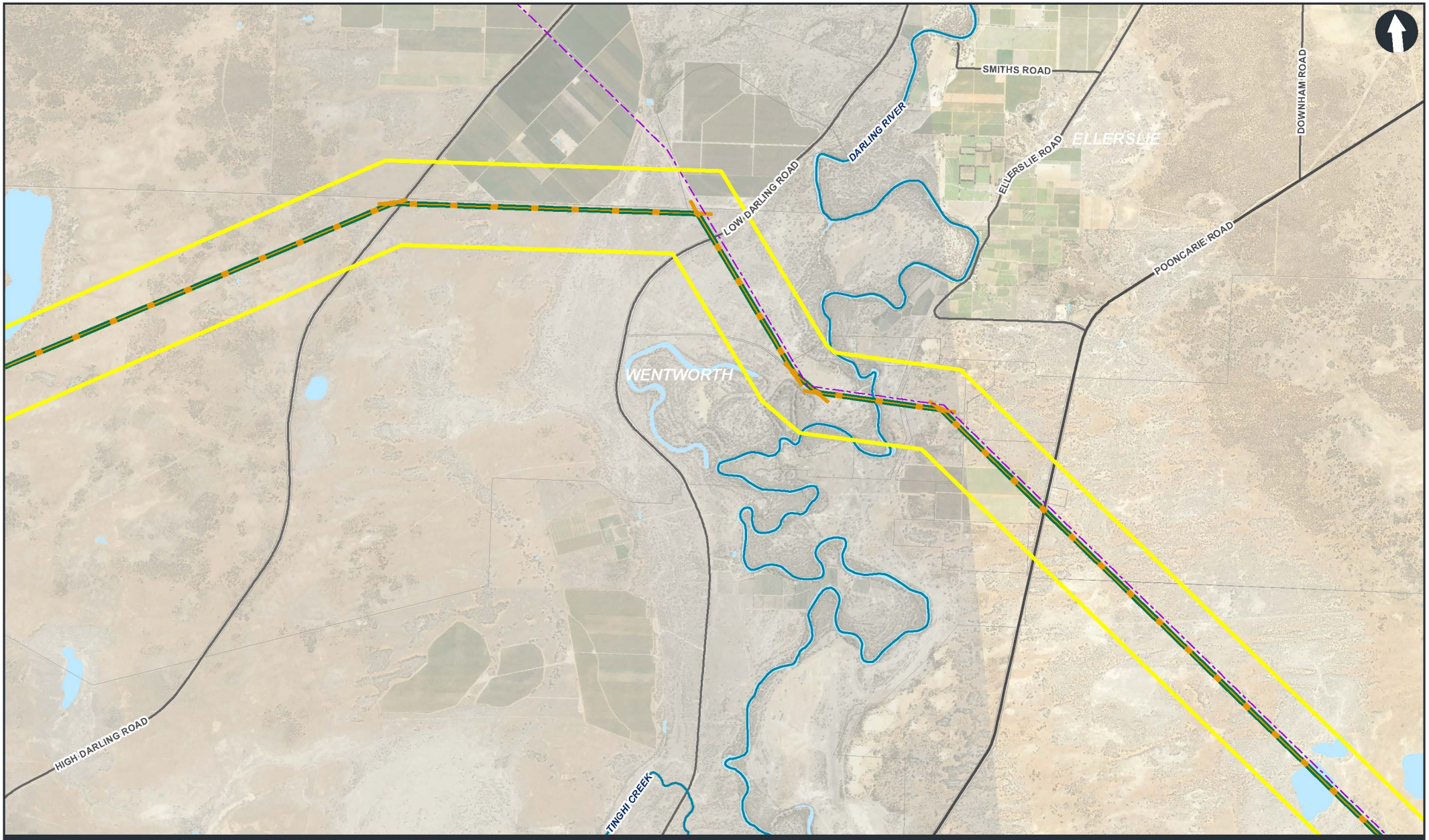

Figure 9.2i

Proposal disturbance area including construction and operational impacts

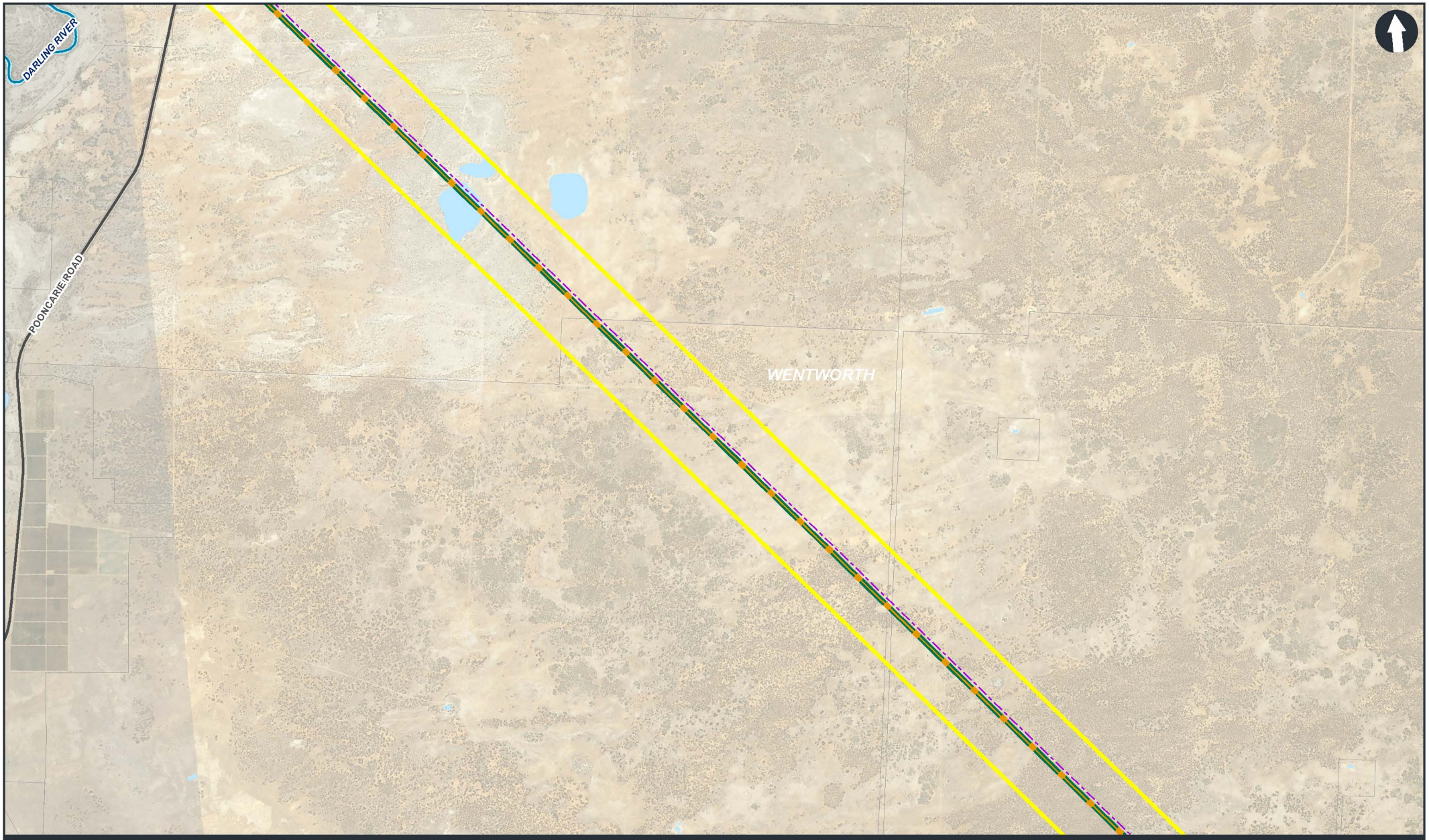

Figure 9.2j

Proposal disturbance area including construction and operational impacts

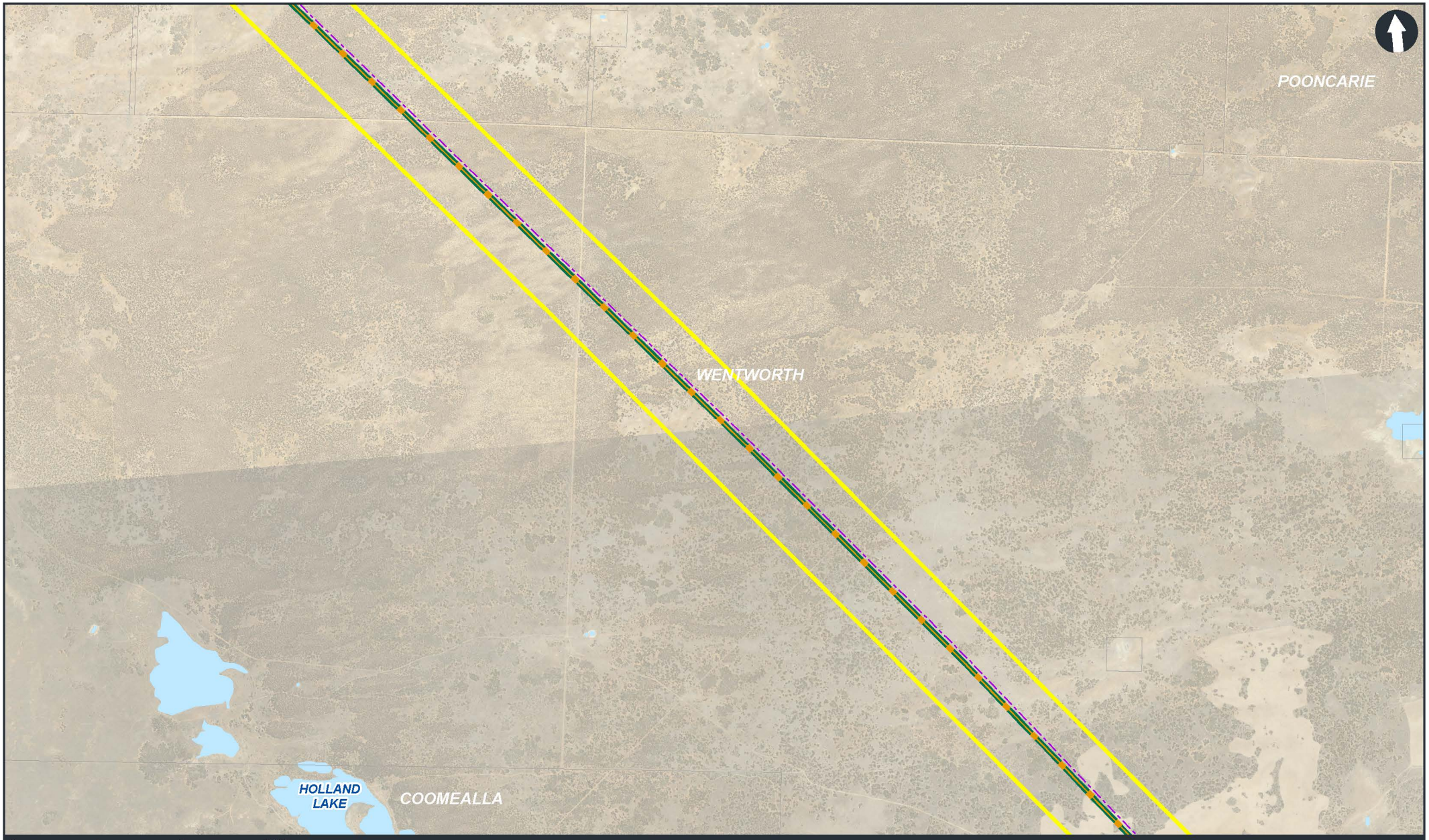

Figure 9.2k

Proposal disturbance area including construction and operational impacts

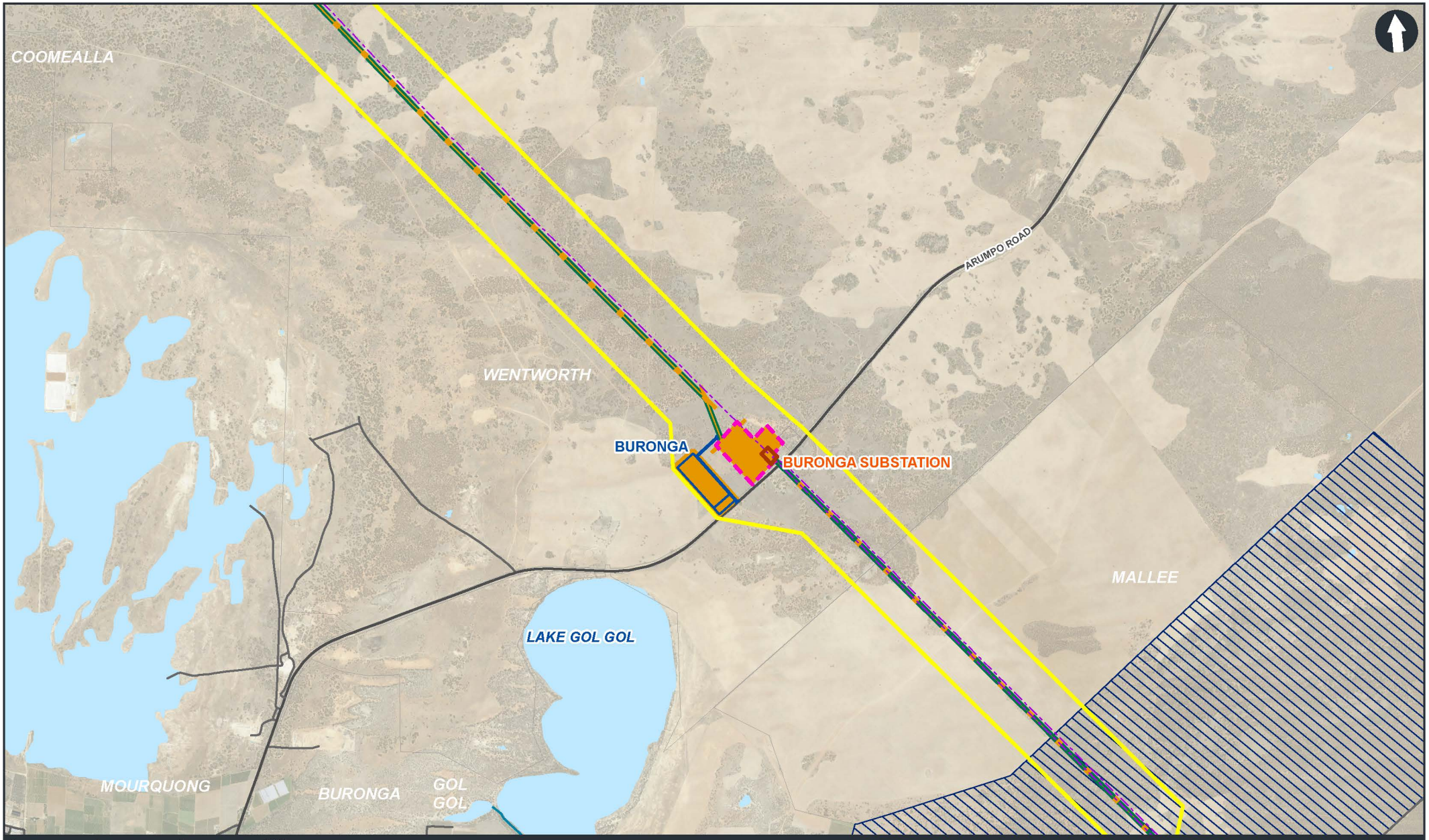

Figure 9.2l

Proposal disturbance area including construction and operational impacts

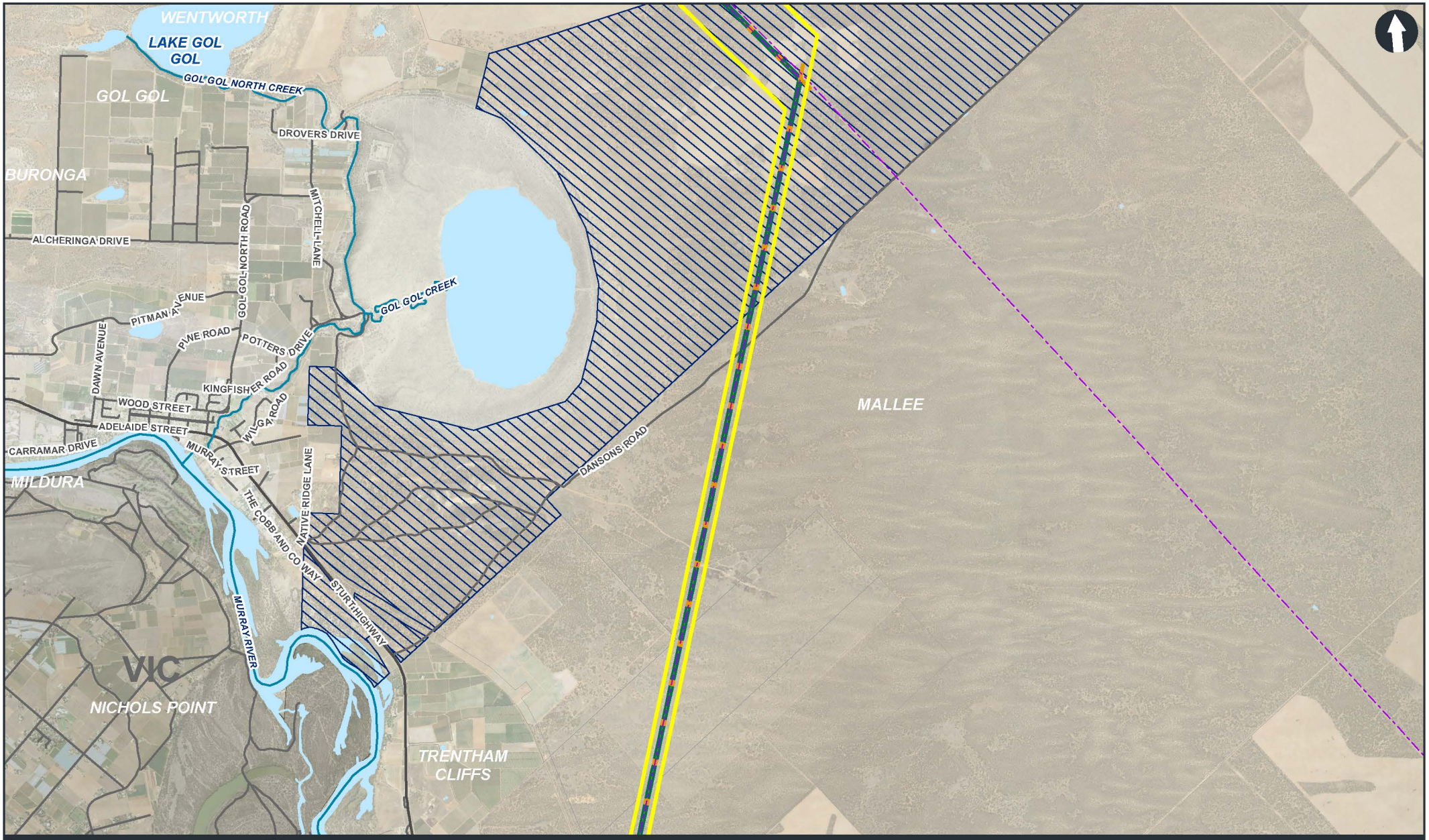

Figure 9.2m

Proposal disturbance area including construction and operational impacts

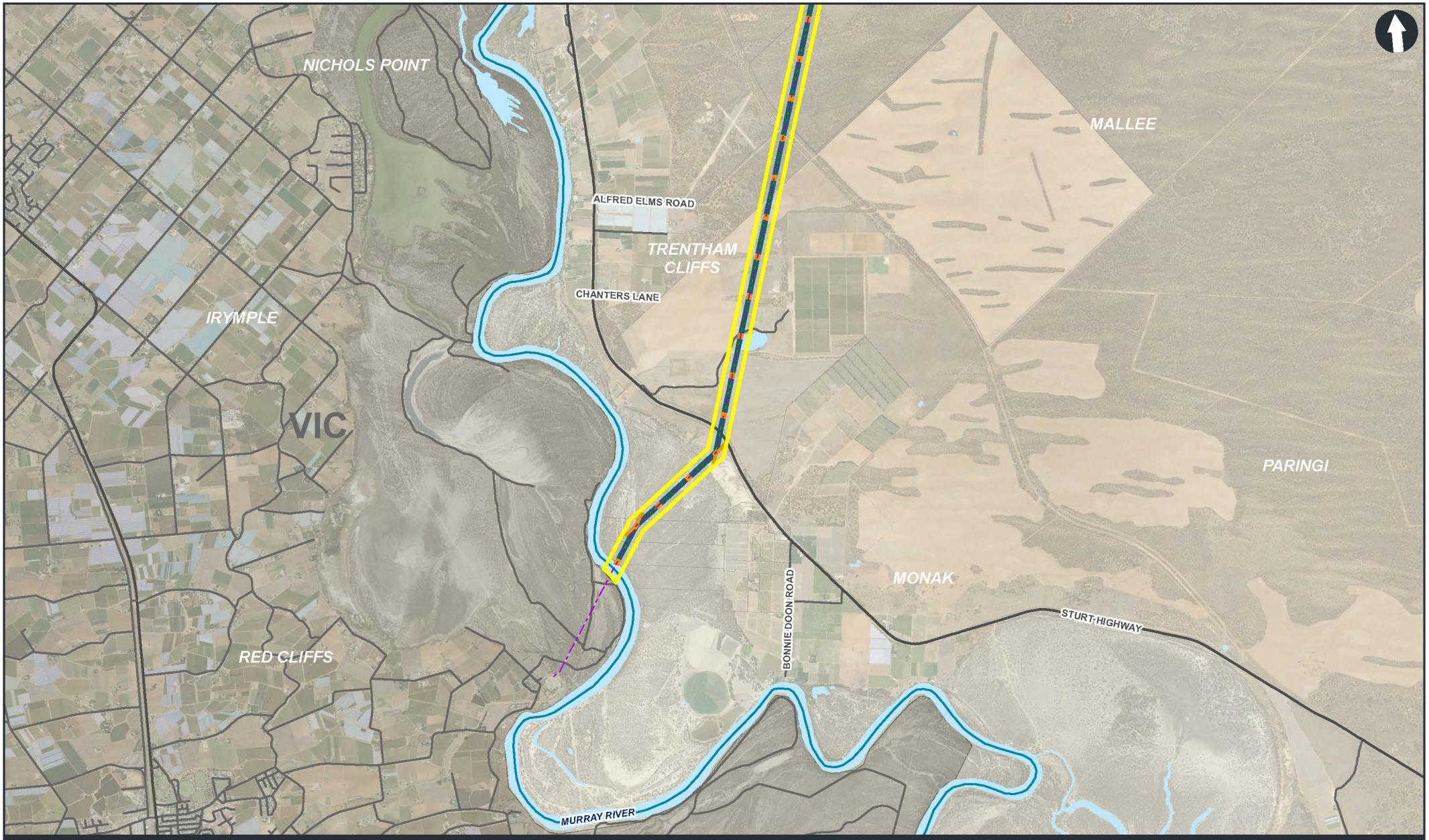

Figure 9.2n

Proposal disturbance area including construction and operational impacts

9.1.1 IMPACTS ON NATIVE VEGETATION

The direct impacts on native vegetation and change in vegetation integrity due to the proposal for each IBRA subregion are outlined in Table 9.2, Table 9.3, Table 9.4 and Table 9.5. Each IBRA subregion requires separate assessment in accordance with the BAM.

Table 9.2 Direct impacts on native vegetation and change in vegetation integrity within the South Olary Plain IBRA subregion due to the proposal

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Arid shrublands (Acacia sub-formation)					
PCT 143 – Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes	modified – disturbance area-A	91.9	-91.9	0	0.99
Arid Shrublands (Chenopod sub-formation)					
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	modified – disturbance area-A	54.8	-54.8	0	57.53
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	modified – disturbance area-A	72.1	-72.1	0	9.72
Saline Wetlands					
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains	modified 'boninka' – disturbance area-A	39.7	-39.7	0	2.84
	modified 'lunette' – disturbance area-A	32.6	-32.6	0	2.07
Semi-arid Woodlands (Grassy sub-formation)					
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	50.2	-50.2	0	1.15
	modified – disturbance area-B	50.2	-13.5	36.8	1.87

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Semi-arid Woodlands (Shrubby sub-formation)					
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area-A	56	-56	0	0.59
	modified – disturbance area-B	56	-16.6	39.4	0.32
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	modified – disturbance area-A	70.1	-70.1	0	6.18
	modified – disturbance area-B	70.1	-20.1	50	3.79
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	modified – disturbance area-A	60.2	-60.2	0	29.34
	modified – disturbance area-B	60.2	-28.69	31.6	59.62
	derived – disturbance area-A	1.3	-1.3	0	36.56
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	modified 'bull' – disturbance area-A	66.5	-66.5	0	9.85
	modified 'bull' – disturbance area-B	66.5	-27.4	39.1	18.17
	modified 'whipstick' – disturbance area-A	58.6	-58.6	0	45.43
	modified 'whipstick' – disturbance area-B	58.6	-20.7	37.9	87.56
	derived – disturbance area-A	2.6	-2.6	0	34.53

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	modified 'bull' – disturbance area-A	66.4	-66.4	0	1.82
	modified 'bull' – disturbance area-B	66.4	-24.1	42.3	4.53
	modified 'whipstick' – disturbance area-A	73.4	-73.4	0	16.64
	modified 'whipstick' – disturbance area-B	73.4	-28.1	45.3	32.48
PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone	modified 'whipstick' – disturbance area-A	61.9	-61.9	0	8.69
	modified 'whipstick' – disturbance area-B	61.9	-18.9	42.9	19.48
PCT 221 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	modified – disturbance area-A	62.6	-62.6	0	1.26
	modified – disturbance area-B	62.6	-12.7	53.5	2.11
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion	modified – disturbance area-A	28.3	-28.3	0	0.73
	modified – disturbance area-B	28.3	10.9	17.4	1.66
	derived – disturbance area-A	0.6	-0.6	0	5.32
Total direct impact on native vegetation					**502.83**

Table 9.3 Direct impacts on native vegetation and change in vegetation integrity within the Great Darling Anabranch IBRA subregion due to the proposal

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Saline Wetlands					
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	modified – disturbance area-A	74.8	-74.8	0	0.24
Semi-arid Woodlands (Grassy sub-formation)					
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	72	-72	0	7.16
	modified – disturbance area-B	72	-33.4	38.6	12.07
Semi-arid Woodlands (Shrubby sub-formation)					
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area-A	50.3	-50.3	0	0.47
	modified – disturbance area-B	50.3	-8.1	42.2	1.20
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	modified – disturbance area-A	67.4	-67.4	0	0.13
	modified – disturbance area-A	67.4	-12.1	55.3	0.59
	derived – disturbance area-B	0.7	-0.7	0	0.06
Total direct impact on native vegetation					**21.92**

Table 9.4 Direct impacts on native vegetation and change in vegetation integrity within the Pooncarie-Darling IBRA subregion due to the proposal

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Arid shrublands (Acacia sub-formation)					
PCT 139 – Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions	modified – disturbance area-A	73	-73	0	1.11
	modified – disturbance area-B	73	-50.3	22.8	0.94
Arid Shrublands (Chenopod sub-formation)					
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	modified – disturbance area-A	83.6	-83.6	0	5.20
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	modified – disturbance area-A	95.2	-95.2	0	0.15
Forested Wetland					
PCT 11 – 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)	modified – disturbance area-A	59.8	-59.8	0	1.05
	modified – disturbance area-B	59.8	-39.5	20.3	0.43
Saline Wetlands					
PCT 63 – Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	modified – disturbance area-A	38.9	-38.9	0	0.30
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	modified – disturbance area-A	60.3	-60.3	0	2.29

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Semi-arid Woodlands (Grassy sub-formation)					
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	74.7	-74.7	0	20.54
	modified – disturbance area-B	74.7	-27.1	47.7	40.55
Semi-arid Woodlands (Shrubby sub-formation)					
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	modified – disturbance area-A	66.5	-66.5	0	0.46
	modified – disturbance area-B	66.5	-10.6	56	0.68
Total direct impact on native vegetation					**73.70**

Table 9.5 Direct impacts on native vegetation and change in vegetation integrity within the Robinvale Plain IBRA subregion due to the proposal

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Arid Shrublands (Chenopod sub-formation)					
PCT216 – Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion	modified – disturbance area-A	70.1	-70.1	0	0.54
Forested Wetland					
PCT11 – 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)	modified – disturbance area-A	60.3	-60.3	0	0.10
	modified – disturbance area-B	60.3	-33.8	26.5	0.00
Freshwater Wetlands					
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	59.5	-59.5	0	0.04
Semi-arid Woodlands (Grassy sub-formation)					
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	74	-74	0	2.25
	modified – disturbance area-B	74	-29.8	44.2	4.56
	derived – disturbance area-A	18.6	-18.6	0	0.47

NATIVE VEGETATION (PCT)	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (HA)
Semi-arid Woodlands (Shrubby sub-formation)					
PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area-A	46.2	-46.2	0	0.18
	modified – disturbance area-B	46.2	-12	34.2	0.17
Total direct impact on native vegetation					**8.31**

Table 9.6 Total direct impact on native vegetation

NATIVE VEGETATION	SOP	GDA	PD	RP	DIRECT IMPACT (HA)
Total direct impact on native vegetation for each IBRA subregion	502.83	21.92	73.70	8.31	606.76
Total direct impact on native vegetation					**606.76**

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

9.1.2 IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES

Direct impacts on threatened ecological communities due to the proposal for each IBRA subregion is outlined in Table 9.7.

Table 9.7 Direct impacts on threatened ecological communities due to the proposal for each IBRA subregion

THREATENED ECOLOGICAL COMMUNITY	BC ACT[1]	SOP	GDA	PD	RP	DIRECT IMPACT (HA)
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	E	10.88	1.67	1.14	0.33	14.02
Total direct impact on threatened ecological communities						**14.02**

(1) E = endangered under the BC Act

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

9.1.3 IMPACTS ON THREATENED SPECIES AND/OR THEIR HABITAT

9.1.3.1 DIRECT IMPACTS ON PREDICTED ECOSYSTEM CREDIT SPECIES

Direct impacts on predicted ecosystem credit species due to the proposal for each IBRA subregion is outlined in Table 9.8.

Table 9.8 Direct impacts on predicted ecosystem credit species due to the proposal for each IBRA subregion

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Birds							
Anseranas semipalmata	Magpie Goose	V	PCT 13, 15	✓	✓	✓	✓
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Botaurus poiciloptilus	Australasian Bittern	E	PCT 11, 13 & 17	-	-	✓	✓
Certhionyx variegatus	Pied Honeyeater	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Cinclosoma castanotum	Chestnut Quail-thrush	V	PCT 170, 171 & 172	✓	-	-	-
Circus assimilis	Spotted Harrier	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Daphoenositta chrysoptera	Varied Sittella	V	PCT 11, 13, 15, 21, 58, 170, 171, 172, 221 & 252	✓	-	-	✓
Drymodes brunneopygia	Southern Scrub-robin	V	PCT 171	✓	-	-	-
Epthianura albifrons	White-fronted Chat	V	PCT 17, 63, 154, 166, 216 & 253	✓	✓	✓	✓
Falco hypoleucos	Grey Falcon	E	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Falco subniger	Black Falcon	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 153, 154, 166, 170, 171, 172, 216, 221, 252, 253	✓	✓	✓	✓
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	PCT 11, 170, 171 & 172	✓	-	-	✓
Grantiella picta	Painted Honeyeater	V	PCT 15, 21, 58 & 143	✓	-	-	-

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Grus rubicunda	Brolga	V	PCT 11, 13, 15, 17, 63 & 166	✓	✓	✓	✓
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	PCT 11, 13, 15, 17, 19, 21, 58, 139, 143, 166, 170, 171 & 216	✓	✓	✓	✓
Hamirostra melanosternon	Black-breasted Buzzard	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Hieraaetus morphnoides	Little Eagle	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Hylacola cautus	Shy Heathwren	V	PCT 170, 171 & 172	✓	-	-	-
Lathamus discolor	Swift Parrot	E	PCT 11	-	-	-	✓
Leipoa ocellata	Malleefowl	E	PCT 170, 171 & 172	✓	-	-	-
Lichenostomus cratitius	Purple-gaped Honeyeater	V	PCT 11, 13, 170, 171 & 172	✓	-	-	✓
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Lophoictinia isura	Square-tailed Kite	V	PCT 11, 13, 15, 21, 58, 221 & 252	✓	✓	✓	✓
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	PCT 15, 19, 21, 58, 139, 143, 170, 171, 172, 221 & 252	✓	✓	✓	✓
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	PCT 11	-	-	✓	✓
Neophema splendida	Scarlet-chested Parrot	V	PCT 170, 171 & 172	✓	-	-	-
Ninox connivens	Barking Owl	V	PCT 11, 13 & 15	✓	✓	✓	✓
Oxyura australis	Blue-billed Duck	V	PCT 17	-	-		✓
Pachycephala inornata	Gilbert's Whistler	V	PCT 11, 13, 17, 19, 21, 58, 170, 171 & 172	✓	✓	✓	✓
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	PCT 11, 13, 15, 58, 170 & 171	✓	✓	✓	✓
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	PCT 15, 19, 58 & 143	✓	-	-	-

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Pyrrholaemus brunneus	Redthroat	V	PCT 154	✓	-	✓	-
Rostratula australis	Australian Painted Snipe	E	PCT 11, 13 & 17	-	-	-	✓
Stagonopleura guttata	Diamond Firetail	V	PCT 11, 13, 19, 58 & 170	✓	-	-	✓
Stictonetta naevosa	Freckled Duck	V	PCT 11, 13 & 17	-	-	✓	✓
Mammals							
Antechinomys laniger	Kultarr	E	PCT 21, 58, 143, 154, 170, 171, 221 & 252	✓	-	-	-
Cercartetus concinnus	Western Pygmy Possum	E	PCT 58, 170, 171, 172 & 221	✓	-	-	-
Chalinolobus picatus	Little Pied Bat	V	PCT 11, 13, 15, 17, 19, 21, 58, 63, 139, 143, 154, 166, 170, 171, 172, 216, 221, 252 & 253	✓	✓	✓	✓
Ningaui yvonneae	Southern Ningaui	V	PCT 170, 171 & 172	✓	-	-	-
Nyctophilus corbeni	Corben's Long-eared Bat	V	PCT 21, 58, 139, 170, 171, 172 & 221	✓	✓	✓	✓
Pseudomys bolami	Bolam's Mouse	E	PCT 21, 58, 170, 171, 172 & 221	✓	-	-	-
Pseudomys hermannsburgensis	Sandy Inland Mouse	V	PCT 58, 143, 154 & 171	✓	-	-	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	PCT 11, 13, 15, 17, 19, 21, 58, 139, 143 & 170	✓	✓	✓	✓
Sminthopsis macroura	Stripe-faced Dunnart	V	PCT 58, 143, 154, 171, 172 & 221	✓	-	-	-
Vespadelus baverstocki	Inland Forest Bat	V	PCT 13, 15, 21, 58, 143, 170, 171, 172 & 221	✓	-	✓	✓
Reptiles							
Aprasia inaurita	Mallee Worm-lizard	E	PCT 170, 171 & 172	✓	-	-	-
Ctenotus brooksi	Wedgesnout Ctenotus	V	PCT 143, 171 & 172	✓	-	-	-
Cyclodomorphus melanops elongatus	Mallee Slender Blue-tongue Lizard	V	PCT 171 & PCT 172	✓	-	-	-
Delma australis	Marble-faced Delma	E	PCT 170, 171 & 172	✓	-	-	-
Echiopsis curta	Bardick	E	PCT 171 & 172	✓	-	-	-

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	NATIVE VEGETATION (PCT)	IBRA SUBREGIONS			
				SOP	GDA	PD	RP
Lerista xanthura	Yellow-tailed Plain Slider	V	PCT 58, 139, 143, 170, 171, 221 & 252	✓	✓	✓	-
Pseudonaja modesta	Ringed Brown Snake	E	PCT 58, 143, 170, 171 & 172	✓	-	-	-
Ramphotyphlops endoterus	Interior Blind Snake	E	PCT 143 & 154	✓	-	-	-
Strophurus elderi	Jewelled Gecko	V	PCT 170, 171 & 172	✓	-	-	-
Tiliqua occipitalis	Western Blue-tongued Lizard	V	PCT 21, 154, 170, 171 & 172	✓	-	-	-

(1) V = vulnerable, E = endangered, CE = critically Endangered under the BC Act

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

9.1.3.2 DIRECT IMPACTS ON THREATENED SPECIES CREDIT SPECIES

The direct impacts on species credit species due to the proposal are restricted to the South Olary Plain and Robinvale Plain IBRA subregions. These impacts are summaries in in Table 9.9 and Table 9.10.

Table 9.9 Direct impacts on threatened species credit species within the South Olary Plain IBRA subregion due to the proposal

SPECIES NAME	COMMON NAME	BC ACT[1]	ASSOCIATED NATIVE VEGETATION (PCT) AND ZONES	DIRECT IMPACT (AREA / INDIVIDUALS)
Threatened flora species				
Acacia acanthoclada	Harrow Wattle	E	PCT 171 – modified 'whipstick' disturbance area-A	0.01 ha
Austrostipa nullanulla	A spear-grass	E	PCT 253 – modified 'boninka' disturbance area-A	0.11 ha
			PCT 253 – modified 'lunette' disturbance area-A	2.07 ha
Santalum murrayanum	Bitter Quandong	E	PCT 170 – modified 'whipstick' disturbance area-A	6 individuals
			PCT 170 – modified 'whipstick' disturbance area-B	8 individuals
			PCT 171 – modified 'whipstick' disturbance area-B	4 individuals

Table 9.10 Direct impacts on threatened species credit species within the Robinvale Plain IBRA subregion due to the proposal

SPECIES NAME	COMMON NAME	BC ACT[1]	ASSOCIATED NATIVE VEGETATION (PCT) AND ZONES	DIRECT IMPACT (AREA / INDIVIDUALS)
Threatened flora species				
Atriplex infrequens	A saltbush	V	PCT 13 – modified disturbance area-A	0.18 ha
			PCT 13 – derived disturbance area-A	0.04 ha
			PCT 17 – modified disturbance area-A	0.04 ha
Threatened fauna species				
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	PCT 11 – modified disturbance area-A	0.10 ha
			PCT 13 – modified disturbance area-A	2.25 ha
			PCT 13 – modified disturbance area-B	4.56 ha

9.2 ASSESSMENT OF INDIRECT IMPACTS UNABLE TO BE AVOIDED

The assessment of indirect impacts has been prepared in accordance with section 9.1.4 of the BAM. Indirect impacts have been considered in terms of the nature, extent and duration of impacts on native vegetation, threatened ecological communities and threatened species habitats likely to be affected. The assessment of indirect impacts is presented in Table 9.11.

Table 9.11 Assessment of indirect impacts

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE (I.E. IMPACTED ENTITIES)	EXTENT	DURATION	CONSEQUENCE
Inadvertent impacts on adjacent habitat or vegetation	Construction	All PCTs Threatened species Threatened ecological communities Aquatic habitat	All PCT Aquatic habitats associated with creeks and rivers	Short term	**Low.** Inadvertent impacts on adjacent vegetation can include a range of indirect impacts including soil disturbance, erosion, sedimentation, enriched run-off and water quality. Construction of the proposal has the potential to result in sedimentation and erosion and mobilisation of contaminants within the indicative disturbance area and into adjoining native vegetation and aquatic habitats, through soil disturbance and construction activities. Sediment laden runoff and spills affect water quality and adversely affect aquatic life particularly during construction near rivers, creeklines and Key Fish Habitats. These impacts have the potential to reduce the viability of habitat for aquatic and semi aquatic species temporarily. The proposal has been carefully designed to minimise impact to these sensitive environmental receivers through targeting narrow width crossing points of waterways and flood out areas (and their associated riparian habitats e.g. around the Great Darling Anabranch, Darling River and Murray River). The mobilisation of sediments would be contained within the indicative disturbance area as sediment containment measures would be implemented as part of mitigation measures.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE (I.E. IMPACTED ENTITIES)	EXTENT	DURATION	CONSEQUENCE
Reduced viability of adjacent habitat due to edge effects	Construction / operational	Native vegetation	All PCTs	Long term	**Negligible.** Where possible works are to occur within existing easements and infrastructure such that fragmentation would be minimised. In addition, indirect impacts on native vegetation and adjacent habitats are considered unlikely due to shrub and ground stratum native vegetation retention to a height of 2 m in areas buffering direct permanent loss. These areas form part of the indicative disturbance area and are required to ensure safe clearance distances are achieved from the conductors. Retained native vegetation within these areas would provide a buffer to permanent impact areas such as transmission towers and access tracks.. Impacts from the main construction compound and accommodation camp sites, and substation works would be comparatively minor at a local and regional scale.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE (I.E. IMPACTED ENTITIES)	EXTENT	DURATION	CONSEQUENCE
Reduced viability of adjacent habitat due to noise, dust or light spill	Construction / operational	Native vegetation Threatened species Threatened ecological communities	All PCTs	Short term	**Negligible.** During construction increased levels of noise and dust are likely however these will be short term and mostly associated with vehicle movements, vegetation clearing, access track and transmission tower construction, break and winch sites and substation construction. A short term increase in construction noise will be mostly limited to daylight hours and is unlikely to have long term adverse effects on the viability of adjacent habitats as they would be short-term in nature only. In terms of increased dust, construction impacts associated with permanent vegetation clearing is limited to disturbance area-A. This clearing area would mostly be buffered by disturbance area-B where partial clearing is limited to vegetation above 2 min height. Disturbance area-B would have limited dust generation post construction. Increased vehicle movements would have a short-term increase in localised dust levels although given the ongoing agricultural landscape usage, current dust levels are unlikely to substantial increase to an extent that would adversely reduce the viability of adjacent habitats. Beyond the easement (such as for construction compounds and substation works) dust impacts are likely to also be limited and short term in nature. The proposal is unlikely to generate light spill to an extent that would adversely reduce the viability of adjacent habitats as lighting within the proposal would be minimal. Operational impacts would be mostly limited to vehicle movements for maintenance activities. These activities would be periodic and of an extent and duration that is unlikely to reduced viability of adjacent habitat due to noise, dust or light spill. Any residual negligible impact such as short-term impact aspects is considered likely to be adequately managed with mitigation measures.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE (I.E. IMPACTED ENTITIES)	EXTENT	DURATION	CONSEQUENCE
Transport of weeds and pathogens from the site to adjacent vegetation	Construction / operational	Native vegetation Threatened flora species Threatened ecological communities	All PCTs	Long term	**Negligible.** Whilst this type of indirect impact has the potential to lead to a reduction of native vegetation integrity in surrounding habitats, mitigation measure would be implemented to ensure biosecurity is managed during construction. During operational phase, all maintenance and associated works would be subject to TransGrid biosecurity protocols.
Increased risk of starvation, exposure and loss of shade or shelter	Construction	All fauna species	All PCTs	Short term	**Negligible.** Displacement of resident fauna species during native vegetation clearing is considered relatively low due to the modified vegetation structure resulting from long term agricultural stock grazing. Given the linear nature of the proposal and mostly highly mobile nature of most potential resident fauna species the increased risk of starvation, exposure and loss of shade or shelter due to the proposal is considered low.
Loss of breeding habitats	Construction	All fauna species	All PCTs	Long term	**Moderate.** The loss of breeding habitat such as hollow-bearing trees, old growth bull mallee lignotubers, *Triodia* grass clumps and fallen timber has the potential to affect native animals such as: — hollow-dependent bats — hollow-nesting and canopy-nesting birds — arboreal mammals — reptiles. The loss of breeding habitats is unlikely to extend beyond the indicative disturbance area. Impacts beyond this area would be avoided through mitigation and management measures.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE (I.E. IMPACTED ENTITIES)	EXTENT	DURATION	CONSEQUENCE
Trampling of threatened flora species	Construction / operation	*Austrostipa nullanulla* associated with PCT 253 – modified 'lunette' *Atriplex infrequens* associated with PCT 17 *Leptorhynchos watzia* associated with PCT 63	PCT 253 – modified 'lunette', PCT 17 and PCT 63	Short term	**Low.** Reduction in population extent and available habitat of threatened flora species that occur in the ground stratum could occur due to trampling or unauthorised material, storage, vehicle and plant equipment. All populations and associated habitat for threatened flora species will be available in GIS files for all contractors and would be designated no-go areas during construction. Mitigation measures would include protection for these areas and inadvertent impacts such as trampling is considered unlikely. During operational phase any maintenance would be subject to TransGrid environmental operational protocols and have a low risk of any inadvertent impacts to any threatened flora species.
Increased risk of fire	Construction / operational	Native vegetation All flora & fauna species	All PCTs	Long term	**Low.** Bushfire risk assessment has been considered as part of the proposal. During construction and operation, the proposal would implement the required bushfire management measures to manage any increased risk of bushfire. The proposed access road would provide addition opportunity for fire breaks across the regional landscape to enable better management of fire and reduce the potential for inappropriate regular fire intervals Design specifications would be adopted to ensure conductor clearance heights exceed recommended levels to minimise any risk of arcing or potential fire events. Vegetation maintenance would occur in accordance with TransGrid standard operational procedures. Impact assessment has considered this maintenance provision and is included in disturbance area-B calculations.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE (I.E. IMPACTED ENTITIES)	EXTENT	DURATION	CONSEQUENCE
Increased risk of collision and EMF with new infrastructure	Operational	Larger and higher-flying birds, and which generally reside over larger territories, such as birds of prey, ravens and magpies, cockatoos and some parrots, waterbirds and waterfowl	All PCTs	Long term	**Low.** Whilst this type of indirect impact has the potential to lead to some level of increase of bird mortality, mitigation measures would be implemented to ensure the likely impacts are minimised. The proposal is mostly located well away from waterways and wetlands which reduces the overall risk. The proposal transmission lines are likely to be below flight paths for a majority of species. While a pair of Regent Parrots were recorded flying next to the Murray River, the proposal in this location follows an existing powerline easement and as such the risk and consequence is not substantially increased compared to the existing situation. As outlined in Section 11.3 mitigation measures would include line markers (i.e. bird flappers / divertors), design measures to discourage nesting and ongoing monitoring of bird mortality.

9.3 ASSESSMENT OF PRESCRIBED BIODIVERSITY IMPACTS

Assessment of prescribed biodiversity impacts is prepared in accordance with section 9.2 of the BAM.

Table 9.12 Assessment of prescribed biodiversity impacts

PRESCRIBED BIODIVERSITY IMPACTS	NATURE (I.E. RELEVANCE TO THE PROPOSAL)	EXTENT	DURATION	CONSEQUENCE
(a) impacts of development 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	One area of geological significance relating to biodiversity within the proposal study area are the gypsum soils associated with lunette rises that were observed in a restricted area on the eastern edge of Nulla Station and adjoin lands. These soils are preferentially favoured by rare gypsum obligate species such as *Austrostipa nullanulla* (Endangered) and the highly restricted *Elacanthus glaber* and *Roepera compressa*	The extent of impacts to the gypsum soils and *Austrostipa nullanulla* is expected to be comparatively minor. The vast majority of occurrence of the gypsum soils and associated *Austrostipa nullanulla* has been avoided and minimised through design refinements. The end extent of indicative impact is 2.18 ha, which is a negligible area when compared to the retained area.	The minor impacts to the gypsum soils and *Austrostipa nullanulla* will be permanent.	The consequence of the impacts would be minor and non-significant as a result of the pro-active design process and the residual impact would be appropriately offset.

PRESCRIBED BIODIVERSITY IMPACTS	NATURE (I.E. RELEVANCE TO THE PROPOSAL)	EXTENT	DURATION	CONSEQUENCE
(b) impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	The proposal has the potential to impact on connectivity for habitat of threatened species that facilitates movement across species' ranges. The nature of the potential impacts to connectivity primarily relate to impacts to aerial species such as birds or bats through interaction with the proposed towers or associated lines. Generally, terrestrial connectivity would not be substantially affected.	The proposal would result in a highly permeable structure for biodiversity and connectivity is expected to remain largely unaffected for all species. However an unknown (though likely low) level of interaction such as birdstrike (and fatality) may occur. Mitigating factors include: — the additional gaps for connectivity likely to be created by the proposal are limited to infrequently used access tracks approximately 10 m in width, which native flora and fauna can generally still disperse across — native vegetation up to 2 m along the easement would be retained, providing cover for native species and connectivity — much of the proposal is co-located with existing transmission easements and along roadside, substantially reducing the overall extent of impact to connectivity.	The impacts to connectivity area expected to be permanent, though minor. They are likely to reduce over time as biodiversity acclimatises to the presence of the towers and powerlines.	The consequence of the impacts would be minor and non-significant as a result of the pro-active design process.

PRESCRIBED BIODIVERSITY IMPACTS	NATURE (I.E. RELEVANCE TO THE PROPOSAL)	EXTENT	DURATION	CONSEQUENCE
(c) impacts of development on movement of threatened species that maintains their life cycle	The proposal has the potential to impact on connectivity for habitat of threatened species that facilitates movement across species' ranges. The nature of the potential impacts to connectivity primarily relate to impacts to aerial species such as birds through interaction with the proposed towers or associated lines.	The proposal would result in a highly permeable structure for biodiversity and connectivity is expected to remain largely unaffected for all species. However an unknown (though likely low) level of interaction such as birdstrike (and fatality) may occur. Refer to the previous prescribed biodiversity impacts for relevant considerations. In addition, for species such as the recorded Regent Parrot, this species is likely to cross the proposal study area when dispersing between breeding and foraging areas, but as co-locating with other existing infrastructure would occur, impacts to Regent Parrot movements are expected to be negligible. Particularly as other mitigation measures such bird flappers / diverters would be investigated and incorporated into the detailed design. Habitats are unlikely to impacted to the degree that life cycles would be impacted, due to the high permeability and the expansive similar habitats in all directions from the indicative disturbance area,	The impacts to connectivity area expected to be permanent, though minor. They are likely to reduce over time as biodiversity acclimatises to the presence of the towers and powerlines and natural regeneration occurs in temporary construction areas.	The consequence of the impacts will be minor and non-significant as a result of the pro-active design process.

PRESCRIBED BIODIVERSITY IMPACTS	NATURE (I.E. RELEVANCE TO THE PROPOSAL)	EXTENT	DURATION	CONSEQUENCE
(d) impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	The proposal has the potential to impact on water quality, water bodies and hydrological processes that sustain threatened biodiversity.	The extent of impact related to this issue is expected to be minor. Essentially the works would mostly be limited to above-ground tower construction and powerline installation, with appropriate water management measures to be implemented. No direct impacts are expected to occur to these aquatic values of reliant threatened species.	The highest potential for these impacts is during construction, although these would be subject to detailed management measures. Once operational, such impacts are considered to be negligible on an ongoing basis.	The consequence of the low-level predicted level of impact to water-values is minor and expected to be able to be appropriately managed.
(e) impacts of wind turbine strikes on protected animals	Not applicable.	Not applicable.	Not applicable.	Not applicable.
(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community	The proposal has the potential to impact on animals through vehicular strike.	The extent of vehicular strike is expected to be minor in context.	The most vehicular movements would be generated during construction. Once construction is completed, vehicular movements are not expected to significantly increase compared to the existing situation.	The consequence of the predicted level of impact is expected to overall be minor. Particular focus would be required during the construction phase to manage vehicle and animal interaction.

9.4 SERIOUS AND IRREVERSIBLE IMPACTS

This section addresses section 10.2 of the BAM and following the Guidance to assist a decision-maker to determine a serious and irreversible impact (Department of Planning, Industry and Environment, 2019).

All threatened entities impacted by the proposal have been considered if they form or have potential to be Serious and Irreversible Impact (SAII) entities. Criteria for listing as an SAII entity are those species which:

- are in a rapid rate of decline
- have a very small population size
- are severely degraded or disrupted
- have a very limited geographic distribution
- are unlikely to respond to measures to improve habitat.

The proposal has been identified to impact on one entity currently listed as an SAII in the Threatened Biodiversity Data Collection (EES, 2020). This SAII is outlined below in Table 9.13.

Table 9.13 SAII entities recorded within the indicative disturbance area

SAII ENTITY	BC ACT	THRESHOLD	IMPACT (HA)
Austrostipa nullanulla (A Spear Grass)	E	Not listed	2.18

A second SAII was recorded but avoided as part of the avoidance process. This species is *Dodonaea stenozyga.*

The locations of both *Austrostipa nullanulla* and *Dodonaea stenozyga* are provided in Figure 9.3.

9.4.1 THREATENED ECOLOGICAL COMMUNITIES

One threatened ecological community, being Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions was recorded in the indicative disturbance area. This threatened ecological community is not considered to meet SAII listing criteria and is not currently identified as an SAII entity.

9.4.2 THREATENED SPECIES

Threatened species identified as SAII entities have been assessed in accordance with impact assessment provision outlined in Section 10.2.3 of the BAM. The assessment of *Austrostipa nullanulla* is provided in Table 9.14. *Dodonaea stenozyga* has not been assessed further as it would be avoided and would not be indirectly impacted by the indicative disturbance area.

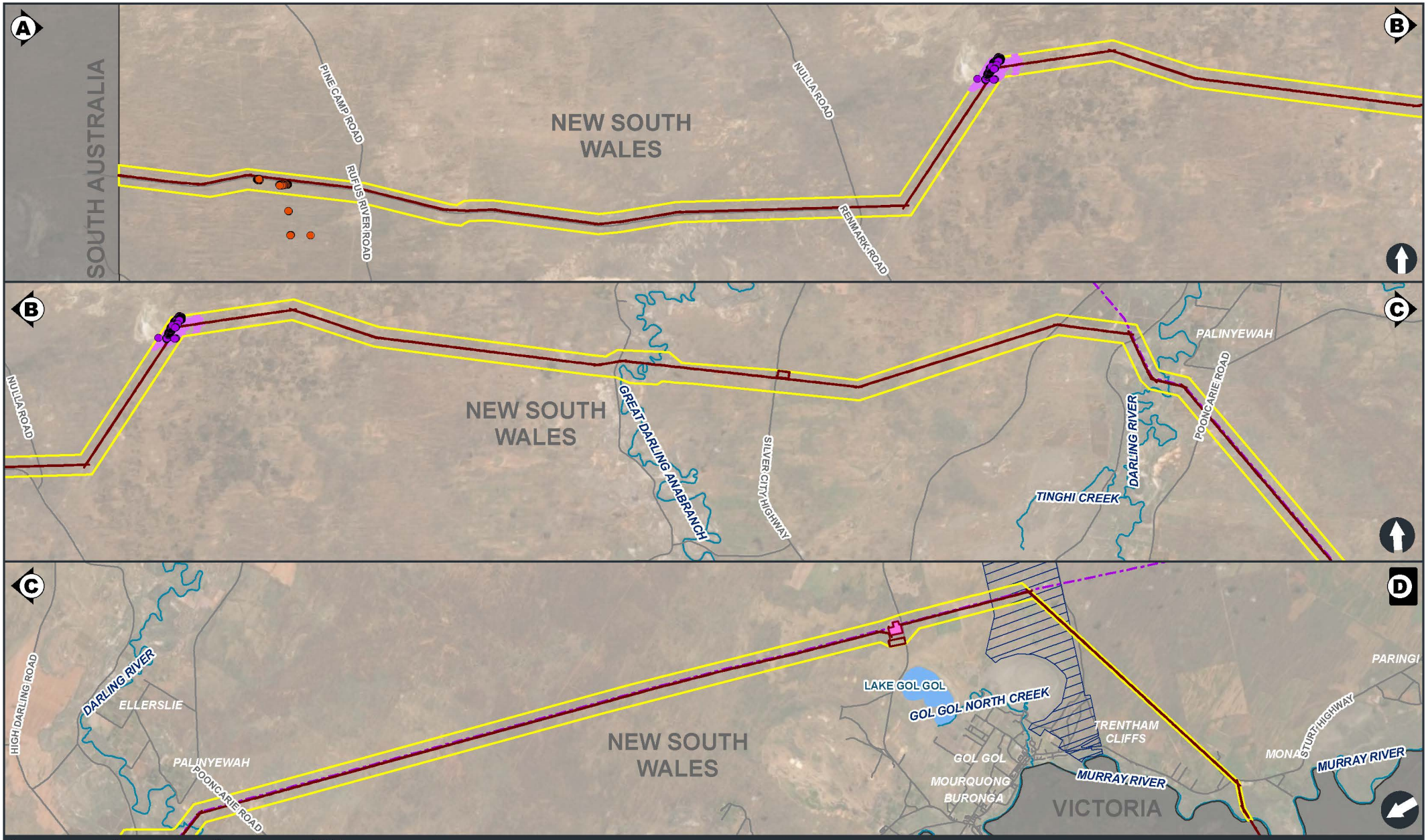

Figure 9.3

Serious and irreversible impacts

- Proposal study area
- Proposed substation expansion area
- Existing transmission line infrastructure
- Property where no access available - State Vegetation Mapping shown
- Disturbance area

Threatened flora individuals located during survey

- *Austrostipa nullanulla* record
- *Dodonaea stenozyga* record
- *Austrostipa nullanulla* species polygon

Source: NSWSS, ESRI, Transgrid, WSP

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Table 9.14 SAII impact assessment of *Austrostipa nullanulla*

IMPACT ASSESSMENT PROVISIONS	*AUSTROSTIPA NULLANULLA*
(a) the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	The proposal was also refined to avoid and minimise impacts on a known population of the endangered threatened flora species *Austrostipa nullanulla*. A large population of *Austrostipa nullanulla* occurs on gypseous rises within Nulla Station and adjoining properties. Several of these occurrences within Nulla Station are protected under conservation agreements specifically for this species. The proposal was positioned south of these areas to enable complete avoidance of all conservation areas. Further refinement based on detailed habitat assessment would enable further micro siting of transmission line towers and positioning access tracks to further avoid and minimise impacts on this species during the detailed design phase.
(b) the size of the local population directly and indirectly impacted by the development, clearing or biodiversity certification	The local population of *Austrostipa nullanulla* has been estimated to comprise of about 200,000+ individuals with a restricted distribution on Nulla Station (BioNet 2020).
(c) the extent to which the impact exceeds any threshold for the potential entity that is specified in the *Guidance to assist a decision-maker to determine a serious and irreversible impact*	At the time of report preparation, no impact thresholds have been published for *Austrostipa nullanulla.*
(d) the likely impact (including direct and indirect impacts) that the development, clearing or biodiversity certification will have on the habitat of the local population, including but not limited to: (i) an estimate of the change in habitat available to the local population as a result of the proposed development (ii) the proposed loss, modification, destruction or isolation of the available habitat used by the local population, and (iii) modification of habitat required for the maintenance of processes important to the species' life cycle (such as in the case of a plant – pollination, seed set, seed dispersal, germination), genetic diversity and long-term evolutionary development.	The proposal would result in the loss of about 2.07 ha of habitat in the form of PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains -modified 'lunette'. This impact would be a permanent loss of available habitat used by the local population. The proposed loss of available habitat occurs on the south-east extent of the population and is unlikely to isolate or fragment the existing population to an extent that would adversely disrupt the life cycle, genetic diversity or long-term evolutionary development of the species.

IMPACT ASSESSMENT PROVISIONS	*AUSTROSTIPA NULLANULLA*
(e) the likely impact on the ecology of the local population	Core areas of available habitat for the local population have been established under conservation agreements and occupy five main areas within Nulla Station. These areas are known as Bluff Belmore, Bluff Huntingfield, Bluff Gilchrist, New Nulla Tank and Woomera. The proposal has been located to the south of these *Austrostipa nullanulla* conservation areas and would restrict impacts to the south-east edge of available habitat used by the local population. Due to the nature of the proposal being mostly aerial spans between transmission towers, ground disturbances are limited to tower pads, break and winch sites and access tracks. The restricted nature of these works and retention of PCT 253 in span areas would ensure existing pollination vectors are not disrupted to a point that would adversely impact on the ecology of the local population.
(f) a description of the extent to which the local population will become fragmented or isolated as a result of the proposed development	Given the location and nature of the proposal it is considered unlikely to fragment or isolate the existing local population.
(g) the relationship of the local population to other population/populations of the species. This must include consideration of the interaction and importance of the local population to other population/populations for factors such as breeding, dispersal and genetic viability/diversity, and whether the local population is at the limit of the species' range	The occurrence of *Austrostipa nullanulla* within the indicative disturbance area is part of a larger local population that occurs within Nulla Station. It is considered likely that breeding, dispersal and genetic exchange occurs between the recorded habitat in the indicative disturbance area and the broader local population on Nulla Station. Direct connectivity between areas and interactivity would be retained.
(h) the extent to which the proposed development will lead to an increase in threats and indirect impacts, including impacts from invasive flora and fauna, that may in turn lead to a decrease in the viability of the local population	The proposal would implement mitigation measures to ensure biosecurity risks are managed to an extent that is unlikely to lead to an increased threat from invasive flora and fauna. Given this, the proposal is considered unlikely to lead to a decrease in the viability of the local population.
(i) an estimate of the area, or number of populations and size of populations that is in the reserve system in NSW, the IBRA region and the IBRA subregion	A large proportion of the local population has been protected under conservation agreements. These areas include Bluff Belmore, Bluff Huntingfield, Bluff Gilchrist, New Nulla Tank and Woomera. A total number of individuals within these conservation areas is unknown although two sites have been recorded to contain 60,000+ individuals each (BioNet 2020).
(j) the measure/s proposed to contribute to the recovery of the species in the IBRA subregion	The proposal does not propose measure to contribute to the recovery of the species in the IBRA subregion. The proposal would provide biodiversity offsets, in the form of 54 species credit species, for impacts to *Austrostipa nullanulla.*

9.5 IMPACTS REQUIRING BIODIVERSITY OFFSETS

Impacts that require biodiversity offsets are determined through applying thresholds outlined in sections 10.3 and 10.4 of the BAM. These thresholds identify where no further assessment is required or where no offsets is required for the proposed impact for some biodiversity values and/or areas of the indicative disturbance area. All biodiversity values that exceed these thresholds are required to provide offsets in accordance with the BAM and Biodiversity Conservation Regulation 2017. The thresholds for determining biodiversity offsets are:

- an assessment of ecosystem credits is not required for areas on the indicative disturbance area without native vegetation (in accordance with Chapters 4 and 5 of this BDAR) .
- an ecosystem credit obligation is not required for a vegetation zone that has a vegetation integrity score of either:
  - less than 15 where the PCT is representative of an endangered or critically endangered ecological community
  - less than 17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community
  - less than 20 where the PCT is not representative of a TEC or associated with threatened species habitat (as represented by ecosystem credits).

Impacts requiring biodiversity offsets because of the proposal are all PCTs and associated vegetation zones where the vegetation integrity score is greater than or equal to 17. All biodiversity values that require offsets are shown in Appendix F-1 and outlined in Chapter 12.

9.6 IMPACTS NOT REQUIRING BIODIVERSITY OFFSETS

Impacts not requiring biodiversity offsets are identified as PCTs and associated vegetation zones that have a vegetation integrity score of less than 17. All biodiversity values that do not require offsets are shown in Appendix F-2 and outlined in Chapter 12.

- PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semiarid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion) – derived
- PCT58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion – derived
- PCT170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones – derived
- PCT252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion – derived
- miscellaneous/exotic.

9.7 ASSESSMENT OF IMPACTS ON GROUNDWATER DEPENDENT ECOSYSTEMS

No high priority GDEs were identified within the recently superseded water sharing plans for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011 and Lower Murray Darling Unregulated and Alluvial Water Sources 2011.

Potential impacts could relate to lower groundwater levels from unexpected groundwater take or groundwater mounding, or, decreasing water quality through the intrusion of saline groundwater.

No impacts direct or indirect are expected as a result of the proposal. Subsurface interaction or modification of groundwater interaction with the GDEs and RAMSAR wetlands is expected to be nil to negligible.

9.8 ASSESSMENT OF IMPACTS ON AQUATIC SPECIES AND HABITAT

9.8.1 THREATENED AQUATIC SPECIES

Areas of mapped key fish habitat have been considered to provide moderate likelihood of occurrence for six threatened species listed under the FM Act (refer to Appendix D-2 for further detail). These species are:

- Darling River Snail (*Notopala sublineata*) listed as critically endangered under the FM Act
- Eel-tailed Catfish (*Tandanus tandanus*) listed as endangered under the FM Act
- Hanley's River Snail (*Notopala hanleyi*) listed as critically endangered under the FM Act
- Murray Crayfish (*Euastacus armatus*) listed as vulnerable under the FM Act
- Murray Hardyhead (*Craterocephalus fluviatilis*) listed as critically endangered under the FM Act
- Silver Perch (*Bidyanus bidyanus*) listed as vulnerable under the FM Act.

Under the FM Act, a '7-part test' is carried out to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the FM Act.

Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered likely to be negligible. Avoiding and minimising impacts on aquatic habitats would be a priority of detailed design and any residual indirect impacts would be subject to mitigation measures. Transmission line structures would be located around 50 to 100 metres from the waterways to minimise impact to riparian areas.

The only likely impact to occur in an area of key fish habitat would be the removal or trimming of tree canopy on the river banks to facilitate the construction and operation of the powerlines spanning each riparian area. All trunk bases and understorey would be retained in-situ adjoining the river banks. All potential indirect impacts associated with erosion and sedimentation impacts would be managed and monitored to ensure that these do not impact the riparian areas. At most, any impact to water quality would be temporary and negligible. Each riparian area would continue to function as it currently functions.

Appendix F-3 contains detailed 7-part tests for these species, which conclude that due to the predicted negligible aquatic impact a significant impact is unlikely to occur.

9.8.2 THREATENED ECOLOGICAL COMMUNITIES

9.8.2.1 THE AQUATIC ECOLOGICAL COMMUNITY IN THE NATURAL DRAINAGE SYSTEM OF THE LOWLAND CATCHMENT OF THE DARLING RIVER

The proposal would span the Great Darling Anabranch and Darling River and would not lead to direct impacts on the assemblage of native fish and aquatic invertebrates that have been listed to form part of this ecological community. The indicative disturbance area would lead to modification of native vegetation associated with the riparian zone influence of this community.

Disturbance within the riparian zone would be limited to upper stratum tree removal with all shrub and ground stratum vegetation below two metres in height would be retained in-situ. Transmission line structures would be located around 50 to 100 metres from the waterways to limit impact to riparian areas. An assessment of significance in accordance with Section 221ZV of the FM Act has been undertaken in Appendix F-3 for impact on this ecological community and concludes that the proposal is unlikely to lead to a significant impact, due to the predicted negligible aquatic impact.

9.8.2.2 THE AQUATIC ECOLOGICAL COMMUNITY IN THE NATURAL DRAINAGE SYSTEM OF THE LOWLAND CATCHMENT OF THE MURRAY RIVER

The proposal would span the Murray River and would not lead to direct impacts on the assemblage of native fish and aquatic invertebrates that have been listed to form part of this ecological community. The indicative disturbance area would lead to modification of native vegetation associated with the riparian zone influence of this community.

Disturbance within the riparian zone would be limited to upper stratum tree removal with all shrub and ground stratum vegetation below two metres in height would be retained in-situ. Transmission line structures would be located around 50 to 100 metres from the waterways to limit impact to riparian areas. An assessment of significance in accordance with Section 221ZV of the FM Act has been undertaken in Appendix F-3 for impact on this ecological community and concludes that the proposal is unlikely to lead to a significant impact, due to the predicted negligible aquatic impact.

9.9 ASSESSMENT OF IMPACTS ON MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Chapter 7 outlines the MNES considered to be relevant to the proposal. Assessment for each MNES was done in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Appendix E-1) and a summary of the outcomes of these are provided hereunder.

9.9.1 THREATENED ECOLOGICAL COMMUNITIES

The PCTs found within the proposal study area do not correspond to any EPBC Act listed threatened ecological communities.

9.9.2 THREATENED FLORA

Table 9.15 lists the flora species considered to have moderate or greater potential habitat within the proposal study area and/or which are listed in the SEAR's for the proposal. The outcomes of the significance assessments undertaken in detail in Appendix E are provided.

Table 9.15 Listed EPBC Act threatened flora species summary of significance of impact

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	SIGNIFICANT IMPACT?
Atriplex infrequens	A saltbush	V	Identified in the SEARs as a matter requiring further consideration. Candidate species credit species.	This species was recorded in May and July 2020 from PCT 17 (see Section 5.2.1). The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species under the EPBC Act.

(1) Threat status under the EPBC Act: V = vulnerable, E = endangered

9.9.3 THREATENED FAUNA

Table 9.16 lists the fauna species considered to have moderate or greater potential habitat within the proposal study area and/or which are listed in the SEAR's for the proposal. The outcomes of the significance assessments undertaken in detail in Appendix E are provided.

Table 9.16 Listed EPBC Act threatened fauna species summary of significance of impact

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	SIGNIFICANT IMPACT?
Amphibians				
Litoria raniformis	Southern Bell Frog	V	Identified in the SEARs as a matter requiring further consideration. Candidate species credit species.	No suitable habitat and not recorded. Predicted habitat occurs within PCT 11, PCT 13, and PCT 17 in the Robinvale Plains IBRA Subregion. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Birds				
Botaurus poiciloptilus	Australasian Bittern	E	Identified in the SEARs as a matter requiring further consideration. Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Australasian Bittern and habitat is considered to be poor. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Calidris canutus	Red Knot	E	Identified in the BioNet search.	Targeted bird surveys within the proposal study area did not record any Red Knot. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Falco hypoleucos	Grey Falcon	V	Identified by the BAM-C. Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Grey Falcon. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	SIGNIFICANT IMPACT?
Geophaps scripta scripta	Squatter Pigeon (Southern Subspecies)	V	Identified by the BAM-C. They are very rare in the southern parts of their range, but suitable habitat is present, however outside of known distribution and was removed as a candidate species credit species.	Targeted bird surveys within the proposal study area did not record any Squatter Pigeon. Squatter Pigeon is not considered an affected species and no further assessment is required.
Grantiella picta	Painted Honeyeater	V	Identified in the PMST, BioNet and BAM-C searches. Habitat occurs with study area and similar habitat is associated with records in SA although there are no records locally. Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Painted Honeyeater. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Hirundapus caudacutus	White-throated Needletail	V	Identified in the BioNet search. Although local records are sparse, due to wide ranging habitats may occur in aerial habitats over the study area on a seasonal basis but usually high in the sky, well above the indicative disturbance area.	Targeted bird surveys within the proposal study area did not record any White-throated Needletail. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Lathamus discolor	Swift Parrot	CE	Identified in the SEARs as a matter requiring further consideration. Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Swift Parrot. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Leipoa ocellata	Malleefowl	V	Identified in the SEARs as a matter requiring further consideration. Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Malleefowl but did record two old Malleefowl mounds. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	SIGNIFICANT IMPACT?
Limosa lapponica baueri	Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit	V	Identified in the PMST search. May occur intermittently around salt-lakes and wetlands but not likely to occur within indicative disturbance area	Targeted bird surveys within the proposal study area did not record any Bar-tailed Godwit. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Manorina melanotis	Black-eared Miner	E	Identified in the SEARs as a matter requiring further consideration. Candidate species credit species.	Targeted bird surveys within the proposal study area did not record any Black-eared Miner and detailed justification in this report demonstrates it is not likely to occur. Black-eared Miner is not considered an affected species however as it was included in SEARs as likely significant impact a precautionary EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Pachycephala rufogularis	Red-lored Whistler	V	Identified in the SEARs as a matter requiring further consideration. Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Red-lored Whistler and detailed justification in this report demonstrates it is not likely to occur. Red-lored Whistler is not considered an affected species however a precautionary EPBC Act significance assessment for this species was carried out as it was included in SEARs as likely significant impact (refer to Appendix E-1). No – the proposal is considered unlikely to have a significant impact on the species.
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	V	Identified in the SEARs as a matter requiring further consideration. Candidate species credit species (breeding habitat) and Predicted ecosystem credit species.	A pair was observed within the proposal study area flying through riverine woodland on the Robinvale Plain IBRA subregion. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the as comparatively minor proportional areas of habitat will be impacted in a regional sense and the species is likely to easily move throughout the locality.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT[1]	DETAILS	SIGNIFICANT IMPACT?
Rostratula australis	Australian Painted Snipe	E	Predicted ecosystem credit species.	Targeted bird surveys within the proposal study area did not record any Australian Painted Snipe. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species.
Fish				
Bidyanus bidyanus	Silver Perch	CE	Identified in the PMST search. The study area traverses Local Government Areas that contain mapped key fish habitats (Strahler 4/5 Order streams) and DPI mapped habitat for this species.	Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered unlikely. Silver Perch is not considered an affected species and no further assessment is required.
Craterocephalus fluviatilis	Murray Hardyhead	E	Identified in the PMST search. The study area traverses Local Government Areas that contain mapped key fish habitats (Strahler 4/5 Order streams).	Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered unlikely. Murray Hardyhead is not considered an affected species and no further assessment is required.
Maccullochella peelii	Murray Cod	V	Identified in the PMST search. The study area traverses Local Government Areas that contain mapped key fish habitats (Strahler 4/5 Order streams).	Impacts from the proposal on aquatic habitats, particularly mapped key fish habitats (Strahler 4/5th Order streams) are considered unlikely. Murray Cod is not considered an affected species and no further assessment is required.
Mammals				
Nyctophilus corbeni (syn. N. timoriensis)	South-eastern Long-eared Bat (Corben's Long-eared Bat & Greater Long-eared Bat)	V	Identified in the SEARs as a matter requiring further consideration. Predicted ecosystem credit species.	Recorded within Mallee woodland including PCT170 – Chenopod sandplain mallee woodland/ shrubland. The EPBC Act significance assessment for this species is detailed in Appendix E-1. No – the proposal is considered unlikely to have a significant impact on the species as comparatively minor areas of habitat would be impacted in a regional sense and the mobile species can be easily move throughout the locality.

(1) Threat status under the EPBC Act: V = vulnerable, E = endangered, CE = critically endangered

9.9.4 MIGRATORY SPECIES

Based on the results of the database searches, 26 listed migratory species may occur in the broader locality (refer to Appendix D-2). The following EPBC Act listed Migratory species are considered moderately likely to occur in, or adjacent to, the proposal study area based on the presence of suitable habitats:

- Migratory marine birds – Fork-tailed Swift
- Migratory terrestrial species – White-throated Needletail
- Migratory wetland species – Common Sandpiper, Sharp-tailed Sandpiper, Red Knot, Curlew Sandpiper, Pectoral Sandpiper, Little Stint, Red-necked Stint, Long-toed Stint, Greater Sand Plover, White-winged Black Tern, Latham's Snipe, Caspian Tern, Broad-billed Sandpiper, Bar-tailed Godwit, Bar-tailed Godwit (baueri), Black-tailed Godwit, Little Curlew, Glossy Ibis, Pacific Golden Plover, Wood Sandpiper, Common Greenshank and Marsh Sandpiper.

EPBC Act listed Marine species including the Great Egret, Cattle Egret, Red-capped Plover, White-bellied Sea-Eagle, Black-winged Stilt, Swift Parrot, Rainbow Bee-eater, Red-necked Avocet and Australian Pratincole may occur in the habitats on occasion.

Of the above species, those that were recorded within the proposal study area were:

- White-bellied Sea-Eagle
- Rainbow Bee-eater
- Great Egret.

And those that were recorded outside of the proposal study area in local or regional wetlands were:

- Sharp-tailed Sandpiper (Chowilla regional reserve in SA)
- Pectoral Sandpiper (Chowilla regional reserve in SA)
- Red-necked Stint (Chowilla regional reserve in SA)
- Greater Sand Plover (Chowilla regional reserve in SA)
- Black-winged Stilt (Chowilla regional reserve in SA)
- Caspian Tern (Recorded in local riparian and wetland habitats)
- Red-necked Avocet (Chowilla regional reserve in SA).

Important habitat for EPBC Act listed Migratory species is defined as (Department of Environment, 2013):

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat that is of critical importance to the species at particular life-cycle stages
- habitat utilised by a migratory species which is at the limit of the species range
- habitat within an area where the species is declining.

While some migratory species of bird are likely to use the proposal study area and locality, it would not be classed as an 'important habitat'. No nationally or internationally important habitats for migratory wetlands species are present in the proposal study area according to the definition provided in the *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Department of the Environment, 2015a). Likewise, there are no important habitats for the Fork-tailed Swift or the White-throated Needletail in the development suite as outlined in the *Draft Referral guideline for 14 birds listed as migratory species under the EPBC Act* (Department of the Environment, 2015b). A nationally significant proportion of a listed Migratory bird population would not be supported by the habitats in the proposal study area. The proposal would not substantially modify, destroy or isolate an area of important habitat for any EPBC Act listed Migratory species and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds. Further detail is provided in Appendix E-1.

9.9.5 WETLANDS OF NATIONAL AND INTERNATIONAL IMPORTANCE

The Riverland Ramsar wetland complex is located in Chowchilla Game Reserve, which is three and a half kilometres to the south-west of the SA/NSW state border at western end of the proposal and is in SA. Banrock station wetland complex is located 40–50 kilometres downstream of the proposal area and is also in SA. These wetlands will not be directly or indirectly impacted by the proposal. Management measures will ensure that water quality impacts will not occur downstream to these areas.

9.9.6 WORLD AND NATIONAL HERITAGE

No World Heritage Properties or National Heritage Places are located within or nearby the proposal study area.

9.9.7 CONSISTENCY WITH CONVENTIONS, CONSERVATION *ADVICE AND RECOVERY PLANS*

The assessment of the proposal under the BAM is consistent with Australia's international obligations (specifically the Biodiversity Convention, the Apia Convention and CITES), conservation advices and recovery and threat abatement plans.

9.9.7.1 BIODIVERSITY CONVENTION

The Convention on Biological Diversity is dedicated to promoting sustainable development. It provides a framework for Australia's integration of natural resources and environment and biodiversity management policies.

A key philosophy of sustainable development and the Convention on Biological Diversity is the principal of 'avoid and minimise impacts to biodiversity', which the proposal has adopted during the planning and design phase. Avoiding and minimising impacts on biodiversity values is a desired performance outcome for the proposal and is a mandatory key consideration for biodiversity impact assessment under the BAM.

The proposal's adherence to this is demonstrated throughout Chapter 8 (Avoid and minimise impacts) of this BDAR.

The biodiversity assessment for the proposed action has been based on the BAM methodology which addresses the ecologically sustainable development hierarchy of avoid, minimise and offset. This has led to the proposal being designed for avoidance of impacts on biodiversity and where residual impacts are unavoidable, identifying offsets and a strategy to minimise impacts against Commonwealth requirements.

9.9.7.2 APIA CONVENTION

The Convention on Conservation of Nature in the South Pacific (the Apia Convention) obliges States (in general terms) to create protected areas to safeguard representative samples of ecosystems, and places of scenic, geological, aesthetic, historical, cultural or scientific importance. The Convention also prohibits the taking or killing of fauna (including eggs and shells) unless the taking is controlled by the competent authorities of the State concerned, or unless in pursuance of 'duly authorised' scientific investigations.

The biodiversity assessment for the proposal has been based on the BAM methodology which addresses the ecologically sustainable development hierarchy of avoid, minimise and offset. This has led to the proposal being designed for avoidance of impacts on biodiversity and where residual impacts are unavoidable, identifying offsets and a strategy to minimise impacts against Commonwealth requirements.

9.9.7.3 CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The proposal would not contribute to or result in an increase in the international trade in specimens of wild animals and plants.

9.9.7.4 CONSERVATION ADVICES

The relevant conservation advices for MNES species and/or communities to be impacted by the proposal were referenced and considered throughout the preparation of this BDAR including in Chapter 3, Chapter 7, Chapter 9, Appendix D-1 – Threatened flora likelihood of occurrence assessment, Appendix D-2 – Threatened fauna likelihood of occurrence assessment and Appendix E – Matters of National Environmental Significance Assessment.

9.9.7.5 RECOVERY AND THREAT ABATEMENT PLANS

The relevant recovery and threat abatement plans are considered throughout the preparation of this Technical paper 3: Biodiversity Development Assessment Report including in Chapter 3, Chapter 7, Chapter 9, Appendix D-1 – Threatened flora likelihood of occurrence assessment, Appendix D-2 – Threatened fauna likelihood of occurrence assessment and Appendix E – Matters of National Environmental Significance Assessment. Conservation Advices were also considered in association with this assessment. National Recovery Plans reviewed as part of this assessment included:

- National Recovery Plan for the Southern Bell Frog *Litoria raniformis* (Clemann & Gillespie, 2012)
- National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders & Tzaros, 2011)
- National Recovery Plan for Malleefowl (Benshemesh, 2007)
- National Recovery Plan for the Black-eared Miner *Manorina melanotis* 2002-2006: Conservation of old-growth dependant mallee fauna (Baker-Gabb, 2003)
- National Recovery Plan for the Mallee Emu-Wren *Stipiturus mallee*, Red-lored Whistler *Pachycephala rufogularis* and Western Whipbird *Psophodes nigrogularis leucogaster* (Department of Environment, Land, Water and Planning, 2016)
- National Recovery Plan for the Regent Parrot (eastern subspecies) *Polytelis anthopeplus monarchoides* (Baker-Gabb & Hurley, 2011)
- National Recovery Plan for the Murray Hardyhead, *Craterocephalus fluviatilis* (Backhouse, G., J. Lyon and B. Cant (2008)
- National Recovery Plan for the Murray Cod *Maccullochella peelii* (National Murray Cod Recovery Team, 2010).

The proposal would not interfere with any Regional/Local priority actions outlined in the Approved Conservation Advices. There are no recovery plans for other relevant MNES assessed in this BDAR.

9.10 KEY THREATENING PROCESSES

Key Threatening Processes (KTP's) applicable to the proposal have been considered and are outlined below in Table 9.17.

Table 9.17 Key Threatening Processes

KEY THREATENING PROCESS	RELEVANCE	MITIGATION MEASURES
Clearing of native vegetation	High	The proposal would result in the clearing of native vegetation and contribute with this key threatening process. Avoidance and minimisation of native vegetation have been considered during transmission line corridor placement, including the strategic options assessment and identification and refinement of the proposal process, however, complete avoidance of removal of native vegetation is not practicable. Mitigation measures would be implemented during construction to manage the impacts of the proposal on biodiversity values, including clearing of native vegetation. These mitigation measures would be outlined in a Biodiversity Management Sub-Plan that would form part of the CEMP. A Biodiversity Management Sub-Plan (BMP) would set out measures to minimise and manage impacts on biodiversity. It would include (as a minimum): — measures to minimise impacts to biodiversity, including measures to reduce disturbance to sensitive flora and fauna — procedures for clearing of vegetation, including pre-clearing inspections and procedures for the relocation of flora and fauna — procedures for the demarcation and protection of retained vegetation, including vegetation adjacent to construction areas — weed management — rehabilitation strategies including progressive rehabilitation, and measures for the management and maintenance of rehabilitated areas (including duration) — procedures for unexpected EECs or threatened flora and fauna during construction, including stop work procedures — monitoring requirements and compliance management. Additional mitigation measures in relation to clearing of native vegetation are stated in Chapter 11. Whilst the proposal would contribute to the clearing of native vegetation, with the implementation of the above mitigation measures it is unlikely that the proposal would significantly exacerbate this key threatening process.

KEY THREATENING PROCESS	RELEVANCE	MITIGATION MEASURES
Infection of native plants by *Phytophthora cinnamomi*	Low	The proposal has the potential to contribute towards these key threatening processes, however, due to the nature, location and implementation of mitigation measures there is a low likelihood that the proposal would result in these key threatened processes from being established within the proposal study area. Whilst the proposal has the potential to lead to a reduction of native vegetation integrity in surrounding habitats, mitigation measures would be implemented to ensure biosecurity is managed during construction. A BMP would set out measures to minimise and manage impacts on biodiversity associated with weeds and pathogens, including weed management and TransGrid biosecurity protocols.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Low	
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Low	
Invasion and establishment of exotic vines and scramblers	Low	
Invasion of native plant communities by exotic perennial grasses	Low	
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low	
Loss of Hollow-bearing Trees	High	The proposal would contribute towards these key threatening processes. The loss of breeding habitat such as hollow-bearing trees, old growth bull mallee lignotubers, *Triodia* grass clumps and dead fallen timber has the potential to affect native animals such as; — hollow-dependent bats — hollow-nesting and canopy-nesting birds — arboreal mammals — reptiles.
Removal of dead wood and dead trees	High	

KEY THREATENING PROCESS	RELEVANCE	MITIGATION MEASURES
		The loss of breeding habitats is unlikely to extend beyond the indicative disturbance area. Avoidance and minimisation of native vegetation and key habitat features have been considered during transmission line corridor placement, including the strategic options assessment and identification and refinement of the proposal process, however, complete avoidance of removal of these habitat features is not practicable. Mitigation measures would be implemented during construction to manage the impacts of the proposal on habitat features and minimise the effect of these key threatening processes. A BMP would set out the following measures to minimise and manage impacts on biodiversity associated with loss of hollow-bearing tree and removal of dead wood and dead trees: — pre-clearing surveys will be completed prior to construction by a suitability qualified ecologist — implementation of nest box strategy and hollow replacement — retention of habitat features where possible and translocation of habitat features (i.e. fallen timber) in adjacent habitat. Mitigation measures in relation to loss of hollow-bearing tree and removal of dead wood and dead trees are stated in Chapter 11. Whilst the proposal would contribute to these key threatening processes, with the implementation of the above mitigation measures and those in the BMP it is unlikely that the proposal would significantly exacerbate these key threatening process.

9.11 CUMULATIVE IMPACTS (CONSTRUCTION)

9.11.1 ENERGYCONNECT

The proposal forms part of a broader project and would share a direct interface at each connection point with the SA section, Victorian Section and the NSW-Eastern Section. These other proposals are currently within the mixed stages of development and environmental assessment.

Cumulative impacts pertaining to loss of biodiversity has the potential to extend beyond the construction of the proposal, through the loss of habitat and vegetation. To manage the cumulative biodiversity impacts of EnergyConnect, the options development for EnergyConnect has considered routes to avoid and minimise impacts to biodiversity, and opportunities will continue to be explored during further proposal development and based on further field investigations. In addition to environmentally sensitive design responses, biodiversity offsets will be provided for the proposal, and would be expected for the NSW-Eastern and Victorian Sections of EnergyConnect, to address cumulative biodiversity impacts where removal of habitat and vegetation is unavoidable. These measures when combined would ensure that a net increase in conservation and protection of impacted species and Plant Community Types.

9.11.2 OTHER PROJECTS

Three other relevant known potential projects occur within the region, being:

- Buronga Solar Farm (Renew Estate)
- Copi Mineral Sand Mine (Relentless Resources Limited)
- Buronga – Gol residential expansion (Wentworth Shire Council).

During construction of the Buronga Solar Farm, it is likely that approximately 500 hectares of mostly Chenopod Sandplain Mallee Woodland would be impacted, with the remainder of the site previously already cleared for agriculture/ dryland cropping. While the connection of this project to the Buronga substation is adjacent to the proposal, most of the impacts are located over one kilometre to the north. There would be a cumulative impact on Chenopod Sandplain Mallee Woodland, although this is a relatively common vegetation type and habitat in the locality and region. Both would implement biodiversity offset strategies which are likely to result in a net increase of protection and conservation of such vegetation and habitat in the locality and region. Therefore, the cumulative impacts from the proposal on the biodiversity of the region are assessed as low.

Ecological surveys completed to date for the Copi Mineral Sands mine project indicate the presence of the endangered *Austrostipa nullanulla*, a native grass species listed as endangered in the NSW Biodiversity Conservation Act 2016 (BC Act). Surveys also identified the Endangered Ecological Community, *Halosarcia lylei* low open shrubland. Threatened or migratory species recorded included Little Eagle, Rainbow Bee-eater (migratory), Redthroat, Hooded Robin, Little Pied Bat and Inland Forest Bat. All of these species except the EEC have also been recorded for the proposal. This project is located approximately 25 kilometres from the proposal and while broad-scale regional impact may be cumulative, they are well dispersed in the landscape and unlikely to be significant in a cumulative sense in terms of biodiversity.

The Buronga – Gol residential expansion, which would comprise a 240 hectare urban release area on land that is largely currently used for irrigated horticulture has negligible potential for cumulative impacts to biodiversity.

In conclusion, while these other projects (including other components of EnergyConnect) are in the planning phase and could potential occur at similar times to the proposal, cumulative impacts during construction are not considered likely to be substantial or significant.

10 ASSESSMENT OF OPERATIONAL IMPACTS

10.1 OVERVIEW

The EIS provides a detailed description of the expected operation and maintenance aspects for the proposal, including both substation and transmission lines components.

Once built and operating, the proposal has limited number of potential ongoing biodiversity impacts. The key potential operational impacts are considered to be the following:

- ongoing regular access requirements for maintenance of the infrastructure
- ongoing vegetation maintenance to ensure that TransGrid maintenance procedures and the required bushfire protection aspects are implemented
- ongoing potential for bird collision or impacts of electric and magnetic fields to local fauna populations.

These are discussed individually below.

10.2 INFRASTRUCTURE MAINTENANCE

The impacts of infrastructure maintenance are expected to be negligible. Once the assessed proposal footprints are occupied, access to the infrastructure would occur via formed tracks or via paddocks.

TransGrid personnel and contractors would be educated about the correct procedures when conducting maintenance, including inductions. The inductions would include highlighting the importance of biodiversity values and their protection. This would be undertaken in accordance with TransGrid's standard procedures. No further assessment of this aspect is considered necessary.

10.3 VEGETATION MAINTENANCE

Vegetation maintenance would be required to maintain appropriate clearances between ground vegetation and transmission lines. Vegetation below transmission lines would require ongoing maintenance throughout the operation to ensure electrical safety clearances and protection zones are maintained. The required clearance of vegetation within the corridor would be undertaken in accordance with TransGrid maintenance guides.

Once constructed and operating, vegetation would be maintained to the level assessed for impact within the indicative disturbance area (disturbance area-B) in this BDAR. Vegetation maintenance would occur in accordance with standard TransGrid procedures. TransGrid personnel and contractors would be educated about the correct procedures when conducting maintenance, including inductions. The inductions would include highlighting the importance of biodiversity values and their protection. No further assessment of this aspect is considered necessary.

10.4 BIRD STRIKE IMPACTS

Impacts to birds during operation of the proposal has been assessed in detail and is provided in Appendix F-4.

The literature reviewed in relation to this aspect identifies that electric and magnetic fields impacts are unlikely to be of significant concern, but that there is the potential for birds to be impacted mostly via collision with the towers. The Electric and Magnetic Field Study for the proposal by BECA (2020) also states that:

"There is a body of research examining the effects of EMF on the reproductive biology and physiology of birds in the wild and under aviary conditions. Most studies indicate that EMF exposure of birds generally changes, but not always consistently in effect or in direction, their behaviour, reproductive success, growth and development, physiology and endocrinology, and oxidative stress under EMF conditions".

It is proposed to include mitigation measures such as transmission line markers, otherwise known as bird flappers or diverters, to assist in birds being able to avoid impacts. These are a demonstrated mitigation measure throughout the world. Design measures to minimise nesting of birds would also be considered and monitoring of post-construction impacts would also occur.

Appropriate consideration of this operational aspect has been afforded and this would continue to be considered during the design, construction and operation phases.

10.5 CUMULATIVE IMPACTS (OPERATION)

10.5.1 ENERGYCONNECT

The proposal forms part of a broader project and would share a direct interface at each connection point with the South Australian section, Victorian Section and the NSW-Eastern Section. These other proposals are currently within the early stages of development and environmental assessment.

Cumulative impacts during operational phases of EnergyConnect are considered likely to be of low or negligible impact. During operation of all sections of EnergyConnect, high permeability would exist for habitat connectivity and consistent mitigation measures to address residual impacts of all components would be implemented in combination with appropriate regional-scale biodiversity offsets.

10.5.2 OTHER PROJECTS

Three other relevant known potential projects occur within the region, being:

- Buronga Solar Farm (Renew Estate)
- Copi Mineral Sand Mine (Relentless Resources Limited)
- Buronga – Gol Gol residential expansion (Wentworth Shire Council).

During operation of the Buronga Solar Farm, Copi Mineral Sands mine project and Buronga – Gol Gol residential expansion, cumulative impacts are expected to be negligible. Birdstrike and/or EMF impacts are unlikely to be exacerbated by these projects to add to any potential cumulative impacts.

In conclusion, while these other projects (including other components for EnergyConnect) are in the planning phase and could potential operate at similar times to the proposal, cumulative impacts during operation are not considered likely to be substantial or significant.

11 MANAGEMENT AND MITIGATION MEASURES

This chapter describes the environmental management approach and framework for biodiversity for the proposal during construction and operation.

11.1 APPROACH TO MANAGEMENT AND MITIGATION

The environmental management approach has been developed to be consistent with the regulatory requirements for management of biodiversity impacts, identified as likely to be encountered during the construction and operational phases of the proposal. Further details on the environmental management approach for the proposal are provided in Chapter 23 (Environmental management and mitigation) of the EIS.

Mitigation measures would be implemented during construction to manage the potential impacts of the proposal on biodiversity values. These mitigation measures would be outlined in a Biodiversity Management Sub-Plan that would form part of the CEMP.

11.2 MITIGATION MEASURES

In addition to the development and implementation of the CEMP, specific mitigation measures have been identified for inclusion in a BMP to be prepared for the proposal.

The proposed measures have been identified to manage both construction and operational impacts and some measures have been identified to manage impacts in a site-specific location. The location/s applicable to each mitigation measure are identified in the table where relevant.

The proposed mitigation measures may be revised in response to submissions received during public exhibition and/or any design changes made following exhibition. The revised list of mitigation measures would be provided in the Response to Submissions and Proposal Amendment Report (if required).

For construction, a Biodiversity Management Sub-Plan (BMP) would set out measures to minimise and manage impacts on biodiversity. It would include (as a minimum):

- measures to minimise impacts to biodiversity, including measures to reduce disturbance to sensitive flora and fauna
- procedures for clearing of vegetation, including pre-clearing inspections and procedures for the relocation of flora and fauna
- procedures for the demarcation and protection of retained vegetation, including vegetation adjacent to construction areas
- weed management
- rehabilitation strategies including progressive rehabilitation, and measures for the management and maintenance of rehabilitated areas (including duration)
- procedures for unexpected EECs or threatened flora and fauna during construction, including stop work procedures
- monitoring requirements and compliance management

Proposed mitigation measures detailed below in Table 11.1.

Table 11.1 Mitigation measures

REFERENCE	MITIGATION MEASURE	TIMING	APPLICABLE LOCATION(S)
B1	The final disturbance area will seek to avoid the clearing of native vegetation and habitats as far as practicable. In particular threatened species recorded and their habitat, including *Acacia acanthoclada*, *Atriplex infrequens*, *Austrostipa nullanulla*, *Dodonaea stenozyga* and *Santalum murrayanum*.	Detailed design	All locations
B2	Where native vegetation disturbance activities are required in areas that have not been previously subject to biodiversity survey, additional survey will be carried out prior to works occurring in any such areas and to inform detailed design. These surveys will be carried out by a suitably qualified ecologist.	Detailed design	All locations
B3	Opportunities to locate site offices, compounds and ancillary facilities in areas of limited biodiversity value (e.g. cleared land or areas of native vegetation with vegetation integrity scores of less than 17) will be prioritised during detailed design.	Detailed design	All locations
B4	Existing tracks and clearings will be used, where possible, to avoid the construction of new tracks. Where this is not possible, the design will seek to minimise impacts to native vegetation.	Detailed design	Transmission line corridor
B5	Transmission line structures will be located to minimise impact to vegetated riparian zones.	Detailed design	Transmission line corridor within the riparian zone of Great Darling Anabranch, Darling River and/or Murray River
B6	Conductor line-marking techniques will be implemented to minimise bird strike.	Detailed design	Transmission line – within one kilometre of wetland/riverine habitats (i.e. Great Darling Anabranch, Darling River and Murray River)
B7	Pre-clearing surveys will be completed prior to construction by a suitability qualified ecologist.	Pre-construction	All locations

REFERENCE	MITIGATION MEASURE	TIMING	APPLICABLE LOCATION(S)
B8	Nest boxes will be provided to minimise habitat loss to hollow-bearing fauna in accordance with a Nest Box Strategy. The strategy will include the following requirements: — hollow-bearing trees will be marked/tagged and mapped in a pre-clearing survey — the size, type, number and location of nest boxes required will be based on the results of the pre-clearing survey — 70 per cent of nest boxes will be installed one month prior to any hollow-bearing vegetation removal, with all nest boxes to be installed within six months from the date of the commencement of clearing.	Pre-construction	All locations where hollow bearing trees are being removed.
B9	Biodiversity exclusion zones for retained vegetation, including identified threatened flora populations that have a high susceptibility to trampling and compaction, will be clearly identified by a suitably qualified ecologist prior to the commencement of construction.	Pre-construction	All locations
B10	Construction workforce will be supplied with sensitive area maps (showing clearing boundaries and exclusion zones) including updates as required.	Construction	All locations
B11	The predicted clearing of native vegetation by the proposal will be monitored against the recorded clearing to inform any final biodiversity offset requirements within the biodiversity offset package.	Construction	All locations
B12	Shrub or ground stratum native vegetation within vegetated riparian zones (within the definition of *Water Management Act 2000*) of the Great Darling Anabranch, Darling River and/or Murray River (and other defined riparian areas) will not be removed, with vegetation clearing limited to the tree stratum only, with trunk bases being retained in-situ.	Construction	Transmission line corridor within the riparian zone of Great Darling Anabranch, Darling River and/or Murray River
B13	Activities within vegetated riparian zones will be managed to minimise impacts to aquatic environments. Riparian areas subject to disturbance will be progressively stabilised and rehabilitated.	Construction	Transmission line corridor within the riparian zone of Great Darling Anabranch, Darling River and/or Murray River
B14	A species unexpected finds protocol will be implemented if threatened ecological communities, flora and fauna species, not assessed in the biodiversity assessment, are identified in the disturbance area.	Construction	All locations

12 BIODIVERSITY OFFSET CREDIT REPORT

This chapter specifically addresses Section 11 of the BAM and provides information on the application of the no net loss standard and the project biodiversity offset obligations. Credit calculations were quantified using the BAM-C Version 1.2.7.2.

12.1 SOUTH OLARY PLAIN IBRA SUBREGION

12.1.1 ECOSYSTEMS CREDIT OFFSET

Ecosystem credits required by the proposal for impacts calculated in the South Olary Plain IBRA subregion are outlined in Table 12.1.

Table 12.1 Biodiversity offset ecosystem credit obligation for South Olary Plain IBRA subregion

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Arid shrublands (Acacia sub-formation)							
PCT 143 – Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes	modified – disturbance area-A	not a TEC	91.9	-91.9	0.99	1.5	34
Arid Shrublands (Chenopod sub-formation)							
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	modified – disturbance area-A	not a TEC	54.8	-54.1	57.53	1.5	1,183
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	modified – disturbance area-A	not a TEC	72.1	-72.1	9.72	1.5	263
Saline Wetlands							
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains	modified 'boninka' – disturbance area-B	not a TEC	39.7	-39.7	2.84	1.5	42
	modified 'lunette' – disturbance area-A	not a TEC	32.6	-32.6	2.07	1.5	25

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Semi-arid Woodlands (Grassy sub-formation)							
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	not a TEC	-50.2	-50.2	1.15	1.75	25
	modified – disturbance area-B	not a TEC	-50.2	-13.5	1.87	1.75	11
Semi-arid Woodlands (Shrubby sub-formation)							
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area-A	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	56	-56	0.59	2	17
	modified – disturbance area-B		56	-16.6	0.32	2	3
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	modified – disturbance area-A		70.1	-70.1	6.18	2	217
	modified – disturbance area-B		70.1	-20.1	3.79	2	38
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	modified – disturbance area-A	not a TEC	60.2	-60.2	29.34	1.75	773
	modified – disturbance area -B	not a TEC	60.2	-28.6	59.62	1.75	747
	derived – disturbance area-A	not a TEC	1.3	-1.3	36.56	1.75	0

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	modified 'bull' – disturbance area-A	not a TEC	66.5	-66.5	9.85	1.5	246
	modified 'bull' – disturbance area-B	not a TEC	66.5	-27.4	18.17	1.5	187
	modified 'whipstick' – disturbance area-A	not a TEC	58.6	-58.6	45.43	1.5	999
	modified 'whipstick' – disturbance area-B	not a TEC	58.6	-20.7	87.56	1.5	681
	derived – disturbance area-A	not a TEC	2.6	-2.6	34.53	1.5	0
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	modified 'bull' – permanent	not a TEC	66.4	-66.4	1.82	1.5	45
	modified 'bull' – maintenance	not a TEC	66.4	-24.1	4.53	1.5	41
	modified 'whipstick' – permanent	not a TEC	73.4	-73.4	16.64	1.5	458
	modified 'whipstick' – maintenance	not a TEC	73.4	-28.1	32.48	1.5	342
PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone	modified 'whipstick' – disturbance area-A	not a TEC	61.9	-61.9	8.69	1.5	202
	modified 'whipstick' – disturbance area-B	not a TEC	61.9	-18.9	19.48	1.5	138

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
PCT 221 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	modified – disturbance area-A	not a TEC	66.2	-62.6	1.26	1.5	31
	modified – disturbance area-B	not a TEC	66.2	-12.7	2.11	1.5	10
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion	modified – disturbance area-A	not a TEC	28.3	-28.3	0.73	1.75	9
	modified – disturbance area-B	not a TEC	28.3	-10.9	1.66	1.75	8
	derived – disturbance area-A	not a TEC	0.6	-0.6	5.32	1.75	0
Total ecosystem credit obligation							**6,775**

12.1.2 SPECIES CREDIT OFFSET

Species credits required by the proposal for impacts calculated in the South Olary Plain IBRA subregion are outlined in Table 12.2.

Table 12.2 Biodiversity offset species credit obligation for South Olary Plain IBRA subregion

SCIENTIFIC NAME	COMMON NAME	BC ACT	VEGETATION INTEGRITY LOSS	VEGETATION ZONE	AREA / COUNT	BIODIVERSITY RISK WEIGHTING	POTENTIAL SAII	SPECIES CREDITS
Acacia acanthoclada	Harrow Wattle	E	-73.4	PCT 171 – modified 'whipstick' disturbance area-A	0.01 ha	2	No	1
Austrostipa nullanulla	A spear-grass	E	-39.7	PCT 253 – modified 'boninka' disturbance area-A	0.11 ha	3	Yes	3
			-32.6	PCT 253 – modified 'lunette' disturbance area-A	2.07 ha			51
Santalum murrayanum	Bitter Quandong	E	n/a	PCT 170 – modified 'whipstick' disturbance area-A	6 individuals	2	No	12
				PCT 170 – modified 'whipstick' disturbance area-B	8 individuals			16
				PCT 171 – modified 'whipstick' disturbance area-B	4 individuals			8
Total species credits obligation								**91**

12.2 GREAT DARLING ANABRANCH IBRA SUBREGION

12.2.1 ECOSYSTEM CREDIT OFFSET

Ecosystem credits required by the proposal for impacts calculated in the Great Darling Anabranch IBRA subregion are outlined in Table 12.3.

Table 12.3 Biodiversity offset ecosystem credit obligation for Great Darling Anabranch IBRA subregion

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Saline Wetlands							
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	modified – disturbance area-A	not a TEC	74.8	-74.8	0.24	1.5	7
Semi-arid Woodlands (Grassy sub-formation)							
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW	modified – disturbance area-A	not a TEC	72	-72	7.16	1.75	225
	modified – disturbance area-B	not a TEC	72	-33.4	12.07	1.75	176

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Semi-arid Woodlands (Shrubby sub-formation)							
PCT 19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area-A	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	50.3	-50.3	0.47	2	12
	modified – disturbance area-B		50.3	-8.1	1.20	2	5
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	modified – disturbance area-A	not a TEC	67.4	-67.4	0.13	1.75	4
	modified – disturbance area-B	not a TEC	67.4	-12.1	0.59	1.75	3
	derived – disturbance area-A	not a TEC	0.7	-0.7	0.06	1.75	0
Total ecosystem credit obligation							**432**

12.3 POONCARIE-DARLING IBRA SUBREGION

12.3.1 ECOSYSTEM CREDIT OFFSET

Ecosystem credits required by the proposal for impacts calculated in the Pooncarie - Darling Anabranch IBRA subregion are outlined in Table 12.4.

Table 12.4 Biodiversity offset ecosystem credit obligation for Pooncarie-Darling IBRA subregion

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Arid shrublands (Acacia sub-formation)							
PCT 139 – Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions	modified – disturbance area-A	not listed	73	-73	1.11	1.75	35
	modified – disturbance area-B	not listed	73	-50.3	0.94	1.75	21
Arid Shrublands (Chenopod sub-formation)							
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	modified – disturbance area-A	Not listed	83.6	-83.6	5.20	1.5	163
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	modified – disturbance area-B	not listed	95.2	-95.2	0.15	1.5	5

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Forested Wetlands							
PCT 11 – 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)	modified – disturbance area-A	not listed	59.8	-59.8	1.05	1.5	24
	modified – disturbance area-B	not listed	59.8	-39.5	0.43	1.5	6
Saline Wetlands							
PCT 63 – Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	modified – disturbance area-A	not listed	38.9	-38.9	0.30	1.5	4
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	modified – disturbance area-A	not listed	60.3	-60.3	2.29	1.5	52
Semi-arid Woodlands (Grassy sub-formation)							
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	not listed	74.7	-74.7	20.54	1.75	671
	modified – disturbance area-B	not listed	74.7	-27.1	40.55	1.75	480

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Semi-arid Woodlands (Shrubby sub-formation)							
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	modified – disturbance area-A	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	66.5	-66.5	0.46	2	15
	modified – disturbance area-B		66.5	-10.6	0.68	2	4
Total ecosystem credit obligation							**1480**

12.4 ROBINVALE PLAIN IBRA SUBREGION

12.4.1 ECOSYSTEM CREDITS

Ecosystem credits required by the proposal for impacts calculated in the Robinvale Plain IBRA subregion are outlined in Table 12.5.

Table 12.5 Biodiversity offset ecosystem credit obligation for Robinvale Plain IBRA subregion

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Arid Shrublands (Chenopod sub-formation)							
PCT216 – Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion	modified – permanent	Not listed	70.1	-70.1	0.54	1.5	14
Forested Wetlands							
PCT 11 – 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)	modified – disturbance area-A	not listed	60.3	-60.3	0.10	1.5	2
	modified – disturbance area-B	not listed	60.3	-33.8	0	1.5	0
Freshwater Wetlands							
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	not listed	59.5	-59.5	0.04	1.75	1

NATIVE VEGETATION TYPES	VEGETATION ZONE	THREATENED ECOLOGICAL COMMUNITY	CURRENT VEGETATION INTEGRITY	VEGETATION INTEGRITY LOSS	AREA (HA)	BIODIVERSITY RISK WEIGHTING	ECOSYSTEM CREDITS
Semi-arid Woodlands (Grassy sub-formation)							
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	modified – disturbance area-A	not listed	74	-74	2.25	1.75	73
	modified – disturbance area-B	not listed	74	-29.8	4.56	1.75	59
	derived – disturbance area-A	not listed	18.6	-18.6	0.47	1.75	4
Semi-arid Woodlands (Shrubby sub-formation)							
PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	modified – disturbance area-A	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – Endangered BC Act	46.2	-46.2	0.18	2	4
	modified – disturbance area-B		46.2	-12	0.17	2	1
Total direct impact on native vegetation							**158**

12.4.2 SPECIES CREDIT OFFSET

Species credits required by the proposal for impacts calculated in the Robinvale Plain IBRA subregion are outlined in Table 12.6.

Table 12.6 Biodiversity offset species credit obligation for Robinvale Plain IBRA subregion

SCIENTIFIC NAME	COMMON NAME	BC ACT	VEGETATION INTEGRITY LOSS	VEGETATION ZONE	AREA / COUNT	BIODIVERSITY RISK WEIGHTING	POTENTIAL SAII	SPECIES CREDITS
Threatened flora species								
Atriplex infrequens	A saltbush	V	-74	PCT 13 – modified disturbance area-A	0.18 ha	2	No	7
			-18.6	PCT 13 – derived disturbance area-A	0.04 ha			1
			-59.5	PCT 17 – modified disturbance area-A	0.04 ha			1
Threatened fauna species								
Polytelis anthopeplus monarchoides	Regent Parrot (eastern subspecies)	E	-60.3	PCT 11 – modified disturbance area-A	0.10 ha	2	No	3
			-74	PCT 13 – modified disturbance area-A	2.25 ha			83
			-29.8	PCT 13 – modified disturbance area-B	4.56 ha			68
Total species credits obligation								**163**

12.5 SUMMARY OVERVIEW OF PROPOSAL OFFSET OBLIGATION

12.5.1 ECOSYSTEM CREDIT OFFSET

Table 12.7 Summary of biodiversity offset ecosystem credit obligation for the proposal

VEGETATION TYPE	SOP	GDA	PD	RP	TOTAL CREDITS
Arid Shrublands (Acacia sub-formation)					
PCT 139 – Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions	0	0	56	0	**56**
PCT 143 – Narrow-leaved Hopbush – Scrub Turpentine – Senna shrubland on semi-arid and arid sandplains and dunes	34	0	0	0	**34**
Arid Shrublands (Chenopod sub-formation)					
PCT 153 – Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	1,183	0	163	0	**1,346**
PCT 154 – Pearl Bluebush low open shrubland of the arid and semi-arid plains	263	0	5	0	**268**
PCT216 – Black Roly Poly low open shrubland of the Riverina Bioregion and Murray Darling Depression Bioregion	0	0	0	14	**14**
Forested Wetlands					
PCT11 – 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)	0	0	30	2	**32**
Freshwater Wetlands					
PCT17 – Lignum shrubland wetland of the semi-arid (warm) plains (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	0	0	0	1	**1**
Saline Wetlands					
PCT 63 – Spiny Lignum – Slender Glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	0	0	4	0	**4**
PCT 166 – Disturbed annual saltbush forbland on clay plains and inundation zones mainly of south-western NSW	0	7	52	0	**59**
PCT 253 – Gypseous shrubland on rises in the semi-arid and arid plains	67	0	0	0	**67**
Semi-arid Woodlands (Grassy sub-formation)					
PCT13 – Black Box – Lignum woodland wetland of the inner floodplains in the semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	0	0	0	136	**136**
PCT 15 – Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	36	401	1,151	0	**1,588**

VEGETATION TYPE	SOP	GDA	PD	RP	TOTAL CREDITS
Semi-arid Woodlands (Shrubby sub-formation)					
PCT19 – Cypress Pine woodland of source-bordering dunes mainly on the Murray and Murrumbidgee River floodplains	20	17	0	5	**42**
PCT 21 – Slender Cypress Pine – Sugarwood – Western Rosewood open woodland on sandy rises mainly in the Riverina Bioregion and Murray Darling Depression Bioregion	255	0	19	0	**274**
PCT 58 – Black Oak – Western Rosewood open woodland on deep sandy loams mainly in the Murray Darling Depression Bioregion	1,520	7	0	0	**1,527**
PCT 170 – Chenopod sandplain mallee woodland/shrubland of the arid and semi-arid (warm) zones	2,113	0	0	0	**2,113**
PCT 171 – Spinifex linear dune mallee mainly of the Murray Darling Depression Bioregion	886	0	0	0	**886**
PCT 172 – Deep sand mallee of irregular dunefields of the semi-arid (warm) zone	340	0	0	0	**340**
PCT 221 – Black Oak – Pearl Bluebush open woodland of the sandplains of the semi-arid warm and arid climate zones	41	0	0	0	**41**
PCT 252 – Sugarwood open woodland of the inland plains mainly Murray Darling Depression Bioregion	17	0	0	0	**17**
Total ecosystem credit obligation	**6,775**	**432**	**1,480**	**158**	**8,845**

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

12.5.2 SPECIES CREDIT OFFSET

Table 12.8 Summary of biodiversity offset species credit obligation for the proposal

THREATENED SPECIES	SOP	GDA	PD	RP	TOTAL CREDITS
Threatened flora species					
Acacia acanthoclada (Harrow Wattle)	1	0	0	0	**1**
Atriplex infrequens (A saltbush)	0	0	0	9	**9**
Austrostipa nullanulla (A spear-grass)	54	0	0	0	**54**
Santalum murrayanum (Bitter Quandong)	36	0	0	0	**36**
Subtotal of threatened flora species credits	*91*	*0*	*0*	*9*	***100***
Threatened fauna species					
Polytelis anthopeplus monarchoides (Regent Parrot (eastern subspecies)	0	0	0	154	**154**
Subtotal of threatened fauna species credits	*0*	*0*	*0*	*154*	***154***
Total species credit obligation	**91**	**0**	**0**	**163**	**254**

Note: IBRA subregions
SOP – South Olary Plain
GDA – Great Darling Anabranch
PD – Pooncarie-Darling
RP – Robinvale Plain

12.6 BIODIVERSITY OFFSET STRATEGY

The biodiversity offset strategy for this proposal, that would enable the credit obligations to be met, comprises four options. These options are:

- the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register
- establishing biodiversity stewardship site(s) on lands with like for like biodiversity values to those impacted by the proposal
- making a payment into the Biodiversity Conservation Fund
- alternative strategic offset outcomes.

12.6.1 EXISTING BIODIVERSITY CREDITS

The purchase and retirement of existing biodiversity credits is required to be undertaken based on like for like trading rules as outlined under the BC Reg and as identified by the BAM calculator output for the proposal (see Appendix G).

12.6.1.1 ECOSYSTEM CREDIT OPTIONS – LIKE FOR LIKE

Like for like ecosystem credit trading rules are based around two main principles, being offsets for impacts on threatened ecological communities and offset for impacts on the habitat of threatened species that are ecosystem credit species or other native vegetation (other than impacts on threatened ecological communities). The like for like ecosystem credit trading rules are:

In the case of impacts on threatened ecological communities, like-for-like biodiversity credits represent:

- the same threatened ecological community located in:
  - the same or an adjoining Interim Biogeographic Regionalisation of Australia subregion as the impacted site, or
  - any such subregion that is within 100 kilometres of the outer edge of the impacted site, and
- if the threatened ecological community contains hollow bearing trees--vegetation that contains hollow bearing trees.

In the case of impacts on the habitat of threatened species that are ecosystem credit species or other native vegetation (other than impacts on threatened ecological communities), like-for-like biodiversity credits represent:

- the same class of native vegetation located in:
  - the same or an adjoining Interim Biogeographic Regionalisation of Australia subregion as the impacted site, or
  - any such subregion that is within 100 kilometres of the outer edge of the impacted site, and
- the same or a higher offset trading group, and
- if the impacted habitat contains hollow bearing trees – vegetation that contains hollow bearing trees.

In circumstances where like for like ecosystem credits options are not available, variations rules may be applied as outlined in Section of the BC Reg.

The like for like ecosystem credit class options for the proposal biodiversity offset credit obligation is summarised for each IBRA subregion in Table 12.9, Table 12.10, Table 12.11 and Table 12.12.

Table 12.9 Like for like ecosystem credit classes and trading group options for the South Olary Plain IBRA subregion

PCT	CLASS	TRADING GROUP	HBT	IBRA REGION
15	Inland Floodplain Woodlands. This includes PCT's: 13, 15, 16, 83, 438, 454, 630	Inland Floodplain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	Yes	South Olary Plain, Barrier Range Outwash, Darling Depression, Great Darling Anabranch, Lachlan, Menindee, Murray Fans, Murray Scroll Belt, Murrumbidgee, Pooncarie-Darling and Robinvale Plains. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
19	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – TEC This includes PCT's: 19, 21, 28, 48, 75		Yes	
21			Yes	
58	Semi-arid Sand Plain Woodlands This includes PCT's: 58, 252	Semi-arid Sand Plain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	Yes	
143	Sand Plain Mulga Shrublands This includes PCT's: 69, 119, 124, 128, 129, 139, 140, 143, 199, 215, 220, 232	Sand Plain Mulga Shrublands – < 50% cleared group (including Tier 7 or higher)	No	
153 154	Aeolian Chenopod Shrublands This includes PCT's: 151, 152, 153, 154, 222, 225	Aeolian Chenopod Shrublands – < 50% cleared group (including Tier 7 or higher)	No	
170	Sand Plain Mallee Woodlands This includes PCT's: 142, 170, 173, 174, 190, 193, 355, 474	Sand Plain Mallee Woodlands – < 50% cleared group (including Tier 7 or higher)	Yes	
171 172	Dune Mallee Woodlands This includes PCT's: 171, 172, 191	Dune Mallee Woodlands – < 50% cleared group (including Tier 7 or higher)	Yes	
221	Semi-arid Sand Plain Woodlands This includes PCT's: 57, 58, 59, 221, 252	Semi-arid Sand Plain Woodlands – < 50% cleared group (including Tier 7 or higher)	Yes	South Olary Plain, Barrier Range Outwash, Darling Depression, Great Darling Anabranch, Lachlan, Menindee, Murray Fans, Murray Scroll Belt, Murrumbidgee, Pooncarie-Darling and Robinvale Plains. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
252	Semi-arid Sand Plain Woodlands This includes PCT's: 58, 252	Semi-arid Sand Plain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	Yes	
252	Inland Saline Lakes This includes PCT's: 18, 62, 63, 64, 65, 149, 162, 164, 166, 189, 198, 253, 262, 263	Inland Saline Lakes – < 50% cleared group (including Tier 7 or higher)	No	

Table 12.10 Like for like ecosystem credit classes and trading group options for the Great Darling Anabranch IBRA subregion

PCT	CLASS	TRADING GROUP	HBT	IBRA REGION
15	Inland Floodplain Woodlands. This includes PCT's: 13, 15, 16, 83, 438, 454, 630	Inland Floodplain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	Yes	Great Darling Anabranch, Menindee, Murray Scroll Belt and South Olary Plain. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
19	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – TEC This includes PCT's: 19, 21, 28, 48, 75		Yes	
58	Semi-arid Sand Plain Woodlands This includes PCT's: 58, 252	Semi-arid Sand Plain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	No	
166	Inland Saline Lakes This includes PCT's: 18, 62, 63, 64, 65, 149, 162, 164, 166, 189, 198, 253, 262, 263	Inland Saline Lakes – < 50% cleared group (including Tier 7 or higher)	No	

Table 12.11 Like for like ecosystem credit classes and trading group options for the Pooncarie - Darling IBRA subregion

PCT	CLASS	TRADING GROUP	HBT	IBRA REGION
11	Inland Riverine Forests This includes PCT's: 2, 5, 7, 8, 9, 10, 11, 36, 78, 112, 233, 234, 249, 356, 362	Inland Riverine Forests – < 50% cleared group (including Tier 7 or higher)	Yes	Great Darling Anabranch, Menindee, Murray Scroll Belt and South Olary Plain. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
15	Inland Floodplain Woodlands. This includes PCT's: 13, 15, 16, 83, 438, 454, 630	Inland Floodplain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	Yes	
21	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – TEC This includes PCT's: 19, 21, 28, 48, 75		Yes	
139	Sand Plain Mulga Shrublands This includes PCT's: 69, 128, 139, 220	Sand Plain Mulga Shrublands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	No	
153 154	Aeolian Chenopod Shrublands This includes PCT's: 151, 152, 154, 222, 225	Aeolian Chenopod Shrublands – < 50% cleared group (including Tier 7 or higher)	No	
166	Inland Saline Lakes This includes PCT's: 18, 62, 63, 64, 65, 149, 162, 164, 166, 189, 198, 253, 262, 263	Inland Saline Lakes – < 50% cleared group (including Tier 7 or higher)	No	

Table 12.12 Like for like ecosystem credit classes and trading group options for the Robinvale Plain IBRA subregion

PCT	CLASS	TRADING GROUP	HBT	IBRA REGION
11	Inland Riverine Forests This includes PCT's: 2, 5, 7, 8, 9, 10, 11, 36, 78, 112, 233, 234, 249, 356, 362	Inland Riverine Forests – < 50% cleared group (including Tier 7 or higher)	Yes	Robinvale Plains, Murray Fans, Murray Scroll Belt, Murrumbidgee and South Olary Plain. or Any IBRA subregion that is within 100 km of the outer edge of the impacted site.
13	Inland Floodplain Woodlands This includes PCT's: 13, 15, 16, 83, 438, 454, 630	Inland Floodplain Woodlands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	No	
17	Inland Floodplain Shrublands This includes PCT's: 17, 115, 161, 241, 247, 375	Inland Floodplain Shrublands – ≥ 50% – < 70% cleared group (including Tier 6 or higher)	No	
19	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions – TEC This includes PCT's: 19, 21, 28, 48, 75		No	
216	Riverine Chenopod Shrublands This includes PCT's: 157, 158, 159, 163, 165, 168, 195, 196, 211, 212, 216, 236, 254, 377, 466	Riverine Chenopod Shrublands – < 50% cleared group (including Tier 7 or higher)	No	

12.6.1.2 SPECIES CREDIT OPTIONS – LIKE FOR LIKE

In the case of impacts on threatened species that are species credit species, like-for-like biodiversity credits represent the same threatened species. Like for like species may be sourced from anywhere in NSW. In circumstances where like for like species credits options are not available, variations rules may be applied that include:

- if the impacted species is a plant-they represent a plant, and
- if the impacted species is an animal-they represent an animal, and
- they represent a species that has the same or a higher category of listing under Part 4 of the Act as a threatened species, and
- they represent a location that is in:
  - the same or an adjoining Interim Biogeographic Regionalisation of Australia subregion as the impacted site, or
  - any such subregion that is within 100 kilometres of the outer edge of the impacted site.

12.6.2 ESTABLISHMENT OF BIODIVERSITY STEWARDSHIP AGREEMENTS

Under the BC Act, land with biodiversity values can be established under a biodiversity stewardship agreement to allow for in-perpetuity conservation and management. Biodiversity stewardship agreements allow the landholder to create biodiversity credits that can be traded to offset development impacts. TransGrid are actively progressing a number of potential biodiversity stewardship sites that have been identified to contain like for like biodiversity values to those identified within the indicative disturbance area.

12.6.3 PAYMENT INTO THE BIODIVERSITY CONSERVATION FUND

Payments for the proposal offset obligations could be paid into the Biodiversity Conservation Fund although it should be noted that payment for offsets are subject to change and that credit payment prices are reviewed quarterly.

12.6.4 TIMING OF BIODIVERSITY OFFSET PROVISION

The calculations in this BDAR are based on indicative disturbance areas only, as detailed design for the proposal has not yet been completed.

Accordingly, the final biodiversity offset liability is subject to the timing of detailed design refinements and would be determined at that stage.

13 CONCLUSION

The proposal is required to complete the missing link between the SA and NSW transmission networks, connecting the outreaches of the state networks at Chowilla in SA and Buronga in NSW. The proposal's upgrade to the existing transmission line between Buronga and Red Cliffs would also enhance the capacity of the network to provide electricity between NSW and Victoria.

This report has been prepared in accordance with the BC Act, BC Reg, BAM and EPBC Act. It specifically:

- provides an assessment of biodiversity values within the proposal study area and indicative disturbance area
- demonstrates the proposals effort to avoid and minimise impacts on biodiversity values
- provides mitigation and management of impacts on biodiversity values
- calculates the offset requirement for impacts on biodiversity values that are unable to be avoided
- provides an assessment of significance on threatened species, ecological communities or their habitats listed under the FM Act and EPBC Act.

13.1 AVOIDANCE AND DESIGN REFINEMENTS

The proposal has been refined to avoid and minimise potential impacts on biodiversity values including:

- positioning of the transmission line corridor (which contains the indicative disturbance area) to co-locate where possible with existing infrastructure (i.e. Renmark Road and existing Broken Hill to Buronga 220kV electrical infrastructure) to reduce impacts on biodiversity values
- relocation of transmission line corridor from southern side of Renmark Road to the northern side to avoid impacts on the critically endangered threatened flora species *Dodonaea stenozyga* and the endangered flora species *Acacia acanthoclada*.
- relocation of indicative disturbance area south at Nulla Station to avoid high biodiversity value areas that contain a population of the endangered flora species *Austrostipa nullanulla*
- positioning of the transmission line corridor to co-locate with the existing Broken Hill to Buronga 220kV electrical infrastructure to avoid impacts on individuals of the vulnerable flora species *Atriplex infrequens*.

Ongoing commitment to avoid and minimise impacts on biodiversity values would be further achieved through micro siting new transmission line structures, brake/winch sites and access tracks during the detailed design phase.

13.2 IMPACT SUMMARY

Impacts unable to be avoided by the proposal have been assessed in accordance with Stage 2 of the BAM, Item 16 of Appendix A of the SEARs and Matters of National Environmental Significance - Significant impact guidelines 1.1 (2013) EPBC Act.

Impacts on biodiversity values resulting from the proposal are:

- the proposal will directly impact on 20 native vegetation PCTs and one threatened ecological community. Direct impacts on native vegetation because of the proposal will include:
  - direct impacts on up to 606.76 hectares of native vegetation (full disturbance in disturbance area A is 313.99 hectares, partial disturbance in disturbance area B is 292.77 hectares)
  - the loss of up to 14.02 hectares of threatened ecological community in the form of Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions which is listed as endangered under the BC Act

- indirect impacts on native vegetation are considered unlikely due to shrub and ground stratum native vegetation retention to a height of two meters in areas buffering direct permanent loss. Mitigation measure would further ensure any residual indirect impact to native vegetation is managed during both the construction and operational phases of the proposal
- the proposal is considered unlikely to lead to any adverse impact on groundwater dependent ecosystems
- impacts on threatened species have been determined in accordance with the BAM based on predicted or ecosystem credit species and species credit species. Impacts resulting from the proposal on threatened species includes:
  - a total of 55 threatened fauna species have been identified as predicted or ecosystem credit species
  - a total of four threatened flora species credit species have been identified as affected by the proposal. These include impacts to:
    - 0.01 hectares of habitat for *Acacia acanthoclada* (Harrow Wattle)
    - 0.26 hectares of habitat for *Atriplex infrequens* (A saltbush)
    - 2.18 hectares of habitat for *Austrostipa nullanulla* (A spear-grass)
    - 18 individuals of *Santalum murrayanum* (Bitter Quandong)
  - a total of one threatened fauna species credit species have been identified as affected by the proposal. This include impacts to:
    - 6.91 hectares of habitat for *Polytelis anthopeplus monarchoides* (Regent Parrot (eastern subspecies)).
- the proposal is considered unlikely to lead to a significant impact on threatened aquatic species, ecological communities or their habitats.

In terms of impacts on Matters of National Environmental Significance the proposal will:

- not impact on any listed threatened ecological communities
- impact on known or assumed habitat for one threatened flora species listed under the EPBC Act
- impact on known or assumed habitat for 17 threatened fauna species comprising of one amphibian, 12 birds, three fish and one mammal listed under the EPBC Act
- impact on potential habitat for 24 migratory species listed under the EPBC Act.

The impact assessment outcomes for Matters of National Environmental Significance conclude that:

- the proposal is unlikely to lead to a significant impact on any threatened species and/or their habitat listed under the EPBC Act
- the proposal is considered unlikely to substantially modify, destroy or isolate an area of important habitat for any EPBC Act listed migratory species and is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds
- the proposal would not impact on any wetlands of national or international importance.

13.3 MANAGEMENT AND MITIGATION

The specific performance outcomes for the proposal regarding biodiversity include:

- minimising or where possible avoiding impacts to threatened flora and fauna species, and ecological communities listed under the BC Act and EPBC Act
- offsetting impacts to threatened ecological communities and species.

A Construction Environmental Management Plan (CEMP) describes the approach to environmental management, monitoring and reporting during construction. Specifically, it lists the requirements to be addressed by the construction contractor including sub-plans, and other supporting documentation for each specific environmental aspect.

Specific sub-plans from the CEMP that would be developed to address biodiversity values would include a Biodiversity Management Sub-Plan (BMP).

13.4 OFFSETTING BIODIVERSITY IMPACTS

Residual impacts that are not able to be managed through mitigation would be offset in accordance with BAM calculations for both ecosystem and species credits. The proposal offset obligation has been calculated to require the following biodiversity credits:

- 8,845 ecosystem credits
- 254 species credits.

The proposal offset obligations would be met through implementing a combination of the following offset delivery options, being:

- the purchase and retirement of existing biodiversity credits currently available on the biodiversity credit register
- establishing biodiversity stewardship site(s) on lands with like for like biodiversity values to those impacted by the proposal
- making a payment into the Biodiversity Conservation Fund
- alternative strategic offset outcomes.

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- I.R.K Sluiter. (2010). On the distribution, ecology and conservation status of three rare plant taxa *Zygophyllum compressum*, *Elachanthus glaber* and *Eremophila crassifolia* in southwestern New South Wales. Cunninghamia, 11(4), 419–424.
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- VicFlora. (2020). Flora of Victoria Comprehensive Guide. Retrieved from https://vicflora.rbg.vic.gov.au/.
- WSP. (2020). Preliminary Biodiversity Assessment - EnergyConnect (NSW - Western Section). Retrieved from Newcastle, NSW.

Table 14.1 References reliability and uncertainty analysis

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
Atlas of Living Australia. (2020). Atlas of Living Australia Database.	Atlas of Living Australia (ALA) is a collaborative digital resource that pulls together Australian biodiversity data from multiple sources, including natural history collections, universities and research agencies, government departments (national, state and local), as well as non-government agencies and community groups. As such, a reasonable level of reliability is assumed however verification against other sources of data should always be considered.	Any uncertainties identified should be considered in the context of data source (i.e. Government, consultant, community etc) and verified against other sources of data (i.e BioNet)
Australian Weeds Committee. (2020). Weeds of National Significance (WoNS) Retrieved from http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html	This is a government webpage informed by specialists. As such, a moderate to high level of reliability is assumed being a government prepared and released resource.	As a Government resource a low level of uncertainty can be assumed.
Avian Power Line Interaction Committee (APLIC). (2012). Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Retrieved from Washington, D.C.	This is a specialist report prepared by scientifically robust committee of experts. As such, a moderate to high level of reliability is assumed being a specialist paper.	A low level of uncertainty can be assumed, due to scientific peer review process and expert contribution before publication of specialist paper.
Bureau of Meteorology. (2020). Bureau of Meteorology - Groundwater Dependent Ecosystems Atlas. Retrieved from http://www.bom.gov.au/water/groundwater/gde/	This is a government webpage informed by specialists. As such, a moderate to high level of reliability is assumed being a government prepared and released resource.	As a Government resource a low level of uncertainty can be assumed.
Eamus, D., Froend, R., Loomes, R., Hose, G., & Murray, B. (2006). A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. Australian Journal of Botany, 24, 97–114.	This is a scientific paper prepared by multiple specialists and published by credible academic journal. This paper has been assessed through scientifically robust process of reviews by external experts' committees. As such, a moderate to high level of reliability is assumed being a scientific paper.	A low level of uncertainty can be assumed, due to scientific peer review process before publication within an academic journal.

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
Environment Energy and Science Group Environment Energy and Science Group. (2020a, 6 January 2020). Areas of Outstanding Biodiversity Value register. Retrieved from https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value/area-of-outstanding-biodiversity-value-register Environment Energy and Science Group. (2020b, 21 January 2020). BioNet Atlas of NSW Wildlife. Retrieved from http://www.bionet.nsw.gov.au/ Environment Energy and Science Group. (2020c). BioNet Vegetation Classification Database Version 2.1. Environment Energy and Science Group. (2020d). Saving our Species (SoS) database. Retrieved from https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/saving-our-species-program/saving-our-species-database Environment Energy and Science Group. (2020e). Threatened Species Profile Database. Retrieved from http://www.bionet.nsw.gov.au/	These documents, guidelines, databases, and webpages have been prepared by qualified specialists representing the government in their various field. As such, a moderate to high level of reliability is assumed being a government prepared and released resource.	As a Government resource a low level of uncertainty can be assumed.
Fisheries Scientific Committee. (2003). Aquatic Ecological Community in the natural drainage system of the Lowland Catchment of The Darling River.	This is a specialist report prepared by scientifically robust committee of experts. As such, a moderate to high level of reliability is assumed being a specialist paper.	A low level of uncertainty can be assumed, due to scientific peer review process and expert contribution before publication of specialist paper.
Hatton, T., & Evans, R. (1998). Dependence of ecosystems on groundwater and its significance to Australia. Retrieved from Canberra.	This is an occasional paper, prepared by specialist from the CSIRO for the government. As such, a moderate to high level of reliability is assumed being a specialist paper.	A low level of uncertainty can be assumed, due to scientific peer review process and expert contribution before publication of specialist paper.

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
I.R.K Sluiter. (2010). On the distribution, ecology and conservation status of three rare plant taxa *Zygophyllum compressum*, *Elachanthus glaber* and *Eremophila crassifolia* in southwestern New South Wales. Cunninghamia, 11(4), 419–424.	This is a scientific paper prepared by multiple specialists and published by credible academic journal. This paper has been assessed through scientifically robust process of reviews by external experts' committees. As such, a moderate to high level of reliability is assumed being a scientific paper	A low level of uncertainty can be assumed, due to scientific peer review process before publication within an academic journal.
Jacobs (2019a) Project EnergyConnect – EPBC Act Protected Matters Significant Impact Assessment – SA / NSW Border to Buronga, Draft	The report was prepared by suitably qualified ecologists based on preliminary field surveys and reviews of relevant publicly available desktop sources. As such, a reasonably high level of reliability is assumed however more recent reports using further extensive survey results should be deemed more reliable.	Any uncertainties identified in the cited text should be considered in the context of the uncertainties of those database, desktop and preliminary field survey results presented and would be subject to completion of further detailed surveys.
Jacobs (2019b) Preliminary Ecological Constraints Assessment, prepared for ElectraNET and TransGrid	The report was prepared by suitably qualified ecologists based largely on reviews of relevant publicly available desktop sources. As such, a reasonable level of reliability is assumed however field verification associated with other reports should be deemed more reliable.	Any uncertainties identified in the cited text should be considered in the context of the uncertainties of those database, desktop and preliminary field survey results presented and would be subject to completion of further detailed surveys.
Pennay, M., Law, B., & Reinhold, L. (2004). Bat calls of NSW. Region based guide to the echolocation calls of microchiropteran bats. Retrieved from Sydney.	This is guideline has been prepared by specialists in the field. . As such, a moderate to high level of reliability is assumed being a specialist paper.	A low level of uncertainty can be assumed, due to scientific peer review process and expert contribution before publication of specialist paper.
Royal Botanic Gardens. (2020). Plantnet - The Plant Information Network System of Botanic Gardens Trust Version 2.0. Retrieved from http://plantnet.rbgsyd.nsw.gov.au/	This is a database has been prepared by a scientifically robust and diverse committee of experts. It is seen as trusted source within the scientific community. As such, a moderate to high level of reliability is assumed being a specialist paper.	A low level of uncertainty can be assumed, due to scientific peer review process and expert panel that contributes to this database.

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
State and Federal government bodies Department for Planning Industry and Environment. (2020). Surveying threatening plants and their habitats - NSW survey guide for the Biodiversity Assessment Method. Retrieved from Parramatta: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/surveying-threatened-plants-and-habitats-nsw-survey-guide-biodiversity-assessment-method-200146.pdf Department of Agriculture Water and the Environment. (2020a). Australian Faunal Directory Retrieved from https://biodiversity.org.au/afd/home Department of Agriculture Water and the Environment. (2020b). Species Profile and Threats Database (SPRAT). Retrieved from https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl Department of Environment and Climate Change. (2009). Threatened species survey and assessment guidelines: field survey methods for fauna - Amphibians. Department of Environment and Climate Change Retrieved from http://www.environment.nsw.gov.au/resources/threatenedspecies/09213amphibians.pdf. Department of Environment and Conservation. (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft). Retrieved from Hurstville: Department of Environment and Energy. (2020a). Directory of Important Wetlands in Australia. Department of Environment and Energy. (2020b). Species Profile and Threats Database (SPRAT). Retrieved from https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl	These documents, guidelines, databases, and webpages have been prepared by qualified specialists representing the government in their various field. As such, a moderate to high level of reliability is assumed being a government prepared and released resource.	As a Government resource a low level of uncertainty can be assumed.

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
Department of Environment Water Heritage and the Arts. (2010). Survey guidelines for Australia's threatened birds - Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Retrieved from Department of Infrastructure Planning and Natural Resources. (2004). Guideline for the Preparation of Environmental Management Plans. Retrieved from Sydney, NSW: Department of Land and Water Conservation. (2002). The NSW State Groundwater Dependent Ecosystem Policy. Retrieved from Sydney: Department of Planning and Environment. (2018). NSW Transmission Infrastructure Strategy. Retrieved from https://energy.nsw.gov.au/media/1431/download Department of Planning Industry and Environment. (2019). Guidance to assist a decisionmaker to determine a serious and irreversible impact. Retrieved from Goulburn Street, Sydney NSW 2000: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/guidance-decision-makers-determine-serious-irreversible-impact-190511.pdf Department of Planning Industry and Environment. (2020a). Mitchell Landscapes. Retrieved from: https://data.nsw.gov.au/data/dataset/nsw-mitchell-landscapes-version-3-1 Department of Planning Industry and Environment. (2020b). State Vegetation Type Map: Western Region v1.0. VIS_ID 4492. from Department of Planning, Industry and Environment https://data.nsw.gov.au/data/dataset/state-vegetation-type-map-western-region-v1-0-vis_id-4492		

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
Department of Primary Industries. (2020a). NSW WeedWise. Retrieved from https://weeds.dpi.nsw.gov.au/ Department of Primary Industries. (2020b). Threatened Aquatic Fauna Database Search. Retrieved from http://pas.dpi.nsw.gov.au/Species/Species_byRegion.aspx Department of the Environment. (2013). Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Canberra, ACT: Commonwealth of Australia. Department of the Environment. (2015). Draft Referral guideline for 14 birds listed as migratory species under the EPBC Act. Retrieved from http://www.environment.gov.au/system/files/resources/c05f5b87-0a99-4998-897e-7072c236cf83/files/migratory-birds-draft-referral-guideline.pdf Department of the Environment and Energy. (2016). An Interim Biogeographic Regionalisation of Australia (IBRA) - Version 7. Retrieved from Canberra: Department of the Environment Water Heritage and the Arts. (2010). Survey guidelines for Australia's threatened frogs - guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Water, Heritage and the Arts.		

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
State government bodies NSW Department of Primary Industries. (2020). Fisheries NSW Spatial Data Portal. Retrieved from https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal NSW Government. (2020a, 18/06/2020 (Version: 29)). Biodiversity Assessment Methodology - Calculator. NSW Government. (2020b). Spatial Services. Historical, Aerial and Satellite Imagery. Retrieved from https://portal.spatial.nsw.gov.au/portal/apps/sites/#/home/pages/map-viewers Office of Environment & Heritage. (2016). NSW Guide to Surveying Threatened Plants. Retrieved from Sydney: Office of Environment & Heritage. (2017). Biodiversity Assessment Method (BAM). Retrieved from Sydney: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/biodiversity-assessment-method Office of Environment & Heritage. (2018). 'Species credit' threatened bats and their habitats - NSW Survey guide for the Biodiversity Assessment Method. Retrieved from 59 Goulburn Street, Sydney, NSW Office of Environment Energy and Science. (2020). BioNet Atlas of NSW Wildlife. Retrieved from http://www.bionet.nsw.gov.au/	These documents, guidelines, databases, and webpages have been prepared by qualified specialists representing the government in their various field. As such, a moderate to high level of reliability is assumed being a government prepared and released resource.	As a Government resource a low level of uncertainty can be assumed.
Taylor, R. J., & Oneill, M. G. (1988). Summer Activity Patterns of Insectivorous Bats and Their Prey in Tasmania. Wildlife Research, 15(5), 533-539. doi:10.1071/WR9880533	This is a scientific paper prepared by multiple specialists and published by credible academic journal. This paper has been assessed through scientifically robust process of reviews by external experts' committees. As such, a moderate to high level of reliability is assumed being a scientific paper	A low level of uncertainty can be assumed, due to scientific peer review process before publication within an academic journal.

REFERENCE SOURCE	RELIABILITY	UNCERTAINTIES
VicFlora. (2020). Flora of Victoria Comprehensive Guide. Retrieved from https://vicflora.rbg.vic.gov.au/	This is a government webpage informed by specialists. As such, a moderate to high level of reliability is assumed being a government prepared and released resource.	As a Government resource a low level of uncertainty can be assumed.
WSP (2020a). EnergyConnect (NSW – Western Section) Scoping Report. Report prepared for TransGrid.	In this report, WSP has relied on information from publicly available desktop sources such as the NSW BioNet Atlas, Aboriginal Heritage Information Management System (AHIMS) database, and other published literature and reports. These sources are listed within the report. The report has been prepared by suitably qualified environmental consultants. As such, a reasonably high level of reliability is assumed in the context of the information presented.	Any uncertainties identified in the cited text should be considered in the context of the uncertainties of those database, desktop and preliminary field survey results presented and would be subject to completion of further detailed surveys.
WSP (2020b) EnergyConnect EPBC Act Protected Matters Significant Impact Assessment New South Wales WSP (2020c). EnergyConnect Preliminary Biodiversity Assessment. Report prepared for TransGrid	The report was prepared by suitably qualified ecologists based on preliminary field surveys and reviews of relevant publicly available desktop sources. As such, a reasonably high level of reliability is assumed	Any uncertainties identified in the cited text should be considered in the context of the uncertainties of those database, desktop and preliminary field survey results presented and would be subject to completion of further detailed surveys.

ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With 43,600 talented people in more than 550 offices across 40 countries, we engineer projects that will help societies grow for lifetimes to come.