

New Dubbo Bridge

Biodiversity Assessment

Roads and Maritime Services | February 2019



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Executive summary

Background

Roads and Maritime Services NSW (Roads and Maritime) proposes to build a new bridge over the Macquarie River and construct around 2.2 kilometres of new highway and intersection upgrades between the Thompson Street / Whylandra Street intersection and the River Street / Bourke Street intersection in Dubbo, NSW (the proposal).

The Newell Highway is the longest highway in NSW. This main north-south route runs through Dubbo, including crossing the Macquarie River over the Emile Serisier Bridge. This bridge crosses the river at a low level and is under water when the river floods, causing the bridge to close. When this occurs, long delays are experienced in the Dubbo town centre as all traffic is diverted across the LH Ford Bridge.

The LH Ford Bridge is a high level bridge but cannot currently carry higher mass limit (HML) vehicles such as B-Triple road trains. The LH Ford Bridge is currently undergoing strengthening works to accommodate HML vehicles (up to a 68 tonne B-Double configuration). These works are not expected to be completed until early 2020. Under existing conditions, all HML vehicles are required to travel via the Emile Serisier Bridge, which is susceptible to inundation during flood events. During these flood events, HML vehicles are required to make a substantial detour to re-join the Newell Highway, increasing journey times and decreasing the route's reliability.

The Dubbo region is also experiencing significant residential growth, with those areas seeing an increase in traffic volumes, worsening issues experienced when the Emile Serisier Bridge is closed due to flooding. The proposal will alleviate significant disruptions in Dubbo during a major flood when the Emile Serisier Bridge is under water and unable to be used.

A Review of Environmental Factors (REF) has been prepared to fulfil Roads and Maritime's obligations under s.5.5 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and s.5.7 in making decisions on the likely significance of any environmental impacts. This biodiversity assessment forms part of the REF prepared for the proposal and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act. Section 1.7 of the EP&A Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) is assessed using the test of significance outlined in s.7.3 of the BC Act.

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The approval applies to Roads and Maritime activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. As a result, Roads and Maritime proposals assessed via an REF:

- Must address and consider potential impacts on nationally listed threatened species, populations, ecological communities and migratory species, including application of the "avoid, minimise, mitigate and offset" hierarchy
- Do not require referral to the Federal Department of the Environment for these matters, even if the activity is likely to have a significant impact.

Roads and Maritime must consider impacts to nationally listed threatened species, ecological communities and migratory species as part of the approval process under the strategic assessment. To assist with this, assessments are required in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013).

A field survey was undertaken within the study area over two days in early September 2018 (5-6th) to ground-truth the results of the background research and habitat assessment. The

corridor field studies provide an inventory of terrestrial and aquatic flora and fauna (biodiversity) including a list of known and potential threatened communities, populations and species.

Existing environment

Four Plant Community Types have been identified in the study area based on floristic composition, geological substrate, and landscape position, these are described with reference to the NSW Vegetation Classification System. Portions of each PCT have been stratified according to condition classes and identify areas that are in poor and moderate condition. Planted native and exotic vegetation also occurs that cannot be matched to a PCT. The remainder of the study area were classified as highly disturbed areas of exotic grassland and pasture grazing and cropping land.

One number of the PCTs identified is consistent with a threatened ecological community listed under the NSW BC Act, 2016 as follows:

- Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act).

A background review and general surveys were conducted for threatened flora and fauna species listed under the BC Act and EPBC Act. No threatened flora and fauna were detected during surveys. There is potential habitat in the study area for one threatened plant species (*Diuris tricolor*) and seventeen fauna with a moderate likelihood of occurrence.

All fish and aquatic invertebrates (worms, crustaceans, insects, molluscs, rotifers etc.) in natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains in the Lower Darling region form part of *The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (Lowland Darling River aquatic ecological community) which is listed as an endangered ecological community under the Fisheries Management Act. The aquatic habitats in the study area were identified as providing potential habitat for the following species

- Trout Cod (Endangered species EPBC Act and FM Act)
- Murray Cod (Vulnerable EPBC Act)
- Eel Tailed Catfish (Endangered population FM Act)
- Olive Perchlet (Endangered population FM Act)
- Silver Perch (Endangered species EPBC Act, Vulnerable FM Act).

Potential impacts

Based on the current design, the estimated clearing of native vegetation for the proposal as a whole is about 0.74 hectares. No impacts to state listed TECs. The assessment identifies the loss of vegetation relevant to the proposal, in order to provide data that may be used to further avoid and minimise impacts to vegetation.

An assessment of significance was prepared in accordance with the BC Act (Section 7.3) and EPBC Act (Significant Impact Guidelines 1.1) for the identified TEC as a precaution. The assessment was based on the current proposal and has concluded that the proposal would not have a significant impact to a threatened species or threatened ecological community.

Avoidance and mitigation

As there will be residual impacts to biodiversity, mitigation measures would need to be implemented during the construction and operational phases to further lessen the potential ecological impacts of the proposal. The Roads and Maritime *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011a) identify a range of mitigation techniques to be applied and these techniques apply to this proposal.

Offsets

Roads and Maritime would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds described in the *RMS Guideline for Biodiversity Offsets* (2016). The current proposal is below the threshold for applying an offset under the Roads and Maritime Guideline, and therefore biodiversity offsets are not required.

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Glossary of terms

Glossary of terms	
Cumulative impact	The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Refer to Clause 228(2) of the EP&A Regulation 2000 for cumulative impact assessment requirements.
Direct impact	Where a primary action is a substantial cause of a secondary event or circumstance which has an impact on a protected matter (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2014).
Indirect impact	Where an event or circumstance is a direct consequence of the action (ref http://www.environment.gov.au/system/files/resources/0b0cfb1e-6e28-4b23-9a97-fdadda0f111c/files/environment-assessment-manual.pdf).
Matters of NES	A matter of national environmental significance (NES) protected by a provision of Part 3 of the EPBC Act
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000 (OEH 2014).
Mitigation	Action to reduce the severity of an impact. (OEH 2014).
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Population	All the individuals that interbreed within a given area.
Proposal area/ Proposal site	The area of land that is directly impacted on by a proposed Major Proposal that is under the EP&A Act, including access roads, and areas used to store construction materials (OEH 2014).
Study area	The area directly affected by the development and any additional areas likely to be affected by the development, either directly or indirectly (OEH 2014).
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure.
BBCC	BioBanking Credit Calculator
BC Act	Biodiversity Conservation Act 2016
BVT	Biometric Vegetation Type
CEMP	Construction Environmental Management Plan
DP&E	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community

Glossary of terms	
EIS	Environmental Impact Statement
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999 (Federal).
FM Act	Fisheries Management Act 1994 (NSW)
GDE	Groundwater dependent ecosystems
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
PCT	Plant Community Type
REF	Review of Environmental Factors
TECs	Threatened Ecological Communities
TSPD	Threatened Species Profile Database
VIS	Vegetation information system

1 Introduction

1.1 Proposal background

Roads and Maritime Services NSW (Roads and Maritime) proposes to build a new bridge over the Macquarie River and construct around 2.2 kilometres of new highway and intersection upgrades between the Thompson Street / Whylandra Street intersection and the River Street / Bourke Street intersection in Dubbo, NSW (the proposal).

The Newell Highway is the longest highway in NSW. This main north-south route runs through Dubbo, including crossing the Macquarie River over the Emile Serisier Bridge. This bridge crosses the river at a low level and is under water when the river floods, causing the bridge to close. When this occurs, long delays are experienced in the Dubbo town centre as all traffic is diverted across the LH Ford Bridge.

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The Dubbo region is also experiencing significant residential growth, with those areas seeing an increase in traffic volumes, worsening issues experienced when the Emile Serisier Bridge is closed due to flooding. The proposal will alleviate significant disruptions in Dubbo during a major flood when the Emile Serisier Bridge is under water and unable to be used.

1.2 The proposal

The proposal would include:

- Upgrading the Thompson Street / Victoria Street intersection on the Mitchell Highway to carry Performance Based Standard 3A (PBS 3A) heavy vehicles
- Replacing the existing T intersection at the Thompson Street / Whylandra Street (Newell Highway) intersection with a four way intersection with traffic lights that can accommodate heavy vehicles Providing a high level flood detour road to the west of the existing Emile Serisier Bridge
- Construction of about 2.2 kilometres of new carriageway with a single lane in each direction between the Thompson Street / Whylandra Street (Newell Highway) intersection and the River Street / Bourke Street (Newell Highway) intersection, including:
 - Two 3.5 metres wide lanes
 - A one metre wide painted median
 - A two metre wide shoulder on both sides of the road
- Construction of a new 16 span high level bridge over the Macquarie River and Brisbane Street. The new bridge would be about 545 metres long and 13 metres wide and would generally include:
 - Two 3.5 metres wide lanes
 - A one metre wide painted median
 - Twin rail safety barriers
 - A minimum vertical clearance of 0.5 metres over the Macquarie River in the 100 year annual reoccurrence interval (ARI) flood event
 - Flood immunity up to the 50 year ARI flood event, determined by the eastern abutment
 - Vertical clearance of 5.3 metres over Brisbane Street
- Construction of around 55 metres of retaining wall structures along sections of River Street
- Upgrading the existing four leg intersection at River Street/Newell Highway (Bourke Street) to include traffic lights that can accommodate heavy vehicle

- Construction of a new intersection between Darling Street and Brisbane Street
- Adjustments to the Brisbane Street/River Street and the Darling Street/River Street intersections including removal of access from Darling Street into River Street
- Road widening and tie-in works
- Construction of a high level flood route west of the intersection between Thompson Street/Whylandra Street (Newell Highway). Widening of the intersection between Mitchell Highway and Thompson Street is provided as part of this flood detour route to facilitate heavy vehicle movements when the flood route is in operation
- Relocation and adjustments of utilities, services, drainage and streetlights
- Property acquisitions, leases and adjustments
- Landscaping
- Temporary construction facilities including construction compounds, stockpile sites, crane pads, access tracks, erosion and sedimentation measures.

The location of the proposal is shown in **Figure 1-1** and an overview of the proposal is provided in **Figure 1-2**. **Chapter 3** describes the proposal in more detail.

1.2.1 Study area

The proposal is located in the city of Dubbo, NSW. Dubbo is located about 306 kilometres north-west of Sydney, within the Dubbo Regional Council local government area (LGA). Dubbo is a major regional centre for NSW, as it is an intersection for three major highways: the Newell, Mitchell and Golden Highways. The proposal is centred around the following roads:

- Thompson Street
- Emile Serisier Bridge
- Newell Highway
- River Street
- Darling Street
- Brisbane Street.

The study area surrounding the proposal includes a mix of residential, agricultural, recreational, industrial and transport related land uses. The main features of the proposal area and its surrounds include:

- Jehovah's Witness Temple facility and Riverside Church Dubbo on the west side of Macquarie River and the north side of Thompson Street near the intersection with Newell Highway
- Dubbo rail bridge, a State and National heritage item
- Mount Olive, a National trust property on the western bank of the Macquarie River
- Items of Aboriginal heritage interest
- Businesses on the River Street / Newell Highway intersection
- Businesses along River Street
- Residential properties along Thompson Street.

The Macquarie River follows a north-south route through the centre of Dubbo. The Main Western railway line, NSW, orientates west-east across the Macquarie River, to the south of the Emile Serisier Bridge.

1.3 Legislative context

1.3.1 Environmental Planning and Assessment Act 1979 (NSW)

A Review of Environmental Factors (REF) has been prepared to fulfil Roads and Maritime obligations under s.5.5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) to "examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity" and s.5.7 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms

part of the REF prepared for the New Dubbo Bridge proposal and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Under s.5.5 of the EP&A Act, Roads and Maritime must consider the effect of an activity on:

- Any conservation agreement entered into under the *National Parks and Wildlife Act 1974* (NP&W Act) any plan of management adopted under the NP&W Act for the conservation area to which the agreement relates
- Any joint management agreement entered into under the NSW [http://www.austlii.edu.au/au/legis/nsw/consol_act/tsca1995323/Biodiversity Conservation Act 2016](http://www.austlii.edu.au/au/legis/nsw/consol_act/tsca1995323/Biodiversity%20Conservation%20Act%202016) (BC Act)
- Any Biodiversity Stewardship Agreement entered into under the BC Act
- Any wilderness area (within the meaning of the *Wilderness Act 1987*) in the locality
- Critical habitat
- Threatened, populations and ecological communities, and their habitats and whether there is likely to be a significant effect
- Any other protected fauna or protected native plants within the meaning of the BC Act.

1.3.2 Biodiversity Conservation Act 2016 (NSW)

The stated purpose of the NSW BC Act is to maintain a healthy, productive and resilient environment consistent with the principles of ecologically sustainable development in particular, to conserve biodiversity at bioregional and State scales through a variety of mechanisms such as supporting research, knowledge-sharing, regulation of human interaction with wildlife, assessment of the extinction risk of species and ecological communities, supporting conservation action, and establishing market-based conservation mechanisms.

Section 7.3 of the BC Act requires that the significance of the impact on threatened species, populations and endangered ecological communities listed under the BC Act is assessed using the 'test of significance'. Where a significant impact is likely to occur, the proponent must either apply the Biodiversity Offsets Scheme or prepare a species impact statement (SIS). in accordance with the Environment Agency Head's requirements.

1.3.3 Fisheries Management Act 1994 (NSW)

The NSW *Fisheries Management Act 1994* (FM Act) aims to conserve threatened species, populations and ecological communities of fish and key fish habitats. The FM Act is administered by the Department of Industry. Part 7 of the FM Act relates to the protection of aquatic habitats including providing management of dredging and reclamation work within permanently or intermittently flowing watercourses.

Construction works associated with some culvert work may meet the definition of reclamation work under Section 198A of the FM Act, which defines reclamation as:

1. using any material (such as sand, soil, silt, gravel, concrete, oyster shells, tyres, timber or rocks) to fill in or reclaim water land, or
2. depositing any such material on water land for the purpose of constructing anything over water land (such as a bridge) or
3. draining water from water land for its reclamation.

The Department of Primary Industries (DPI) is part of the Department of Industry. Roads and Maritime are required to consult with DPI prior to undertaking any reclamation work, as defined under Section 199 of the FM Act.

In addition to the requirements of Section 199 and depending on construction methodologies developed during further proposal development, a permit may be required under Section 219 of the FM Act regarding blockage of fish passage. Section 219 requires a permit for any works carried out by a public authority that could result in the temporary or permanent blockage of fish passage within a waterway.

Part 7A Section 220ZZ of the FM Act requires that the significance of impacts on threatened species, populations and endangered ecological communities listed under the FM Act is assessed using the test of significance. Where a significant impact is likely to occur, a SIS must be prepared in accordance with the Environment Agency Heads requirements.

1.3.4 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage matters of national environmental significance (MNES) including the following biodiversity-related matters:

- Commonwealth marine areas
- Great Barrier Marine Park
- listed migratory species
- listed threatened species and ecological communities
- Ramsar Wetlands
- World Heritage properties and National Heritage places (those listed wholly or in part for their biodiversity values).

In September 2015, a 'strategic assessment' approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Roads and Maritime activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species.

As a result, Roads and Maritime proposals assessed via an REF:

- Must address and consider potential impacts on nationally listed threatened species, populations, ecological communities and migratory species, including application of the 'avoid, minimise, mitigate and offset' hierarchy
- Do not require referral to the Federal Department of the Environment and Energy for these matters, even if the activity is likely to have a significant impact, unless the impact is considered likely to have an unacceptable impact.

Under the strategic assessment approval, Roads and Maritime must ensure that where a road or traffic management activity is identified through the REF process as likely to significantly impact Specified Protected Matters, measures are applied to ensure such impacts will not be unacceptable.

In the event that an unacceptable impact is identified during the planning and assessment of an activity subject to Division 5.1 of the EP&A Act, Roads and Maritime must:

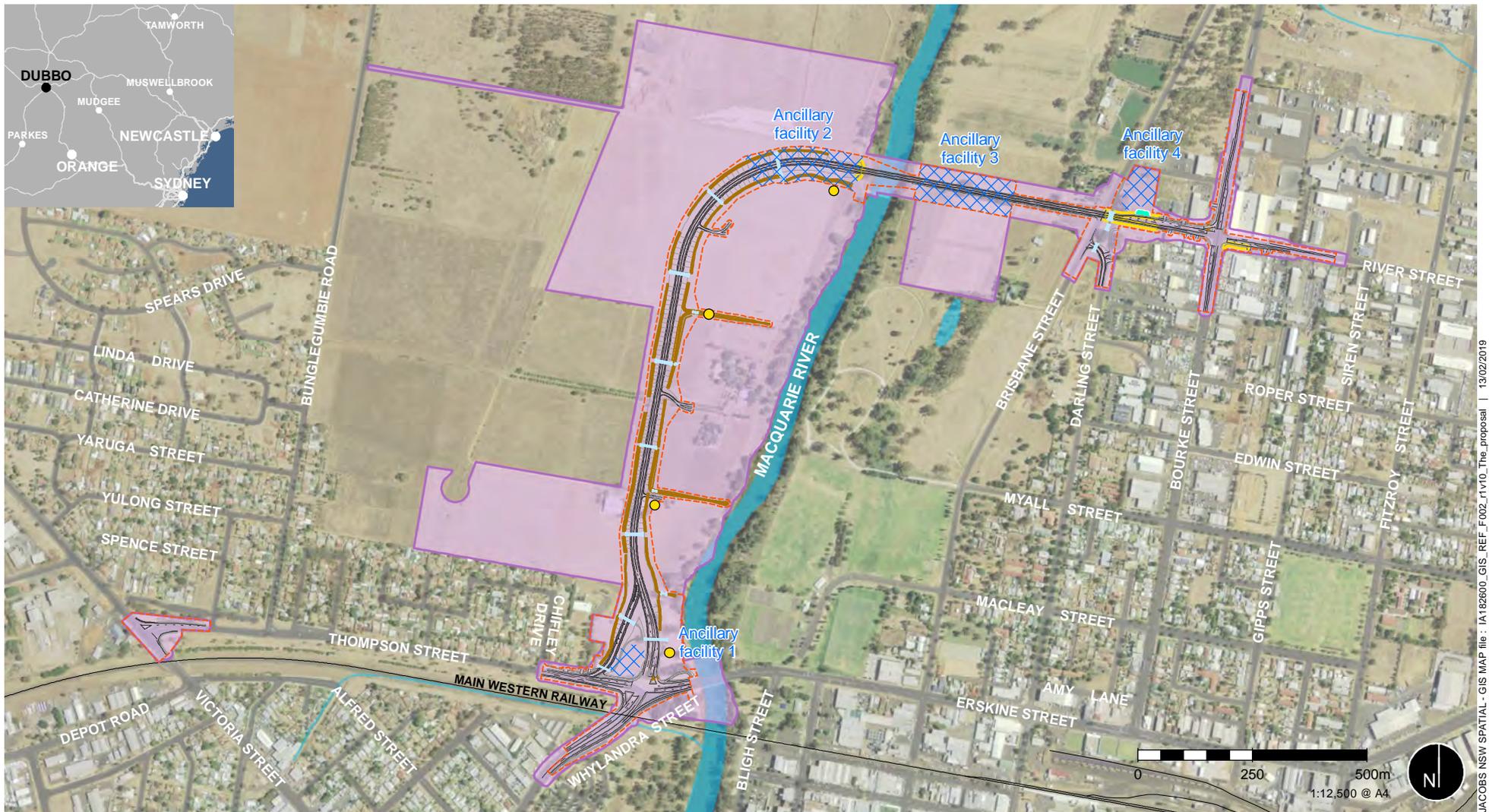
- Not proceed with the activity as proposed
- Re-examine options to reduce the impacts to a level that is acceptable, including through additional offsets or supplementary actions
- Determine whether impacts of the activity are of such significance that it would be more appropriately considered under the environmental impact assessment requirements applicable to state significant infrastructure projects (under Division 5.2 of the EP&A Act)
- Consult with the Australian Government Department of the Environment.



JACOBS NSW SPATIAL - GIS MAP file : I:\182800_GIS_REF_F001_r1v3_Proposal_Area | 4/02/2019



Figure 1-1 | Location of the proposal



JACOBS NSW SPATIAL - GIS MAP file : I:\162800_GIS_REF_F02_r1v10_The_proposal | 13/02/2019

Legend

- 80% concept design
- Retaining wall
- Sediment basin
- ▨ Proposed ancillary facility
- Study area
- Operational basin
- - - Proposal area
- Culvert
- Swales

Figure 1-2 | The proposal

2 Methods

2.1 Personnel

This biodiversity assessment was undertaken and prepared by a team of appropriately qualified and experienced ecologists (refer to **Table 2-1**).

Table 2-1 Personnel, role and qualifications

Name	Role	Qualifications
Jonathan Carr	Terrestrial field survey and reporting	Bachelor of Environmental Science and Management Biodiversity Assessment Method accredited
Allie Cooke	Aquatic field survey and reporting	Bachelor of Science (Biology)
Lauren Ascah	Reporting	Bachelor of Science (First Class Hons), Ecology
Chris Thomson	Technical review (terrestrial)	Bachelor of Applied Science Graduate Certificate in Natural Resources Biodiversity Assessment Method accredited
Sarah Douglass	Technical review (aquatic)	Masters of Environmental Management Bachelor of Science in Environmental Biology

2.2 Background research

A background review of existing information was undertaken to identify the existing environment of the proposal within a search area of 10 kilometres. The 10 km search area was chosen in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft* (DEC, 2004) which states that:

The size of the locality will vary depending on the location of the study area and the amount of information available. For example, in Sydney the locality may be defined as a 5 km radius of the subject site compared with far western NSW where the locality may be a 50 km radius of the subject site due to the limited number of surveys conducted and information available.

The review focussed on database searches, relevant ecological reports pertaining to the study area, particularly the preliminary ecological assessment prepared for the proposal (WSP, 2017), property boundaries, and relevant GIS layers. The review was used to prepare a list of threatened species, populations and communities as well as important habitat for migratory species with a likelihood of occurrence in the study area and locality. The searches were also undertaken to identify if an Areas of Outstanding Biodiversity Value were present.

The following database searches were performed:

- BioNet - the website for the Atlas of NSW Wildlife and OEH Threatened Species Profile Database (9 October 2018)
- NSW DPI freshwater threatened species distribution maps (9 October 2018)
- The federal Department of Environment and Energy Protected Matters Search Tool (5 June 2018)
- OEH BioNet Vegetation Classification System database (9 October 2018)

- The Federal Bureau of Meteorology’s Atlas of Groundwater Dependent Ecosystems (GDE) (5 June 2018)
- Department of Environment and Energy directory of important wetlands
- Department of Planning and Environment SEPP 14 wetlands spatial data
- Atlas of Living Australia (5 June 2018)
- Register of Declared areas of Outstanding Biodiversity Value.

Regional vegetation mapping projects including the *Central West and Lachlan Regional Native Vegetation Mapping* (NSW Office of Environment and Heritage, 2015) were examined to guide the assessment of vegetation types and habitats.

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the OEH NSW Threatened Species Scientific Committee website (Office of Environment and Heritage, 2017c). There were no preliminary or provisional listings of relevance to the proposal.

2.3 Habitat assessment

A habitat assessment was undertaken within the study area with consideration of the identified list of threatened flora and fauna species known or predicted to occur in the Brigalow Belt South IBRA bioregion that have been recorded within a 30 kilometre radius of the proposal (see Appendix B for the habitat assessment results). This list was identified from databases and literature as well as past surveys. The habitat assessment compared the preferred habitat features for these species with the type and quality of the habitats identified in the study area. This habitat assessment was completed to assess the likelihood of the species being present in the study area (i.e. subject species). The habitat assessment formed the basis for surveys of threatened species in potential habitat within the study area.

The criteria used in the habitat assessment are detailed in **Table 2-2**. The results of the habitat assessment are provided in **Appendix B**.

Table 2-2 Likelihood of occurrence classification and criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (30km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.

Likelihood	Criteria
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (30km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

2.4 Field survey

2.4.1 Survey timing and weather conditions

A field survey was undertaken within the study area over two days in early September 2018 (5-6th) to ground-truth the results of the background research and habitat assessment. Weather conditions were generally fine and sunny with warm temperatures and a thunder storm producing 5.4 millimetres of rain Thursday night/Friday morning (6-7 September). Spring survey timing is generally suitable for detecting native plant species, however the Dubbo region had experienced very low rainfall (31.6 millimetres - Dubbo Airport AWS 065070) three months preceding the field survey, which affected plant growth, particularly on alluvial plains where bare ground was prevalent.

2.4.2 Vegetation surveys

Broad scale vegetation mapping and aerial photography was used to initially identify the extent of native vegetation. The initial vegetation mapping was then ground-truthed in the field and where possible assigned to Plant Community Types (PCTs) according to the OEH BioNet Vegetation Classification System (Office of Environment and Heritage, 2017b). The identified PCTs and their extent were mapped across the study area.

The vegetation survey was completed using field survey methods in line with Chapter 5 of the Biodiversity Assessment Method (BAM) (Office of Environment and Heritage, 2017a). A plot-based vegetation survey of the study area was undertaken. The plot-based floristic survey used a series of 400 m² plots around a central 50 metre transect to assess vegetation structure and composition attributes (species richness and foliage cover). Function attributes (number of large trees, tree stem size class, tree regeneration and length of fallen logs) were recorded within the larger 1000 m² plot. Litter cover was assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots evenly located along the central transect. The number of trees with hollows was determined by counting the number of trees with hollows that are visible from the ground in the 1000 m² plot.

The survey was stratified and targeted to assess environmental variation. Due to the large linear size of the study area, field surveys were focussed on areas within the bounds of the strategic design under consideration at that time and adjacent land within 20 metres. Representative sites were surveyed in detail to enable the floristic and condition classification of vegetation types and extrapolation for areas not subject to detailed survey.

Areas of landscape plantings and grassland dominated by exotic species were mapped. These areas were not assigned vegetation zones as they are not naturally occurring and cannot be matched to a PCT.

A summary of vegetation survey effort, outlining the number of vegetation zones and respective number of floristic plots / transects sampled in the field is presented in **Table 2-3**. The location of each plot / transect is shown in **Figure 2-1**.



JACOBS NSW SPATIAL - GIS MAP file : I:\182800_GIS_BIC_F001_r1v3_Survey Locations | 19/02/2019

Legend

- 80% concept design
- Study area
- ▤ Proposed ancillary facility
- Biodiveristy survey
- Anabat
- Diurnal bird search
- Plot point
- Transect



Data sources

Jacobs 2018, LPI 2018,
© Department of Finance, Services & Innovation 2018

Figure 2-1 | Survey locations

Table 2-3 Summary of survey effort

Plant community type (PCT)	Condition class	Area (ha) in study area	No. plots sampled
River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (78)	Moderate to Poor (Intact canopy with relatively disturbed understorey)	3.00	2 plots (P01, P03)
	Poor (Partly intact canopy with mostly disturbed understorey)	0.29	1 plot (P05)
Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (202)	Moderate to Poor (Intact canopy with relatively disturbed understorey)	0.16	1 plot (P04)
Derived grassland of the NSW South Western Slopes (796)	Poor (Derived Grassland with high disturbance)	0.71	1 plot (P06)
Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (181)	Moderate to Poor (relatively disturbed)	0.13	1 plot (P02)
Total		4.29 ha	6

2.4.3 Flora surveys

The surveys undertaken for all identified candidate flora species considered moderately likely to occur within the study area (see **Table 2-3**) followed the methods described in the *NSW Guide to Surveying Threatened Plants* (Office of Environment and Heritage, 2016). Given the large areas of potential habitat in open grassland, time taken to search areas would be high, therefore random meander surveys were undertaken through habitat. The floristic plot surveys also provided opportunity to record threatened species in discreet areas if they were present.

The details of threatened flora species survey undertaken are outlined in **Table 2-4**. The location of walked random meanders is shown on **Figure 2-1**.

Table 2-4 Survey techniques for threatened flora species and survey effort

Threatened flora species	Status		Recommended survey timing	Survey completed
	BC Act	EPBC Act		
<i>Diuris tricolor</i>	V	-	September to late October	Walked random meanders in potential habitat

2.4.4 Fauna surveys

Given the disturbed nature of the study area and limited intact habitat, only opportunistic observations supplemented by fauna habitat assessments (in BAM plots) were carried out, incorporating a hollow-bearing tree and large woody debris survey. Indirect evidence of faunal

activity, such as scats, scratches and other signs was observed. The focus of the habitat assessment was to identify the suitability and condition of the habitat for threatened fauna species previously recorded in the locality.

No targeted fauna survey techniques such as mammal trapping, spotlighting or call playback, or standardised diurnal bird surveys were undertaken.

Two anabats were used along Macquarie River to detect microchiropteran bat (microbat) species.

Fauna habitat assessments were completed to assess the likelihood of threatened fauna occurring in the study area. Fauna habitats were assessed by examining characteristics such as the structure and floristics of the canopy, understorey and ground vegetation; the structure and composition of the litter layer; and other habitat attributes important for feeding, roosting and breeding.

The survey design for the proposal was designed based on the findings of the PEI which identified the following threatened animal species as likely to occur in the study area and therefore to require targeted survey:

- Yellow-bellied Sheath-tail-bat and Little Pied Bat
- Threatened bird species including Regent Honeyeater, Grey-crowned Babbler, Diamond Firetail, Magpie Goose, Spotted Harrier, Little Eagle, Black Falcon, Brown Treecreeper, Glossy Black-Cockatoo, Black-chinned Honeyeater, Little Lorikeet, Superb Parrot, Flame Robin, Varied Sittella, and Painted Honeyeater.

Table 2-5 Targeted species survey techniques for threatened fauna species and survey effort

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed
	BC Act	EPBC Act			
Black Falcon	V	-	All year	Suggested minimum effort is not specified but the following methods are recommended for diurnal birds in general: <ul style="list-style-type: none"> Area searches; 20 minute surveys of 2 hectare plots. A 20-minute census at dawn or dusk, for each identified water source. 	20 minute dedicated surveys of approx. 2 hectare plots by two people at two (2) locations across all habitat types. Opportunistic surveys during all other site activities (particularly looking for soaring and perched birds while driving and walking). Surveys also included searches for large stick nests.
Grey Falcon	E	-			
Square-tailed Kite	V	-			
Spotted Harrier	V	-			
Black-breasted Buzzard	V	-			
Little Eagle	V	-			
Brolga	V	-	All year	Surveys should include: <ul style="list-style-type: none"> A 20-minute census at dawn or an hour before dusk at each identified source of water in the survey area A one-hour census at dawn or dusk, for each identified wetland. <p>Species-specific requirements for the Australian Painted Snipe according to Commonwealth guidelines, include:</p> <ul style="list-style-type: none"> Targeted stationary observations; 10 hours over 5 days Land-based area searches or line transects; 10 hours over 3 days for sites of less than 50 ha when wetland holds water but is not flooded. 	Permanent/semi-permanent wetland and aquatic habitats in the study area were limited in size allowing for a general survey of the entire habitat at stationary points and walking transects. Most of the potential habitat in the study area (ephemerally flooded grassland and open woodland) is only likely to be utilised during periodic flooding events. No such events occurred during the surveys and hence no land-based searches were conducted.
Black-necked Stork	E	-			
Magpie Goose	V	-			
Australian Painted Snipe	E	E			
Australian Bustard	E	-	All year	Suggested minimum effort is not specified but the following methods are recommended for diurnal birds in general: <ul style="list-style-type: none"> Area searches; 20 minute surveys of 2 hectare plots.. A 20-minute census at dawn or dusk, for each identified water source. <p>Species-specific requirements according to Commonwealth guidelines for the Superb Parrot include:</p> <ul style="list-style-type: none"> Area searches or transect surveys; 12 hours over 4 days per 50 hectares 	Two 20 minute dedicated surveys of approx. 2 hectare plots plus opportunistic surveys during all other site activities. Search for evidence of feeding i.e. chewed cones of <i>Casuarina</i> and <i>Allocasuarina</i> species for black-cocatoos.
Bush-stone Curlew	E	-			
Grey-crowned Babbler	V	-			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed
	BC Act	EPBC Act			
Speckled Warbler	V	-		<ul style="list-style-type: none"> Area searches; 12 hours over 4 days (per 50 hectares); targeting areas of hollow-bearing trees during breeding season. 	
Dusky Woodswallow	V	-			
Hooded Robin	V	-			
Flame Robin	V	-			
Diamond Firetail	V	-			
Brown Treecreeper	V	-			
Varied Sittella	V	-			
Turquoise Parrot	V	-			
Superb Parrot	V	V			
Little Lorikeet	V	-			
Regent Honeyeater	CE	CE			
Black-chinned Honeyeater	V	-			
Painted Honeyeater	V	V			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed
	BC Act	EPBC Act			
Red-tailed Black-cockatoo (Inland subspecies)	V	-			
Glossy Black-Cockatoo	V	-			
Barking Owl	V	-	All year	<p>Suggested minimum effort is:</p> <ul style="list-style-type: none"> • Call playback sites for owls should be separated by 0.8-1 km. • at least 5 visits per call playback site, on different nights for the Barking Owl and the Grass Owl. • at least 8 visits per call playback site, on different nights for the Masked Owl. • Call playback surveys for Bush Stone-curlew should be 2-4km apart and conducted during the breeding season. • Search habitat for pellets, and likely nesting locations. • Observing potential roost hollows for 30mins prior to sunset and 60mins following sunset. • Spotlighting for Bush Stone-curlew (effort not specified). • Flushing of Bush Stone-Curlews by walking through potential habitat (effort not specified). 	<p>Call playback surveys could not be effectively undertaken in the study area due to the presence of small vegetation patches, urbanised areas and traffic noise.</p> <p>There were no large areas of suitable habitat for the Bush Stone-Curlew.</p> <p>Habitat assessment (i.e. presence of possibly suitable large nesting hollows or dense grass/sedge patches) and searches for pellets and evidence of feeding.</p>
Masked Owl	V	-			
Eastern Grass owl	V	-			
Bush Stone-curlew	E	-			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed
	BC Act	EPBC Act			
Koala	V	V	All year	<p>Surveys should include:</p> <ul style="list-style-type: none"> • Diurnal searches including searching for evidence of use (scats and scratches - 30 minutes searching each relevant habitat) • Nocturnal surveys – spotlighting (2 x 1 hour and 1km up to 200 hectares) • Nocturnal surveys – call playback (2 sites per stratification unit >200 ha) • Habitat assessment – Identification of known feed tree species and quantification of feed tree densities. • Specialist techniques for the species. <p>Species-specific requirements according to Commonwealth guidelines include:</p> <ul style="list-style-type: none"> • For actions with a large footprint, or landscape-scale impacts, baseline monitoring which evaluates koala abundance, movement and habitat preferences in the area proposed to be affected by the proposal will be necessary; this may involve a combination of direct and indirect survey methods in the study area, particularly if there is limited desktop data available. • The guidelines do not prescribe survey effort standards for koala surveys, due to the high level of variation in environmental variables across the koala's range; survey effort must be determined on a case-by-case basis in accordance with the identified key principles (those relevant to the proposal are listed below). • Surveys for animals (direct observation) or signs (scats, scratches etc.), for the purposes of gathering presence/absence data, must be undertaken in a manner which maximises the chance of detecting the species. • Failure to detect animals or sign in a single survey does not necessarily mean the koala is absent; spatial and temporal replication of the survey is required in order to infer true absence. • The species' ecology varies across its range; it is not appropriate to extrapolate ecological findings to different communities or bioregions. • Direct observation methods can be valuable but have limitations regarding resource requirements, detection rates, and animal ethics. • Indirect survey methods, scat surveys in particular are recommended as generally a less resource-intensive and more effective way to determine presence/absence and habitat use than direct observation. 	Diurnal surveys within the study area for Koalas and evidence of habitat use (i.e. scratches and scats) using the Koala Rapid Assessment Method (KRAM) as described by Woosnam-Merchez et. al, (2012). An assessment of koala habitat usage and habitat quality was undertaken using 'Table 4 Koala habitat assessment tool' in the EPBC Act referral guidelines (2014).
Yellow-bellied Sheath-tail-bat	V	-	October to March	<p>Suggested survey methods include:</p> <ul style="list-style-type: none"> • Roost site identification – hollows, caves and artificial structures; all species 	Habitat assessment, including assessment of existing bridges as potential roost sites and recording hollow trees.
Little Pied Bat	V	-			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed
	BC Act	EPBC Act			
Large-eared Pied Bat	V	V		<ul style="list-style-type: none"> Trapping (e.g. harp-trapping); all species; Four trap nights over two consecutive nights (with one trap placed outside the flyways for one night) per 100 hectares (or portion thereof) of stratification unit. Call survey; Two recording devices per 100 hectares (or portion thereof) of stratification unit, utilised for the entire night (a minimum of four hours), starting at dusk for two nights. Call survey only appropriate for Little Pied Bat, Large-eared Pied Bat and Yellow-bellied Sheathtailed Bat. <p>Species-specific requirements according to Commonwealth guidelines for Corben's Long-eared Bat include:</p> <ul style="list-style-type: none"> Passive acoustic detection; Bat detectors can be used to identify areas used by long-eared bats, even if they cannot be identified to species level Trapping; traps should be placed in woodland/forest, both in open fly-ways and within cluttered vegetation. If open water bodies occur in or near the proposal area, then significant effort should be given to trapping over the water; 20 trap nights over 5 nights for proposal areas <50 ha over. <p>Species-specific requirements according to Commonwealth guidelines for Large-eared pied bat include a combination of the following techniques and effort over a proposal area less than 50ha:</p> <ul style="list-style-type: none"> Unattended bat detectors; 16 detector nights over 4 nights Attended bat detectors; 6 detector hours over 3 nights Harp traps; 16 trap nights 4 nights. 	Call detection – Two bat call detectors used for two (2) full nights recording from 2000 hours to 0500 hours at two (2) different sites.
Corben's Long-eared Bat	V	V			
Eastern Cave Bat	V	-			
Squirrel Glider	V	-	All year	<p>Surveys should include:</p> <ul style="list-style-type: none"> 2 x 1-hour spotlighting and 1km with two observers up to 200 hectares of stratification unit, walking at approximately 1km per hour on 2 separate nights. Arboreal Elliot traps: 24 trap nights over 3-4 consecutive nights; Effort per stratification unit up to 50 ha, plus an additional effort for every additional 100 ha. 	No targeted surveys were undertaken for these species. Survey effort was limited to habitat assessment.
<p>Note 1: Based on <i>Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft, 2004</i> for NSW BC Act listed species and the following guidelines for Commonwealth species:</p> <ul style="list-style-type: none"> Survey guidelines for Australia's threatened bats Survey guidelines for Australia's threatened birds Survey guidelines for Australia's threatened reptiles Draft Referral guidelines for the nationally listed Brigalow Belt reptiles EPBC Act referral guidelines for the vulnerable koala 					

2.4.5 Aquatic habitat assessment

An aquatic habitat assessment was conducted to assess the waterways in the study area against the NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (NSW Department of Primary Industries, 2013) and *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). These guidelines provide information for waterway classification and describe ways to minimise potential impacts of road projects on fish and other aquatic wildlife by protecting aquatic habitat and maintaining fish passage. The habitat assessment was visual only and no fish surveys or macroinvertebrate surveys were conducted. The aim of the habitat assessment was to identify the presence of 'key fish habitat'.

Aquatic habitats were assessed by examining characteristics such as the structure and floristics of aquatic vegetation, channel width, the presence of surface water, water flow, water depth, turbidity, visible pollutants, erosion, the presence of shelter (rocks, submerged vegetation and woody debris), and channel substrate.

2.5 Limitations

The vegetation field survey was able to provide adequate spatial coverage and survey effort for mapping of vegetation in the proposal area but only included very limited inspection of the broader study area. Detailed floristic survey was undertaken to provide a list of flora species for that point in time.

Targeted surveys were only undertaken in the form of diurnal bird surveys, bat detectors and random meanders in potential habitat for threatened species. These were undertaken at representative locations only; they did not cover the entire proposal area or the entire study area.

Plant growth was inhibited by drought conditions, however some growth for identification was aided with 25 millimetres of rainfall nine days prior to survey where developed seedlings were observed, however, many grasses and forbs were not in flower and some plants could not be identified to species level, and in some instances genus level. Ephemeral and/or cryptic flora species may have also been dormant and could not be detected during survey.

Heavy short-term rainfall on Thursday night/Friday morning (6-7 September) may have affected the second night of anabat sensitivity. Anabat No.2 had switched off with no recordings during Thursday night possibly due to rainfall.

Additional flora and fauna species may appear in other times of the year, particularly cryptic orchids and wetland birds. A period of several seasons or years is often needed to identify all the species present in an area, and specific weather conditions are required for optimum detection (e.g. heavy rainfall events and flowering periods). The conclusions of this report are therefore based upon available data and limited field survey and are indicative of the environmental condition of the study area at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has aimed to identify the presence and suitability of the habitat for threatened species.

The mapping included in this report shows the inferred distribution of plant community types and habitat within the broader study area. In many cases, the boundaries between plant community types and habitats are not well-defined and the mapping provides an approximation of on-ground conditions.

3 Existing environment

This section provides the environmental context of the study area. It includes a discussion of the abiotic and biotic features of the landscape within and surrounding the study area. The description of the ecological characteristics of the existing environment includes:

- The landscape context, including IBRA bioregions, IBRA subregions, catchments and Mitchell landscapes, and other relevant aspects of the landscape (e.g. landuse)
- Describes abiotic influences such as geology, soils, landforms and climate
- Assesses the condition of the biodiversity values of the study area, including factors that have and continue to contribute to its existing condition
- Determines the known and predicted presence and extent of flora and fauna species, populations, ecological communities and their habitats in the survey area and surrounds
- Assesses whether species, populations and ecological communities identified during the background research, but not identified during site survey, are likely to use the habitat
- Analyses the local and regional significance of populations of threatened species and the local distribution of ecological communities known or likely to occur
- Identifies the likely presence and attributes of groundwater dependent ecosystems
- Identification of the presence or absence of listed areas of outstanding biodiversity value and wildlife corridors.

3.1 Environmental context of the study area

3.1.1 Landscape context

Catchment areas

The study area lies within the Macquarie-Bogan catchment. This catchment is in the central-west of NSW and is regulated by two major storages – Burrendong Dam and Windamere Dam. The Macquarie-Bogan Catchment is 74,800 square kilometres in size, with the headwaters of the Macquarie River originating in the Great Dividing Range south of Bathurst and flowing north-westerly for 960 kilometers until it joins the Barwon River near Brewarrina. Long term alteration of natural river flows through construction of dams and weirs as well as erosion related to land clearing have resulted in poor riverine health and water quality.

Surrounding landuse

The catchment is dominated by agricultural land use with over 80 per cent of the catchment being used for grazing. The remainder is made up of dryland cropping, occurring predominantly in the middle and lower parts of the catchment as well as forestry, conservation and other native landscapes (WaterNSW, 2018).

Bioregion

The entire study area is located within the Brigalow Belt South IBRA bioregion, the broad scale characteristics of which are described in **Table 3-1**.

Table 3-1 Brigalow Belt South IBRA bioregion description

Geology and geomorphology	Climate	Vegetation
<p>The bedrock comprises quartz sandstone and shale with areas of conglomerate and basalts. Some rugged topography of cliffs and small plateau features exists. Streams follow joint planes in the sandstone gorges, depositing colluvial fans of coarse sands and gravels in the wider valleys. Further down valley the topography is more subdued, partly buried in alluvial debris and largely eroded to rolling plains. Quaternary age alluvial deposits occur in sand-filled channels and clay plains. The landscape is dominated by Quaternary sediments in the form of alluvial fans and outwash slopes that resemble the larger fans of the adjacent Darling Riverine Plains Bioregion but are composed of coarser sediment and fan out at slightly steeper angles. The relative distribution of sediment from basalt or sandstone has a major impact on soil quality and vegetation.</p>	<p>A subhumid climate, with no dry season and a hot summer, characterises the south-eastern section of the bioregion, while a generally dry subtropical climate dominates to the northwest. Minor patches to the southeast of the bioregion fall within the temperate zone, with no dry season and a warm summer. To the far west of the bioregion and in the outlier enclosed within the Darling Riverine Plains Bioregion, the climate can be described as hot and semi-arid.</p>	<p>Sandstone areas support various forests and woodlands of ironbarks (<i>Eucalyptus</i> spp.), cypress pines (<i>Callitris</i> spp.), apples/gums (<i>Angophora</i> spp.). Boxes (<i>Eucalyptus populnea</i>, <i>E. pilligaensis</i> etc.) occur on coarser soils with occasional silver-leaved ironbark (<i>E. melanophloia</i>). River red gum (<i>E. camaldulensis</i>) lines all streams. In the southern end of the bioregion the vegetation mainly comprises narrow-leaved ironbark, white cypress pine and white box on hills and slope and Grey box (<i>E. microcarpa</i>), yellow box (<i>E. melliodora</i>) and rough-barked apple (<i>Angophora floribunda</i>) occur on valley floors, while river red gum lines larger streams and river oak (<i>Casuarina cunninghamiana</i>) the tributaries. The vegetation on the northern basalts includes brigalow, belah, whitewood, wilga, budda and poplar box on the hills, with river red gum, belah, myall (<i>Acacia pendula</i>) and poplar box on the flats. White box with silver-leaved ironbark, white wood, bull oak and brigalow are present on alluvial clays. Diverse grasslands dominate the Liverpool Plains. On the high (colder) ridge crests, silvertop stringybark (<i>E. laevopinea</i>), manna gum (<i>E. viminalis</i>) and mountain gum (<i>E. dalrympleana</i>) are found with snow gum (<i>E. pauciflora</i>) in cold air drainage hollows. Tallow wood (<i>E. microcorys</i>), blackbutt (<i>E. pilularis</i>) and blue gum (<i>E. saligna</i>) occur on eastern slopes with small areas of vine forest. On northern slopes, white box with rough-barked apple occur with belah in the creeks. Yellow box and Blakely's red gum are found on slopes with a southerly aspect. Eucalypt woodlands and open forests of ironbarks, poplar box, spotted gum (<i>Corymbia maculata</i>), cypress pine (<i>Callitris glaucophylla</i>), Bloodwoods (e.g. <i>Corymbia trachyphloia</i>), Brigalow-Belah forests (<i>Acacia harpophylla</i>, <i>Casuarina cristata</i>) and semi-evergreen vine thicket.</p>

Brigalow Belt South IBRA subregions

The study area is located mostly within Talbragar Valley IBRA subregion and western margins of the study area fall on or near the border of the IBRA Subregion Pilliga which divides the city of Dubbo (OEH 2018). the broad scale characteristics of which are described in **Table 3-2**.

Table 3-2 IBRA subregion descriptions and locations in study area

IBRA subregions
<p>Talbragar Valley subregion</p> <p><u>Geology</u>: Near horizontal Mesozoic quartz sandstone, conglomerates and shales with minor Tertiary basalt caps and extensive alluvial wash plains.</p> <p><u>Landform</u>: Residual rocky hills, undulating long slopes and wash plains, wide valley floors with sandy streams.</p> <p><u>Soils</u>: Thin stony loams and texture contrast soils over most of the landscape with deeper sands and brown earths on valley floors.</p> <p><u>Vegetation</u>: Narrow-leaved ironbark, white cypress pine, white box on hills and slopes. Patches of black cypress pine, hill red gum, occasional kurrajong and scrubby acacia in rocky outcrops. Grey box, yellow box, rough-barked apple on valley floors. River red gum on larger streams and river oak on tributaries.</p>

IBRA subregions
<p>Pilliga subregion</p> <p><u>Geology:</u> Horizontal Jurassic quartz sandstones, limited shales, Tertiary basalt caps and plugs plus the sediments derived from these rocks.</p> <p><u>Landform:</u> Stepped sandstone ridges with low cliff faces and high proportion of rock outcrop. Long gentle outwash slopes intersected by sandy stream beds and prior stream channels. A few patches of heavy clay. Includes the spectacular mountain landscape of volcanic domes, plugs and dykes in the Warrumbungles.</p> <p><u>Soils:</u> Shallow black earths and red loams on basalts. Extensive harsh texture contrast soils, linear patterns of deep yellow sand, stony red brown earths.</p> <p><u>Vegetation:</u> White box with white cypress pine and kurrajong on the basalt hills. Blue-leaved ironbark, white gum, black cypress pine, whitewood, and rough-barked apple on stony sandstone plateau and streams.</p> <p>Narrow-leaved ironbark, white cypress pine, red stringy bark, patches of mallee and broom heath on gentler sandstone slopes. Pilliga box with grey box, poplar box, fuzzy box, bull oak, rosewood, wilga and budda on heavier soils in the west and north. River red gum lines all streams.</p>

NSW Landscape Regions (Mitchell Landscapes)

The study area crosses two NSW Landscape Regions, the characteristics of which are described in **Table 3-3**.

Table 3-3 NSW Landscape Regions descriptions and locations in study area

NSW Landscape Regions
<p>Macquarie Alluvial Plains</p> <p><u>Landform and geology:</u> Holocene fluvial sediments of backplain facies of the Marra Creek Formation associated with the Macquarie River main alluvial fan and distributary stream system, relief 1 to 3m.</p> <p><u>Soils:</u> Dark yellow-brown silty clay with patches of sand and carbonate nodules deposited from suspended sediments in floodwater, often with gilgai. Slightly elevated areas with red-brown texture-contrast soils.</p> <p><u>Vegetation:</u></p> <p>Open grasslands with scattered coolibah (<i>Eucalyptus coolibah</i>), black box (<i>Eucalyptus largiflorens</i>), river cooba (<i>Acacia stenophylla</i>), bimble box (<i>Eucalyptus populnea</i>), belah (<i>Casuarina cristata</i>), lignum (<i>Muehlenbeckia cunninghamii</i>) and myall (<i>Acacia pendula</i>).</p>
<p>Goonoo Slopes</p> <p><u>Landform and geology:</u> Extensive undulating to stepped low hills with long slopes on sub-horizontal Triassic/Jurassic quartz sandstone, conglomerates, siltstone, shale and some coal. General elevation 300 to 500m with overall westerly slope, poorly defined drainage network, local relief to 30m.</p> <p><u>Soils:</u> Stony yellow earths with sandstone outcrop on ridgelines to yellow harsh texture-contrast soils in shallow valleys.</p> <p><u>Vegetation:</u> Broad-leaved ironbark (<i>Eucalyptus fibrosa</i> ssp. <i>fibrosa</i>) and black cypress pine (<i>Callitris endlicheri</i>) on ridges, broad-leaved ironbark, narrow-leaved ironbark (<i>Eucalyptus crebra</i>), red ironbark (<i>Eucalyptus sideroxylon</i>), fringe myrtle (<i>Calytrix tetragona</i>), spur-wing wattle (<i>Acacia triptera</i>), dainty phebalium (<i>Phebalium obcordatum</i>), daphne heath (<i>Brachyloma daphnoides</i>) on slopes with patches of green mallee (<i>Eucalyptus viridis</i>), Dwyer's mallee gum (<i>Eucalyptus dwyeri</i>) and broombush (<i>Melaleuca uncinata</i>). Grey box (<i>Eucalyptus microcarpa</i>), red ironbark (<i>Eucalyptus sideroxylon</i>), red stringybark (<i>Eucalyptus macrorhyncha</i>), fuzzy box (<i>Eucalyptus conica</i>) and Blakely's red gum (<i>Eucalyptus blakelyi</i>) with knob sedge (<i>Carex inversa</i>), and tall sedge (<i>Carex appressa</i>) along streams.</p>

3.1.2 Local soil and geology data

Soil information in the study area and surrounding lands, available through OEH's eSPADE, a Google Maps-based information system containing data sourced mainly from the NSW Soil and Land Information System (SALIS), was reviewed to determine the likely soil and geological types in the study area. No soil data profiles had been sampled in the study area. A summary of the results is presented in **Table 3-4**.

Table 3-4 Local soils types in study area

Soils	Location in study area
Chernozems (Prairie Soils) <u>Topsoil:</u> Dark brown to black loam; moderate structure; angular blocky. <u>Subsoil:</u> Dark brown to black clay loam; moderate structure; angular blocky to prismatic. <u>Parent material:</u> Alluvial materials derived from surrounding source areas	On both sides, along full extent of Macquarie River
Euchrozems <u>Topsoil:</u> Dark reddish-brown clay loam to light clay; strong structure <u>Subsoil:</u> Strongly structured, dark reddish-brown light to medium clay <u>Parent material:</u> In situ and colluvial material (Olivine basalt)	South west corner of study area, along Newell Highway
Red Brown Earths <u>Topsoil:</u> A1 horizon. Hardsetting, dark brown, weakly structured fine sandy loam and A2 horizon. Bleached silty loam <u>Subsoil:</u> B horizon. Reddish-brown medium clay <u>Parent material:</u> Alluvium, relatively old and weathered	Western extent of study area, along Bunglegumbie Road and north eastern extent, along River Street
Red Earths <u>Topsoil:</u> A horizon. Dark reddish-brown to light reddish-brown sandy loam <u>Subsoil:</u> B horizon. Weakly structured dark reddish-brown to light reddish-brown, fine sandy clay loam <u>Parent material:</u> In situ and colluvial-alluvial material pockets of basaltic alluvium	South western extent of study area, along Thompson Street

3.2 Plant community types and vegetation assemblages

Descriptions of vegetation communities are derived from the results of the flora survey undertaken within and in proximity of the study area. Four plant community types (PCTs) and three vegetation assemblages were identified and include:

- River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 78)
- Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (PCT 202)
- Derived grassland of the NSW South Western Slopes (PCT 796)
- Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (PCT 181)
- Mixed native and exotic plantings.

Mixed native and exotic landscape plantings comprised of some locally indigenous species non-indigenous native species to the locality, and exotic species.

The study area is situated in a historically cleared rural landscape that has been highly modified and disturbed and is now predominately urbanised and dominated by exotic/pasture grassland and a mixture of roadside/park plantings, maintained lawns, gardens, as well as native tree plantings.

Table 3-5 Plant community types and vegetation assemblages

Plant community type (PCT)	Vegetation zone	Condition class	Threatened ecological community?	Area (ha) in study area
River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (78)	1	Moderate to Poor (Intact canopy with partly disturbed understorey)	No	3.00
	2	Poor (Partly intact canopy with mostly disturbed understorey)		0.29
Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (202)	3	Moderate to Poor (Intact canopy with relatively disturbed understorey)	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act)	0.16
Derived grassland of the NSW South Western Slopes (796)	4	Poor (Derived Grassland with high disturbance)	No (See note 1)	0.71
Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (181)	5	Moderate to Poor (relatively disturbed)	No	0.14
Mixed native and exotic plantings	-	-	No	4.91
Total				9.20 ha

Note 1: Derived grasslands are not included in the definition of the community under the BC Act or EPBC Act.

River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (78)

Vegetation formation: Forested Wetland

Vegetation class: Inland Riverine Forests

PCT: 78

Conservation status: Not listed

Estimate of percent cleared: 60%

Condition: Moderate to Poor (Intact canopy with partly disturbed understorey), Poor (Partly intact canopy with mostly disturbed understorey)

Extent in study area: 3.29 hectares

Plots completed in:

Vegetation zone 1: P01, P03

Vegetation zone 2: P05

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	18 (10-25)	30 (2-55)	<i>Eucalyptus camaldulensis</i>
Small trees	16 (15-20)	2.5 (2-4)	<i>Casuarina cunninghamiana</i> * <i>Salix babylonica</i> * <i>Schinus areira</i>
Shrubs	1 (0.5-2)	5 (0.1-10)	<i>Einadia hastata</i> * <i>Lycium ferocissimum</i>
Ground covers	0.4 (0.1-1)	65 (40-90)	<i>Austrostipa verticillata</i> <i>Cynodon dactylon</i> , <i>Bothriochloa macra</i> <i>Anthosachne scabra</i> (syn. <i>Elymus scaber</i>) <i>Phragmites australis</i> <i>Urtica incisa</i> * <i>Megathyrsus maximus</i> var. <i>maximus</i> * <i>Bromus catharticus</i> * <i>Cenchrus clandestinus</i> * <i>Harrisia tortuosa</i> * <i>Galium aparine</i> * <i>Taraxacum officinale</i> * <i>Conium maculatum</i> * <i>Datura ferox</i>
Vines & climbers	0	0	* <i>Dolichandra unguis-cati</i>

PCT 78 site description

This community forms very narrow patches restricted to the very edge of the river, generally 1-2 trees wide (10-30 metres). The north western side of the river is fenced from adjacent council land and other heavily grazed land. This area had a greater abundance of native plant

cover, particularly of *Austrostipa verticillata* despite some minor grazing evidence. All other riverside patches of this community were more disturbed where heavy livestock grazing was prevalent.

Open forest of about 20 metres high, dominated by River Red Gum (*Eucalyptus camaldulensis*). Other tree species included River Oak (*Casuarina cunninghamiana*) and exotic *Salix babylonica*.

This community lacks an intact native midstorey, and some locations are dominated with exotic species included *Lycium ferocissimum*.

The groundcover was dominated with *Austrostipa verticillata* and *Cynodon dactylon* and other native grasses such as *Bothriochloa macra*, *Anthosachne scabra* (syn. *Elymus scaber*) and *Phragmites australis*.

Forbs included *Einadia nutans*, *Oxalis perennans*, and ferns *Cheilanthes sieberi*, Nardoo *Marsilea drummondii*. Common weed species included *Rumex crispus*, *Cirsium vulgare*, *Verbena bonariensis* and *Salvia verbenaca*, as well as exotic pasture grasses *Bromus catharticus*, *Avena fatua*, *Paspalum dilatatum* and *Cenchrus clandestinus*.



Photograph 1: River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (78) on western side of river.

Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (PCT 202)

Vegetation formation: Grassy Woodland

Vegetation class: Western Slopes Grassy Woodland

PCT: 202

Conservation status: Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act)

Estimate of percent cleared: 75%

Extent in study area: 0.16 hectares

Condition: Moderate to Poor (Intact canopy with relatively disturbed understorey)

Plots completed in: Vegetation zone 3: P04

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	18 (10-25)	30 (2-55)	<i>Eucalyptus conica</i>
Small trees	8 (2-10)	3 (3)	<i>Alectryon oleifolius</i> * <i>Schinus areira</i> .
Shrubs	0.5 (0.1-0.5)	1 (1)	<i>Maireana microphylla</i> <i>Atriplex semibaccata</i> , <i>Einadia nutans</i> <i>Enchylaena tomentosa</i> * <i>Marrubium vulgare</i>
Ground covers	0.4 (0.1-0.5)	60 (60)	<i>Austrostipa verticillata</i> <i>Anthosachne scabra</i> (syn. <i>Elymus scaber</i>) <i>Bothriochloa macra</i> <i>Austrostipa scabra</i> <i>Vittadenia cuneata</i> <i>Oxalis perennans</i> * <i>Echium plantagineum</i> * <i>Medicago minima</i> * <i>Arctotheca calendula</i> * <i>Malva parviflora</i> * <i>Silybum marianum</i> * <i>Salvia verbenaca</i> * <i>Bromus catharticus</i> * <i>Avena fatua</i> * <i>Sisymbrium irio</i>
Vines & climbers	0	0	None

PCT 202 site description

This community forms very small patch confined to only five remnant *Eucalyptus conica* trees on the crest of north western riverbank. Where the trees have been cleared derived grassland occurs on the flats further along the western edge of patches restricted within fenced area.

Confined Woodland of about 15 metres high, dominated by Fuzzy Box (*Eucalyptus conica*). Other tree species include *Eucalyptus camaldulensis* and *Casuarina cunninghamiana* which occur on the lower banks.

Very open midstorey comprising only remnant Western Rosewood (*Alectryon oleifolius*) and exotic *Schinus areira*.

Uncommon chenopod shrubs occurred in woodland and derived grassland, including *Maireana microphylla*, *Atriplex semibaccata*, *Enchylaena tomentosa*, *Einadia nutans*.

The groundcover was dominated with *Austrostipa verticillata* other native grasses such as *Bothriochloa macra*, *Austrostipa scabra*, *Anthosachne scabra* (syn. *Elymus scaber*).

Other groundcover species included *Vittadenia cuneata*, *Oxalis perennans*, Common weed species included *Medicago minima*, *Arctotheca calendula*, *Malva parviflora*, *Silybum marianum*, *Salvia verbenaca*, *Bromus catharticus*, *Avena fatua*, *Sisymbrium irio* and *Hirschfeldia incana*.



Photograph 2: Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (PCT 202) on western bank of river

Derived grassland of the NSW South Western Slopes (796)

Vegetation formation: Grasslands

Vegetation class: Western Slopes Grasslands

PCT: 796

Conservation status: not listed (Derived grasslands are not included in the definition of the community under the BC Act)

Estimate of percent cleared: 0%

Extent in study area: 0.71 hectares

Condition: Poor (Derived Grassland with high disturbance)

Plots completed in: Vegetation zone 4: P06

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	0	0	
Small trees	0	0	
Shrubs	0.5 (0.1-0.5)	0.2 (0.2)	<i>Maireana microphylla</i> <i>Einadia nutans</i> * <i>Marrubium vulgare</i>
Ground covers	0.4 (0.1-0.5)	40 (40)	<i>Austrostipa verticillata</i> <i>Anthosachne scabra</i> (syn. <i>Elymus scaber</i>) <i>Bothriochloa macra</i> <i>Austrostipa scabra</i> <i>Vittadenia cuneata</i> <i>Oxalis perennans</i> * <i>Echium plantagineum</i> * <i>Medicago minima</i> * <i>Arctotheca calendula</i> * <i>Malva parviflora</i> * <i>Silybum marianum</i> * <i>Salvia verbenaca</i> * <i>Bromus catharticus</i> * <i>Avena fatua</i> * <i>Sisymbrium irio</i> * <i>Hordeum leporinum</i>
Vines & climbers	0	0	None

PCT 796 site description

This community forms a patch of derived grassland considered to have once supported *Eucalyptus conica* Woodland on the alluvial flats adjacent to the riverbank. The patch is restricted within the fenced area where it has been protected from heavy grazing in adjacent paddocks to the west.

Open grassland derived from Fuzzy Box Woodland with no tree canopy or shrub midstorey.

Contains remnant small shrubs *Maireana microphylla* and *Einadia nutans*.

The groundcover was dominated with *Austrostipa verticillata* other native grasses such as *Bothriochloa macra*, *Austrostipa scabra*, *Anthosachne scabra* (syn. *Elymus scaber*).

Other groundcover species included *Vittadenia cuneata*, *Oxalis perennans*, Common weed species included *Medicago minima*, *Arctotheca calendula*, *Malva parviflora*, *Silybum marianum*, *Salvia verbenaca*, *Bromus catharticus*, *Avena fatua*, *Sisymbrium irio* and *Hirschfeldia incana*.



Photograph 3: Derived grassland of the NSW South Western Slopes (796) on upper flats on western riverbank

Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (181)

Vegetation formation: Freshwater Wetland

Vegetation class: Inland Floodplain Swamps

PCT: 181

Conservation status: not listed

Estimate of percent cleared: 33%

Extent in study area: 0.14 hectares

Condition: Moderate to Poor (relatively disturbed)

Plots completed in: Vegetation zone 5: P02

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	0	0	-
Small trees	0	0	-
Shrubs	2 (0.1-2.5)	0.5 (0.5)	* <i>Ricinus communis</i> * <i>Marrubium vulgare</i>
Ground covers	1.5 (1-2)	85 (85)	<i>Phragmites australis</i> <i>Cynodon dactylon</i> , * <i>Rumex crispus</i> * <i>Megathyrsus maximus</i> var. <i>maximus</i> * <i>Bromus catharticus</i> * <i>Cenchrus clandestinus</i> * <i>Harrisia tortuosa</i> * <i>Galium aparine</i> * <i>Taraxacum officinale</i>
Vines & climbers	0	0	None

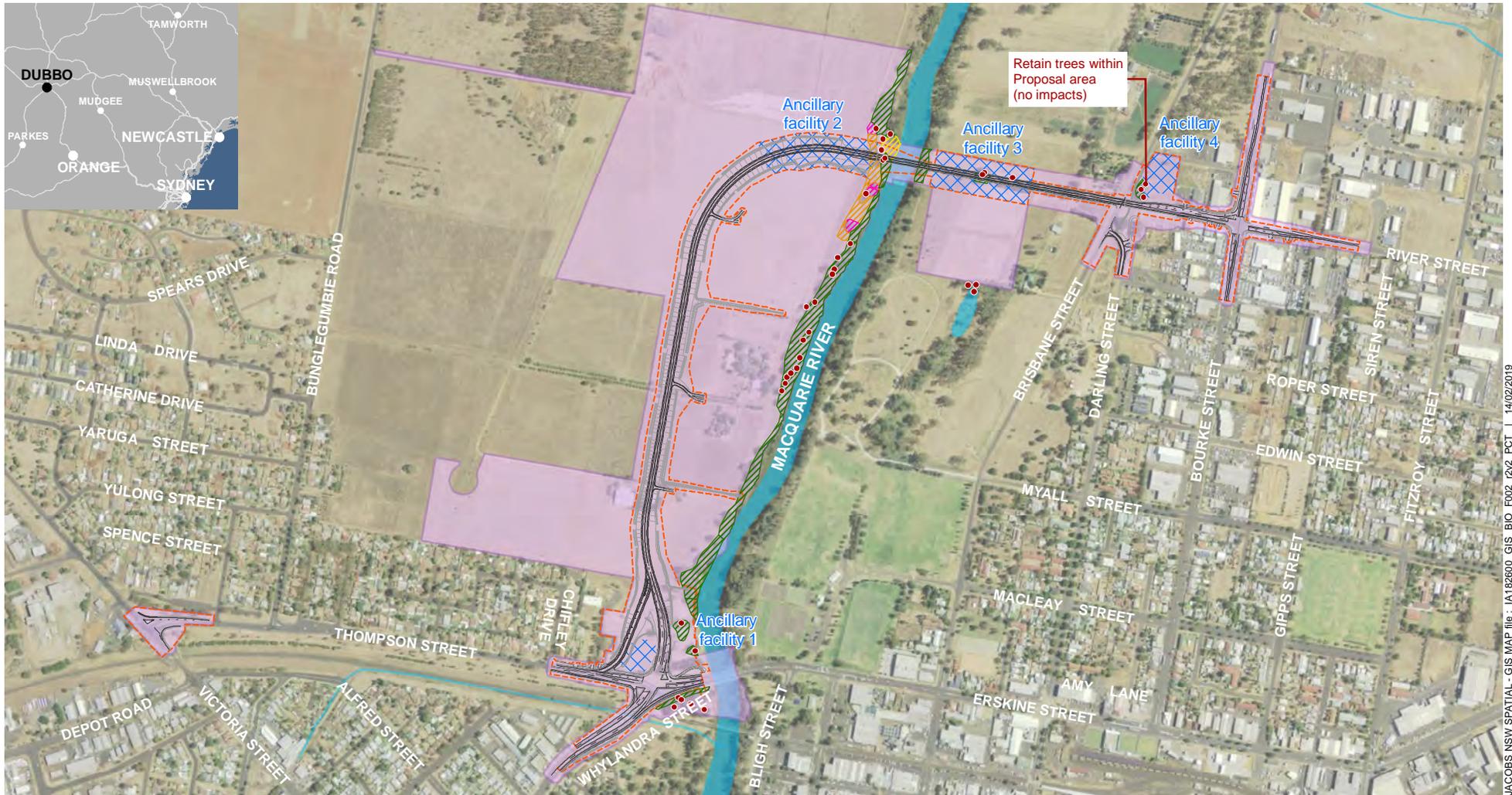
PCT 181 site description

Open grassland (dry wetland) in shallow water connected to river, dominated with *Phragmites australis* with occasional *Eucalyptus camaldulensis* and *Salix babylonica* near river edge and ecotones.

Other groundcover species mostly weed species included *Silybum marianum*, *Megathyrsus maximus* var. *maximus*, *Rumex crispus*.



Photograph 4: Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (181) on lower river fringe (west side)



JACOBS NSW SPATIAL - GIS MAP file : I:\182800_GIS_BIC_F002_r2v2_PCT | 14.02.2019

Legend

- 80% concept design
- Study area
- - - Proposal area
- ▣ Proposed ancillary facility
- Hollow bearing tree
- ▨ Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems
- ▨ Derived grassland of the NSW South Western Slopes
- ▨ Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion
- ▨ River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion



Figure 3-1 | Plant Community Types

Data sources
Jacobs 2018, LPI 2018,

3.3 Fauna habitat

Most of the natural fauna habitat has been removed for rural activities. Numerous remnant River Red Gums, other isolated remnant trees, small patches of planted native trees and other planted exotic trees and shrubs provide the majority of foraging and shelter habitat in the study area. Many of the River Red Gums exhibit hollows which are important locally for hollow-dependent fauna species, they also provide refuge and food resources for a range of fauna. There are occasional habitat logs and woody debris present in the riparian woodland along the length of the river edge in the study area. The riparian habitat contains some important habitat features such as dense leaf litter and woody debris which provide food resources (i.e. insects) and shelter for ground dwelling reptiles, Australian Water Dragon (*Intellagama lesueurii*) observed in burrow along river bank.

Forty-one hollowing bearing trees are located within the study area. These trees contain small (≤ 5 cm), medium (> 5 cm to ≤ 10 cm) and large (> 10 cm) sized hollows that may be suitable as habitat for a range of small tree roosting insectivorous bats (including threatened species), arboreal mammals and small to medium sized birds. Some large hollows are also suitable for Large Forest Owls such as Barking Owl (*Ninox connivens*). Tree species with hollows include, large River Red Gums restricted to the river edge and large stags. Tree hollows provide important sites for mating, hibernation, raising juveniles, protection from predators and social interaction for numerous hollow-dependent fauna species.

Some foraging habitat for fauna is present throughout the study area. Although mostly dominated with exotic groundcover, the riparian habitat provides good shelter for small birds and good foraging habitat for common nectar feeding birds and mammals.

Diurnal bird surveys identified 27 common protected native bird species including:

- Three honeyeaters: White plumed Honeyeater (*Lichenostomus penicillatus*), Red Wattlebird (*Anthochaera carunculata*), Noisy Miner (*Manorina melanocephala*)
- Five parrots: Sulphur Crested Cockatoo (*Cacatua galerita*), Galah (*Eolophus roseicapillus*), Eastern Rosella (*Platycercus eximius*), Crimson Rosella (*Platycercus elegans*), Red-rumped Parrot (*Psephotus haematonotus*)
- Eight small insect eaters: Fairy Martin (*Petrochelidon ariel*), Welcome Swallow (*Hirundo neoxena*), Willie Wagtail (*Rhipidura leucophrys*), Grey Fantail (*Rhipidura fuliginosa*), Superb Fairy-wren (*Malurus cyaneus*), Grey Shrike Thrush (*Colluricincla harmonica*), White-breasted Woodswallow (*Artamus leucorhynchus*), Yellow Thornbill (*Acanthiza nana*)
- Two seed eaters: Peaceful Dove (*Geopelia striata*), Crested Pigeon (*Ocyphaps lophotes*),
- Three wetland/river birds: Australian Wood Duck (*Chenonetta jubata*), Pacific Black Duck (*Anas superciliosa*), Pied Cormorant (*Phalacrocorax varius*)
- Six other large birds: Kookaburra (*Dacelo novaeguineae*), Australian Magpie (*Gymnorhina tibicen*), Magpie-lark (*Grallina cyanoleuca*), Black-faced Cuckoo-Shrike (*Coracina novaehollandiae*), Pied Butcherbird (*Cracticus nigrogularis*), Australian Raven (*Corvus coronoides*).

Three pest bird species were observed, including Rock Dove (*Columba livia*), Spotted Dove (*Streptopelia chinensis*) and Common Starling (*Sturnus vulgaris*).

Native mammals observed included Eastern Grey Kangaroo (*Macropus giganteus*), Common Wallaroo (*Macropus robustus*) and Common Brushtail Possum (*Trichosurus vulpecula*).

Bat call detectors recorded five bat species, mostly tree roosting species comprising Gould's Wattled Bat (*Chalinobus gouldii*), Large Forest bat (*Vespadelus darlingtonia*), Chocolate Wattled Bat (*Chalinobus morio*), *Mormopterus* spp. and *Nyctophilus* spp.

The existing concrete bridge (Emile Seriser Bridge) contained numerous clay nests, made by Fairy Martin (*Petrochelidon ariel*) which also have potential habitat for hollow-roosting microbats. An inspection was conducted of the bridge structure to determine the likely presence of roosting microbats, given that a number of species are known to roost in artificial

structures, this includes threatened species. The bridge exhibited no other cavities or cracks suitable for roosting bats.

A number of factors were considered in concluding that the bridge structure has no potential to be utilised by bats for roosting:

- Large bright areas under bridge
- During the inspection, vibration and noise caused by cars travelling over bridge may act as a deterrent
- The bridge had spider webs covering gaps which may indicate no recent aerial passage.

Tree roosting bats are likely to occupied adjacent habitats with numerous suitable hollows, waterways and direct fly paths.

3.4 Aquatic surface water ecosystems and fish habitat

The Macquarie River is a greater than 5th order stream (Strahler) originating at Fish River above Lake Oberon and flowing northwest through the towns of Bathurst, Wellington, Dubbo, Narromine and Warren to the Macquarie Marshes. The Macquarie River upstream of Dubbo is impounded by Burrendong Dam, a large reservoir built for flow control and irrigation.

The Macquarie River at Dubbo has been classified as a major regulated river by the Office of Environment and Heritage (OEH). These rivers supply irrigation water including town and industrial water, largely through trapping of water in large dams. Therefore, flow can be highly variable throughout the year depending on irrigation requirements.

Aquatic habitat was assessed at four monitoring locations during surface water quality investigations (*Technical Paper: Surface Water*).

The two upstream monitoring locations DBWQ3 and DBWQ4 are both located within public parks which are popular recreation areas and fishing spots. Both sites are located within 50 metres of existing bridge structures and share similar attributes such as a boat ramp and wharf. There was minimal water flow during site inspections and only a small number of woody snags were present. Patches of Common Reed (*Phragmites australis*) were observed on the right bank at site DBWQ4 and a small patch of *Typha orientalis* was present on the left bank at DBWQ3. The riparian zone is largely cleared and mown with a line of 'River Gums' (*Eucalyptus camaldulensis*) along the banks. A small amount of undercutting occurs along the majority of the river bank and overhanging vegetation including *Casuarina cunninghamiana* is present sporadically along the bank.

The downstream monitoring locations DBWQ1 and DBWQ2 had more significant habitat structures including abundant woody debris greater than three metres in length. The upstream section also contains significant overhanging vegetation, predominantly Willows (*Salix babylonica*). There is a large bed of Common Reed on the left bank at site DBWQ1. However, the Common Reed are currently sitting above the water level and the plants are in very poor condition. A weir crosses this section of the river, restricting fish movement upstream. The weir, which is essentially an overflow structure has altered the rivers flow characteristics and pools the water until it is deep enough to flow over the top of the weir, therefore increasing flow velocity downstream. Due to increased flow, riffles occur over the gravel/cobble substrate where fish may forage.

An assessment of the fish habitat value of these areas, based on the modelled habitat of threatened fish, field observation, and aerial photograph interpretation has been completed. The assessment has also considered the Policy and Guidelines for Fish Habitat Conservation and Management (Department of Primary Industries 2013), and the current indicative distribution of the threatened species in NSW, modelled from past catchment data and environmental conditions as provided by the Department of Primary Industries (2017).

The Macquarie River is classified as Type 1 highly sensitive key fish habitat (DPI 2013) and contains suitable habitat for numerous threatened fish including, the Eel Tailed Catfish

(*Tandanus tandanus*), Silver Perch (*Bidyanus bidyanus*), Trout Cod (*Maccullochella macquariensis*) and Olive Perchlet (*Ambassis agassizii*). With respect to fish passage, the river is classified Class 1, major key fish habitat (Fairfull and Witheridge 2003).

3.5 Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are ecological communities that are dependent, either entirely or in part, on the presence of groundwater for their health or survival. The NSW DPI Water Risk Assessment Guidelines for Groundwater Dependent Ecosystems (Serov et al., 2012) adopts the definition of a GDE as 'Ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater.'

GDEs might rely on groundwater for the maintenance of some or all of their ecological functions, and that dependence can be variable, ranging from partial and infrequent dependence, i.e. seasonal or episodic, to total continual dependence.

The presence of GDEs in the region of the site was assessed using:

- BOM's Atlas of GDEs – this resource maps the potential for aquatic, terrestrial and subterranean ecosystems which rely on the presence of groundwater. The mapping in this atlas is based on broad national scale GIS data and, where available, regional studies. As a result, the conclusions drawn from the mapping are considered indicative only
- The proposals applicable WSP legislation (NSW Government) – High priority GDEs are identified in the Water Sharing Plan for the water source in which they reside and are regulated under the NSW Aquifer Interference Policy.

The BOM's GDE atlas mapped the Macquarie River as an unclassified potential Aquatic GDE and a high potential terrestrial GDE. Land immediately adjacent to the river up to a distance of about 80 metres from the river was also mapped as a high potential terrestrial GDE. Some areas in the vicinity of the proposed bridge were mapped as low potential terrestrial GDE, with a very small area near Brisbane Street mapped as moderate potential GDE.

3.5.1 Classification of groundwater dependent ecosystems

The degree of groundwater dependence of ecosystems in terms of three broad categories:

- Non-dependent ecosystems; ecosystems that occur mostly in recharge areas and have no connection with groundwater
- Facultative GDEs; require groundwater in some locations but not in others, particularly where an alternative source of water can be accessed to maintain ecological function
- Obligate GDEs; ecosystems that are restricted to locations of groundwater discharge (e.g. mound springs) and ecosystems located within aquifers (e.g. subterranean cave and stygofauna communities (Kuginis *et al.* 2012)
- Facultative GDEs have varying degrees of groundwater dependence and are described under three dependence subcategories:
 - Highly dependent; some locations within the ecosystem likely to require continual access to groundwater; likely to be damaged or destroyed if groundwater attributes fall below a critical threshold
 - Proportional; exhibit proportional responses to changes in groundwater attributes; do not generally exhibit the threshold type response of the more dependent ecosystems
 - Opportunistic; ecosystems which use groundwater as required when surface water / soil moisture is unavailable, such as at the end of a dry period.

Minor changes to the groundwater regime in facultative GDEs with proportional or opportunistic groundwater dependence may not have any adverse impacts but these ecosystems can be damaged or destroyed if a lack of access to groundwater is prolonged (Kuginis *et al.* 2012).

Groundwater dependant ecosystems have been classified into seven types under two broad categories as follows (Kuginis *et al.* 2012):

- Subsurface ecosystems – Underground ecosystems:
 - Karst systems and caves (limestone geology)
 - Subsurface aquifer (phreatic) ecosystems
 - Baseflow streams (hyporheic or subsurface component)
- Surface ecosystems – Above ground ecosystems:
 - Groundwater dependent wetlands
 - Baseflow surface streams (surface/free-water component)
 - Estuarine and near shore marine ecosystems
 - Groundwater dependent terrestrial ecosystems; dependent on subsurface groundwater (phreatophytic).

3.5.2 Groundwater dependant ecosystems in the proposal area

The level of groundwater dependence and potential for interaction is identified for terrestrial ecosystems in the study area is identified in **Table 3-6**.

Table 3-6 Level of groundwater dependence of terrestrial ecosystems in study area

Ecosystem	Potential for GDE interaction (BoM, 2017)	Type of GDE (Kuginis <i>et al.</i> 2012)	Likely type and degree of groundwater dependence (Kuginis <i>et al.</i> 2012)
River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (78)	High potential GDE - from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Facultative-proportional; Likely to be dependent in part on groundwater may be modified (e.g. in species composition) by changes in groundwater attributes but is unlikely to be destroyed. Likely to be moderately reliant on groundwater particularly during times of water stress.
Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (202)	Low potential GDE - from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Facultative-opportunistic Likely to use groundwater where available during times of water stress but to be dependent chiefly on rainfall.
Derived grassland of the NSW South Western Slopes (796)	Low potential GDE - from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Facultative-opportunistic Likely to use groundwater where available during times of water stress but to be dependent chiefly on rainfall.
Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (181)	High potential GDE - from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Facultative-proportional; Likely to be dependent in part on groundwater may be modified (e.g. in species composition) by changes in groundwater attributes but is unlikely to be destroyed. Likely to be moderately reliant on groundwater particularly during times of water stress.

Figure 3-2 and **Figure 3-3** shows the distribution of potential aquatic and terrestrial GDEs.

Aquatic groundwater dependant ecosystems

Macquarie River is an aquatic groundwater dependent ecosystem with an unclassified potential GDE within the study area.

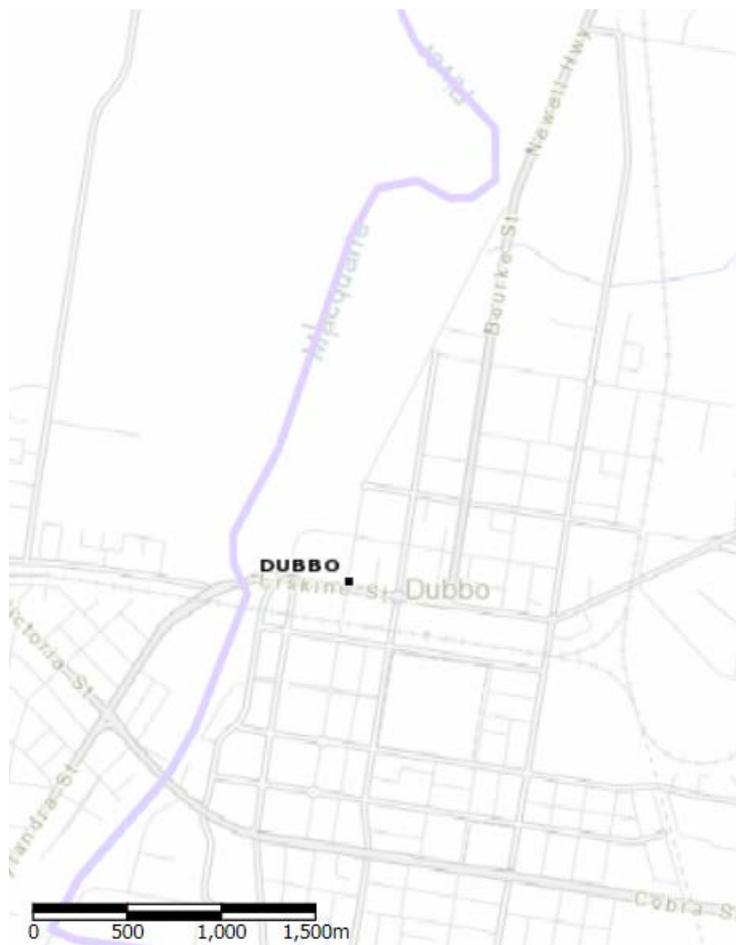


Figure 3-2 Aquatic groundwater dependent ecosystems



Figure 3-3 Terrestrial groundwater dependent ecosystems

3.6 Aquatic threatened ecological communities

Under Part 7A of the FM Act (Division 1, Section 220B), an ecological community means an assemblage of species of fish or marine vegetation (or both) occupying a particular area. Listing of Endangered Ecological Communities is provided for by Part 7A, Division 2 of FM the Act.

3.6.1 Lowland Darling River aquatic ecological community

The Macquarie River is a tributary of the Darling River. All fish and aquatic invertebrates (worms, crustaceans, insects, molluscs, rotifers etc.) in natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains in the Lower Darling region form part of *The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (Lowland Darling River aquatic ecological community) which is listed as an endangered ecological community under the FM Act.

Man-made/artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs are excluded from the aquatic ecological community.

As the river has been significantly altered since European settlement, the habitat type is at risk of becoming extinct in NSW. The community spans a large area which encompasses the Darling River and its major tributaries, from the Queensland border to the Victorian border. Consequently, all species and habitats within the community are protected by state legislation. Heavy penalties and legal implications for harming species or habitat (without appropriate authority) within this zone are enforced (DPI 2007).

3.7 Threatened ecological communities

One threatened ecological community listed under the BC Act was recorded across the study area, as described in **Table 3-7**. The distribution and extent of this threatened ecological community in the study area is mapped in **Figure 3-1**.

Table 3-7 Terrestrial threatened ecological communities and condition thresholds

BC Act listed threatened ecological community	EPBC Act listed threatened ecological community?	Associated plant community type (PCT/s)	Relevant condition class and extent	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)	No	Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (PCT 202))	Moderate to Poor (Intact canopy with relatively disturbed understorey) 0.16 ha	<p>The relevant patches of vegetation are located in the Brigalow Belt South bioregion and are dominated by Fuzzy Box (<i>Eucalyptus conica</i>) The floristic composition of the vegetation observed and the associated PCT matches the BC Act determination for the TEC and the PCT is listed as being part of the TEC in the BioNet Vegetation classification database.</p> <p>The occurrence of the PCT in Moderate to Poor (Intact canopy with relatively disturbed understorey) condition occurring in a very small patch with mature trees and some native all vegetation layers but is dominated by weeds in some parts. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition.</p> <p>Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland (PCT 796) is therefore excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located adjacent to or within patches of the community containing elements of the upper and/or middle vegetation strata; such areas of derived grassland are considered to have potential to naturally regenerate into the community under appropriate management.</p>

3.8 Threatened species and populations

Surveys were undertaken throughout the study area for some threatened species considered as having a moderate to high likelihood of occurring. The initial list was based mostly on the findings of the PEI. The results of the surveys are shown below in **Table 3-8**, with a new likelihood of occurrence provided based on habitat assessments undertaken during field surveys (presence or absence of key habitat features including associated PCTs and taxa, topographic, soil and geological preferences, microhabitats e.g. damp areas, and disturbance regime of the habitat).

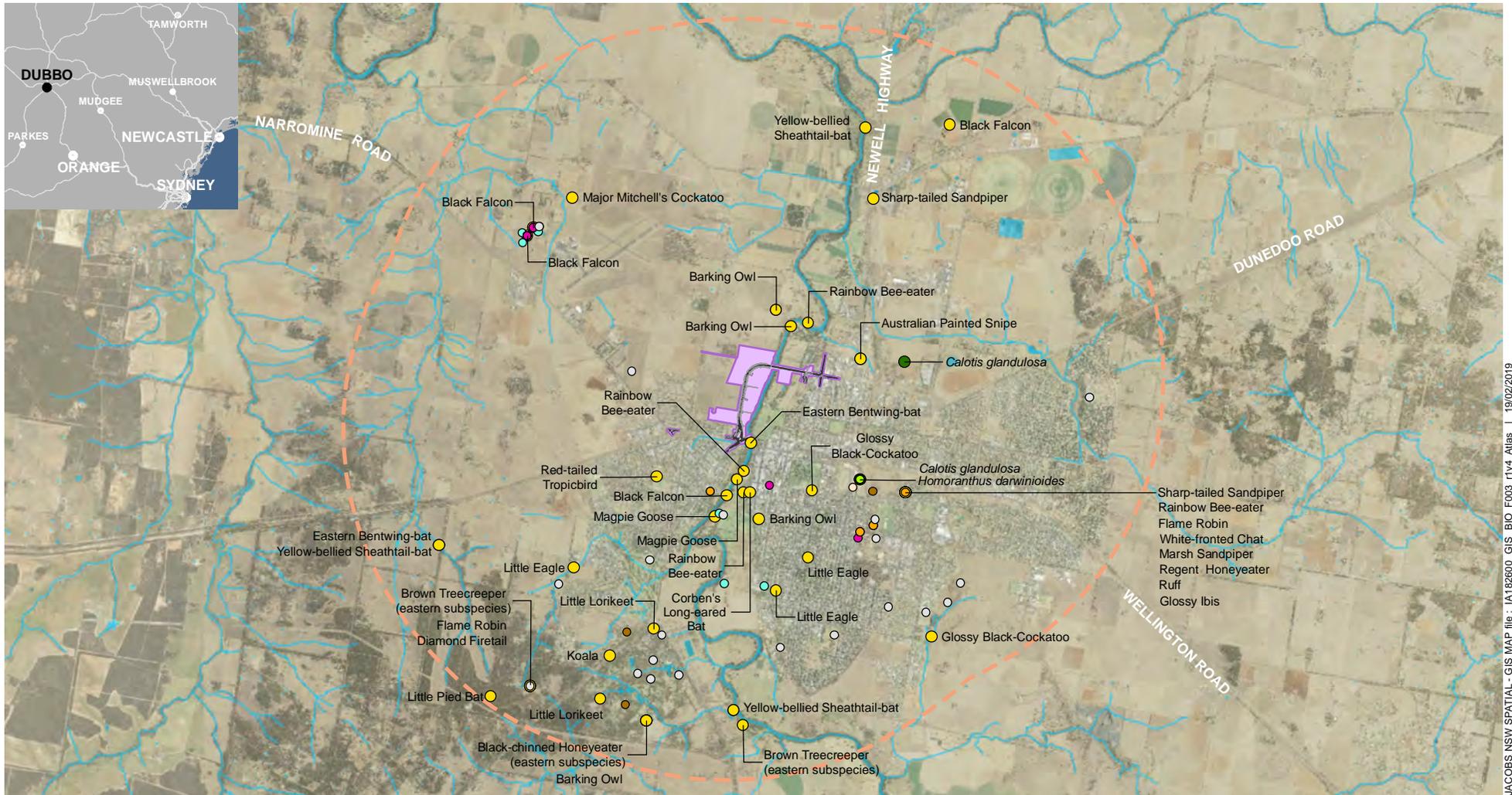
No targeted surveys for aquatic threatened species were carried out. If suitable fish habitat was present, then the aquatic species listed in **Table 3-8** have been assumed to occur based on DPI NSW threatened species distribution maps (2015). The Purple Spotted Gudgeon (*Mogurnda adspersa*), which is listed as endangered under the FM Act is also expected or likely to occur approximately five kilometres downstream of the proposal area.

No threatened flora and/or fauna species were detected during surveys. Species predicted to have a moderate to high likelihood of occurring within the study area are listed in the table below. **Figure 3-4** illustrates locations of threatened species past records in the study locality.

Table 3-8 Threatened species with a moderate to high likelihood of occurrence

Species name	Common name	Status			Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	FM Act	
<i>Diuris tricolor</i>	Pine Donkey Orchid		V		Moderate -in derived grassland
<i>Swainsona murrayana</i>	Slender Darling-pea	V	V		Moderate -in derived grassland
<i>Tandanus tandanus</i>	Eel Tailed Catfish			E	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River).
<i>Maccullochella macquariensis</i>	Trout Cod	E		E	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
<i>Maccullochella peelii</i>	Murray Cod	V			Moderate likelihood of occurrence
<i>Ambassis agassizzi</i>	Olive Perchlet			EP	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
<i>Bidyanus bidyanus</i>	Silver Perch	E		V	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat		V		Moderate
<i>Chalinolobus picatus</i>	Little Pied Bat		V		Moderate likelihood of occurrence

Species name	Common name	Status			Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	FM Act	
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat		V		Moderate likelihood of occurrence
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	V	V		Moderate
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	V	V		Moderate
<i>Anseranas semipalmata</i>	Magpie Goose		V		Moderate
<i>Chthonicola sagittata</i>	Speckled Warbler		V		Moderate – recorded within the study locality
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V		Moderate
<i>Glossopsitta pusilla</i>	Little Lorikeet		V		Moderate
<i>Polytelis swainsonii</i>	Superb Parrot	V	V		Moderate
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler		V		Moderate
<i>Stagonopleura guttata</i>	Diamond Firetail		V		Moderate
<i>Falco subniger</i>	Black Falcon		V		Moderate
<i>Circus assimilis</i>	Spotted Harrier		V		Moderate
<i>Hieraaetus morphnoides</i>	Little Eagle		V		Moderate
<i>Ninox connivens</i>	Barking Owl		V		Moderate – Recorded within the study locality
EP = Endangered Population, E = Endangered, V = Vulnerable					



JACOBS NSW SPATIAL - GIS MAP file : I4182800_GIS_BIC_F003_riv4_Atlas | 19/02/2019

Legend

- 80% concept design
- Study area
- ⊞ 5 km buffer around study area

Threatened species

Fauna

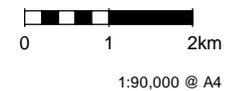
- Grey-crowned Babbler (eastern subspecies)
- Regent Honeyeater

● Spotted Harrier

- Superb Parrot
- Other fauna (labelled on the map)

Flora

- *Commersonia procumbens*
- *Diuris tricolor*
- *Indigofera efoliata*
- Other flora (labelled on the map)



Data sources

Jacobs 2018, LPI 2018, OEH 2018,
© Department of Finance, Services & Innovation 2018

Figure 3-4 | Database records of threatened flora and fauna from the locality

3.9 Wildlife connectivity corridors and habitat fragmentation

Habitat fragmentation *per se* relates to the physical dividing up of once continuous habitats into separate smaller ‘fragments’ (Fahrig, 2002). The patches of habitat within the study area are fragments that have been formed by historic habitat clearing. The barriers posed by the Newell Highway and other roads reduce fauna movement ability between the habitat patches. However, functional habitat connectivity for more mobile species (e.g. birds, insectivorous bats, insects, and wind-dispersed and bird-dispersed plants) is still present. The current roadway does not totally prevent movement of terrestrial and arboreal fauna (e.g. possums, wallabies, reptiles) between habitat fragments; fauna can and likely do cross the road but the road is likely to reduce the frequency of such movements and to present a considerable hazard.

There are no officially mapped wildlife corridors in the IBRA subregions in which the study area is located. The vegetation remnants in the locality are separated by expanses of cleared land now occupied by cropping areas, grazing paddocks, local roadways, a railway line, the Newell Highway and other development. In a highly cleared landscape such as that of the study area, wildlife connectivity corridors often consist primarily of relatively narrow strips of riparian vegetation, which is particularly evident along the Macquarie River, which would act as a corridor linking larger areas of habitat. Such habitat connectivity features can be very important for the long-term viability of wildlife populations as they allow movement of animals between sub-populations centred on larger areas of habitat, facilitating maintenance of genetic diversity and re-colonisation of habitats after localised extinctions caused by major disturbance events such as large floods or intense and widespread bushfires.

3.10 Matters of National Environmental Significance

3.10.1 Threatened ecological communities

There were no plant community types in the study area associated with nationally listed threatened ecological communities.

3.10.2 Threatened species and populations

Table 3-9 list the nationally listed threatened flora and fauna species either recorded in the study area or considered as having a moderate to high likelihood of occurring based on the presence of suitable habitat.

Table 3-9 Habitat assessment and survey results for nationally listed threatened species of plants

Species name	Common name	Status			Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	FM Act	
<i>Maccullochella macquariensis</i>	Trout Cod	E		E	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
<i>Maccullochella peelii</i>	Murray Cod	V			Moderate likelihood of occurrence
<i>Bidyanus bidyanus</i>	Silver Perch	E		V	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area

Species name	Common name	Status			Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	FM Act	
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	V	V		Moderate
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	V	V		Moderate
<i>Polytelis swainsonii</i>	Superb Parrot	V	V		Moderate

3.10.3 World and national heritage

There are no world heritage properties in the locality. There are no national heritage properties or commonwealth heritage places in the locality that are listed for their biodiversity values.

The proposal is unlikely to affect the biodiversity values of any world heritage properties, national heritage properties or national heritage places.

3.10.4 Wetlands of international importance

There are no wetlands of international importance in the locality.

3.10.5 Migratory species

Table 3-10 lists the nationally listed migratory fauna species considered as having a moderate to high likelihood of occurring based on the presence of suitable habitat.

Table 3-10 Habitat assessment and survey results for nationally listed migratory fauna

Species name	Common name	EPBC Act	Likelihood of occurrence
<i>Ardea alba</i>	Great Egret	Migratory	Moderate.
<i>Rhipidura rufifrons</i>	Rufous Fantail	Migratory	Moderate – few records occur in the locality. May pass through the study area on occasion.
<i>Tringa nebularia</i>	Common Greenshank	Migratory	Moderate – Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
<i>Ardea ibis</i>	Cattle Egret	Migratory	Moderate – may occur in study area when cattle are present.
<i>Merops ornatus</i>	Rainbow Bee-eater	Marine	Moderate – species has been recorded in the locality. Suitable habitat in study area.
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory	Moderate – would likely fly over the study area during migration.
<i>Hirundapus caudacutus</i>	White-throated Needletail	Migratory,	Moderate – likely to fly over the study area during migration.

3.11 Weeds

Weeds are now managed under the *Biosecurity Act 2015* implemented on the 1 July 2017. Noxious weeds are now known as 'priority weeds' that are allocated to new management arrangements to prevent, eliminate, minimise or manage and/or control the risk of weed spread and establishment.

Three priority weeds declared for the Dubbo Region are present within the study area (see **Table 3-11**). Species were in low to moderate abundance within the study area.

Table 3-11 Priority weeds present within the study area

Priority Weed	Duty	Weed of National Significance (WONS)
African boxthorn (<i>Lycium ferocissimum</i>)	Prohibition on dealings Must not be imported into the State or sold	Yes
Cat's claw creeper (<i>Dolichandra unguis-cati</i>)	Regional Recommended Measure Land managers should mitigate the risk of the plant being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment. Land managers to reduce impacts from the plant on priority assets.	No
Harrisia species (<i>Harrisia tortuosa</i>)	Regional Recommended Measure Land managers should mitigate the risk of new weeds being introduced to their land. The plant should be eradicated from the land and the land kept free of the plant. The plant should not be bought, sold, grown, carried or released into the environment.	No

4 Impact assessment

4.1 Construction impacts

4.1.1 Removal of native vegetation

On the basis of the road alignment and bridge location (including a five metre construction buffer beyond the design), the estimated clearing of native vegetation for the proposal as a whole is about 0.74 hectares. The vegetation loss is minimal as the road alignment predominantly traverses a cleared agricultural landscape (additional 1.9 ha). A summary of the vegetation loss is shown in **Table 4-1**.

Table 4-1 Quantum of native vegetation loss across proposal section and whole proposal

Plant community type (PCT)	Threatened ecological community?	Loss of vegetation (ha)
River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (78)	No	0.41
		0.06
Fuzzy Box woodland on colluvium and alluvial flats in the Brigalow Belt South Bioregion (including Pilliga) and Nandewar Bioregion (202)	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act)	0.02
Derived grassland of the NSW South Western Slopes (796)	No	0.19
Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (181)	No	0.06
Total loss of native vegetation		0.74 ha

4.1.2 Threatened Ecological Communities

Construction impacts to threatened ecological communities are not expected to occur under the current proposal and design.

4.1.3 Removal of threatened species and habitat

The extent of vegetation clearing estimated to result from the proposal is outlined above in **Section 4.1.1**. This vegetation provides suitable habitat for a range of threatened animal and plant species listed under the BC Act and EPBC Act. As such, direct impacts to habitat for threatened species would occur during construction.

Of the 41 hollow bearing trees identified in the study area, eight trees may be lost during construction, this includes four large River Red Gums and four large stags with multiple hollows, some with large hollows. These habitat features are very important landscape refuges for fauna, particularly the large River Red Gums and may potentially support roosting and nesting for breeding birds, microbats and arboreal mammals as well as threatened species.

Other large trees important habitat values such as River Red Gums will remain intact and may sustain minor branch lopping near minor works.

There would be a loss of ephemeral wetland habitat (Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems) suitable for foraging wetland birds as well as threatened and migratory species.

The direct impacts of the proposal to threatened species and their habitats have been estimated based on the current design. A breakdown of the direct impacts to habitat for threatened flora and fauna is provided in **Table 4-2** and **Table 4-3** respectively.

Table 4-2 Impacts on threatened plant species

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
<i>Diuris tricolor</i>	Pine Donkey Orchid	-	V	Moderate – species not known from locality but is known from a relevant IBRA subregion and study area contains potential habitat. Survey timing was not suitable for detection of this species. Associated habitat to be impacted includes: <ul style="list-style-type: none"> Derived grassland of the NSW South Western Slopes (0.19 ha) Total potential habitat affected = 0.19 hectares
<i>Swainsona murrayana</i>	Slender Darling-pea	V	V	Moderate – species is known from a single record in the locality and contains potential habitat. Survey timing was not suitable for detection of this species. Associated habitat to be impacted includes: <ul style="list-style-type: none"> Derived grassland of the NSW South Western Slopes (0.19 ha) Total potential habitat affected = 0.19 hectares

Table 4-3 Summary of habitat impacts on threatened fauna

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	-	V	Moderate; species likely to occur in the study area. Habitat widespread. Associated habitat to be impacted includes: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19 ha) Total known and potential habitat affected = 0.66 hectares

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
<i>Circus assimilis</i>	Spotted Harrier	-	V	Moderate – known from locality. Suitable habitat widespread; the most suitable habitat includes the edges of ephemeral wetlands and river. Associated habitat to be impacted includes: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) Total potential habitat affected = 0.53 hectares
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	-	V	Moderate – recorded in the locality at moderate frequency and suitable habitat widespread in study area. <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19 ha) Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) Total potential habitat affected = 0.72 hectares
<i>Chthonicola sagittata (Pyrrholaemus sagittatus)</i>	Speckled Warbler	-	V	Moderate – marginal habitat present (relatively small patch size, linear shape and fragmentation). Associated habitat to be impacted includes: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19 ha) Total potential habitat affected = 0.66 hectares
<i>Hieraaetus morphnoides</i>	Little Eagle	-	V	Moderate – suitable habitat widespread and recorded at moderate frequency; including a record immediately adjacent to the study area. Associated habitat to be impacted includes: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19ha) Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) Total potential habitat affected = 0.72 hectares
<i>Ninox connivens</i>	Barking Owl	-	V	Moderate – suitable habitat widespread through study area. Recorded in larger woodland areas NE of study area. <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Total potential habitat affected = 0.47 hectares

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Moderate – suitable habitat widespread, particularly in areas with mistletoes. Associated habitats in the study area include: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Total potential habitat affected = 0.47 hectares
<i>Chalinolobus picatus</i>	Little Pied Bat	-	V	Moderate; likely to forage in the study area and may roost in hollow-bearing trees and bridges/culverts. Associated habitats in the study area include: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19 ha) Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) Total potential habitat affected = 0.72 hectares
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	V	Moderate – this species may forage in woodland/forest and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19 ha) Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) Total potential habitat affected = 0.72 hectares
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V	Moderate. infrequently recorded in the locality and habitat is widespread in the study area. <ul style="list-style-type: none"> River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) Derived grassland of the NSW South Western Slopes (0.19 ha) Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) Total potential habitat affected = 0.72 hectares

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	-	V	<p>Moderate – infrequently recorded in the locality but suitable habitat is present. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>
<i>Falco hypoleucos</i>	Grey Falcon	-	E	<p>Moderate – not common in the locality however this species may pass through the study area on occasion. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>
<i>Lophoictinia isura</i>	Square-tailed Kite	-	V	<p>Moderate – Likely to pass through the study area on occasion. May nest in large trees in the study area. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>
<i>Stagonopleura guttata</i>	Diamond Firetail	-	V	<p>Moderate – suitable habitat widespread but few local records. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
<i>Falco subniger</i>	Black Falcon	-	V	<p>Moderate – suitable habitat widespread. This species may hunt and perch in the study area; nesting habitat in the study area is likely.</p> <p>Potential habitat in the study area includes all woodland/forest and grasslands with scattered trees. The habitat likely to be most suitable for the species includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>
<i>Petaurus norfolcensis</i>	Squirrel Glider	-	V	<p>Moderate – Although vegetation in the study area is fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands.</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) <p>Total potential habitat affected = 0.47 hectares</p>
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V	<p>Moderate – Not common in the area though is likely to pass through. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) <p>Total potential habitat affected = 0.47 hectares</p>
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat	V	V	<p>Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	-	V	<p>Moderate – this species may forage in and around woodland/forest and roost in bridges/culverts in the study area. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	<p>Moderate – this species previously recorded occasionally in and around Dubbo. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat to be impacted includes:</p> <ul style="list-style-type: none"> • River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (0.47 ha) • Derived grassland of the NSW South Western Slopes (0.19 ha) • Common Reed - Bushy Groundsel aquatic tall reedland grassland wetland of inland river systems (0.06 ha) <p>Total potential habitat affected = 0.72 hectares</p>

4.1.4 Aquatic impacts

As impacts on aquatic biodiversity are likely, the *Fisheries NSW policy and guidelines for fish habitat conservation and management* (DPI 2013) has been considered in the assessment of impacts on aquatic biodiversity.

Impacts on the habitat of threatened fish and threatened aquatic ecological communities are described in **Table 4-4**.

Table 4-4 Potential impacts on aquatic biodiversity

Water body	Key Fish Habitat status based on habitat assessment	Potential impacts on the waterway and associated threatened species and the <i>Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River Endangered Ecological Community (Lowland Darling River EEC)</i>
Macquarie River	Class 1: Major key fish habitat if threatened species present	<p>Bridge construction in this location may disturb the bed of the river. Direct impacts on threatened fish individuals is unlikely.</p> <p>Potential impact on downstream water quality is possible due to turbidity and sedimentation from the works, tannins from mulch, and accidental spills/leaks. Minimal impact on riparian or aquatic vegetation, logs or other habitat structures. Slight increase in the obstruction to fish passage and changes to hydrology.</p> <p>A small area of habitat of the Lowland Darling River EEC would be removed in this location due to clearing of vegetation on floodplain comprising 0.40 hectares.</p>

4.1.5 Injury and mortality

Fauna injury or death has the greatest potential to occur during construction when vegetation clearing would occur. The extent of this impact would be proportionate to the extent of vegetation that is cleared. Less mobile species (e.g. ground dwelling reptiles), or those that are nocturnal and nest or roost in trees during the day (e.g. arboreal mammals and microchiropteran bat species), may find it difficult to rapidly move away from the clearing when disturbed. The study area is known to contain a number of arboreal species such as birds that may be injured or killed during vegetation removal. Reptiles and frogs may also be injured or killed during construction as habitat is cleared.

Entrapment of wildlife in any trenches or pits that are dug is a possibility if the trenches are deep and steep sided. Wildlife may also become trapped in or may choose to shelter in machinery that is stored in the study area overnight. If these animals were to remain inside the machinery, or under the wheels or tracks, they may be injured or may die once the machinery is in use.

Mitigation measures designed to reduce an injury and mortality of fauna are provided in **Section 5**.

4.1.6 Ancillary facilities

Proposed ancillary facilities are located in exotic grassland used for pasture livestock grazing and council activities and areas of parkland with planted shrubs and trees. Direct impacts to biodiversity are unlikely to occur if kept with proposed areas. There is potential for indirect impacts to nearby riparian habitats of the Macquarie River. If unmitigated, sediment-laden surface water runoff and spills of pollutants may flow into the watercourse. Activities

undertaken at ancillary facilities that have the potential to impact downstream aquatic habitats include:

- Storage of chemicals
- Vehicle washdown areas
- Vehicle refueling areas
- High frequency of vehicle movements.

In order to minimise the transport of sediments and pollutants from ancillary facilities, the sites are best located on flat ground that do not require vegetation clearance, away from overland flowpaths and in areas of high topography with minimal upstream catchment. Sediment basins at ancillary sites greater than 0.5 hectare would be confirmed at the detailed design stage.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity corridors and habitat fragmentation

Throughout its length, the proposal would result in a small increase in isolation of habitats as the current habitat patches would be made smaller which would increase the physical distance between habitat fragments, particularly at the bridge location. The isolation that may be caused by the proposal is not likely to have an appreciable impact on nomadic or migratory species such as many species birds and bats, however, it may detrimentally affect the dispersal ability of less mobile fauna such as ground-dwelling and arboreal reptiles and mammals.

The construction of the new bridge and extension of highway would contribute to an increase in isolation of habitats through loss of some small stepping-stone patches, narrowing and degradation of linear patches of vegetation, and an increased distance between habitats on to the river from the westside. The predicted level of isolation from the proposal is not likely to be enough to prevent the breeding and dispersal of plant pollinators. The dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches would continue with little impact for those species with seeds dispersed by wind and larger animal. The dispersal capabilities of plants with no specialised dispersal mechanisms and those with ant-dispersed seeds may however be adversely impacted. Functional connectivity for many species would remain in the study area. However, local division of some wildlife populations, isolation of key habitat resources, loss of genetic interchange, and loss of population viability for some species may result.

This impact would be of low magnitude and targeted mitigation measures to restore habitat connectivity and thereby address this impact are considered necessary.

Mitigation measures designed to reduce the impact of the proposal on wildlife connectivity and habitat fragmentation are provided in **Section 5**.

4.2.2 Edge effects on adjacent native vegetation and habitat

The development of linear infrastructure is known to cause disturbance in terms of reducing habitat quality in adjacent areas. This is due to the greater potential for edge effects and habitat fragmentation and barrier effects due to the high perimeter to area ratio of linear developments. Edge effects typically take the form of weed invasion, increased light levels, increased wind speeds, and greater temperature fluctuations.

The proposal would be built in an area that is currently subject to a high level of edge effects from agricultural activity, the existing roadways and other development. The vegetation patches within the study area affected by high weed invasion and other edge effects along existing edges, typically extending 5-7 metres from the existing road formation and other clearings. There are likely to be additional edge effects resulting from the proposal as the new edges would typically be in areas only currently experiencing low to moderate weed invasion and other edge effects.

This impact would be of moderate magnitude and targeted mitigation measures are considered necessary to address this issue.

4.2.3 Injury and mortality

There is a chance of fauna mortality during the operational phase of the proposal through vehicle collision (i.e. roadkill). Numerous macropods were observed on the west side of the river, including Eastern Grey Kangaroo and Common Wallaroo. Vehicle collision is a direct impact that reduces local population numbers. Mammals, reptiles, amphibians and birds are all at risk of vehicle strike. As there are no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations is unknown. A variety of road-killed fauna species were noted in the study area including birds, macropods and reptiles.

With the expansion of the road on the west side of the river, the risk of vehicle strike is expected to increase to a minor degree, where macropod populations may move to access the river, but the significance of such an impact cannot be easily predicted. For this reason, opportunities to reduce road-kill mortality of fauna should be investigated during detailed design. The increased impact on most threatened species is expected to be low.

4.2.4 Invasion and spread of weeds

Proliferation of weed and pest species is an indirect impact (i.e. not a direct result of proposal activities). The most likely causes of weed dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery during all phases. The study area contains significant weed growth, in all areas, particularly on agricultural land and along minor roads and tracks. As such, the spread and proliferation of weeds must be managed during construction.

Mitigation measures designed to limit the spread and germination of weeds are provided in **Section 5**.

4.2.5 Invasion and spread of pests

The study area is currently known or likely habitat for a range of pest species including foxes (*Vulpes vulpes*) and rabbits (*Oryctolagus cuniculus*).

Proposal activities have the potential to disperse pest species out of the proposal area across the surrounding landscape but the magnitude of this impact would be low and mitigation measures are not likely to be effective and are not deemed necessary.

4.2.6 Invasion and spread of pathogens and disease

Several pathogens known from NSW have potential to impact on biodiversity as a result their movement and infection during construction. Of these, three are listed as a key threatening process under either the EPBC Act and/or BC Act including:

- Dieback caused by *Phytophthora* (Root Rot; EPBC Act and BC Act)
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and BC Act)
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (BC Act).

While these pathogens were not observed or tested for in the study area the potential for pathogens to occur should be treated as a risk during construction. The most likely causes of pathogen dispersal and importation associated with the proposal include earthworks, movement of soil, and attachment of plant matter to vehicles and machinery during all proposal phases (construction and operation). Pathogens would be managed within the proposal site according to the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (NSW Roads and Traffic Authority, 2011b) (see **Section 5**).

4.2.7 Changes to hydrology

The proposal will involve the construction of bridge and increased elevation of the road surface. This may cause changes to the duration and extent of inundation of areas in the vicinity of waterways. These changes are considered likely to only impact relatively small areas. They are unlikely to result in the loss of native vegetation but may cause changes in the relative abundance of species. For instance, if areas are more frequently inundated, sedges and other semi-aquatic plants are likely to proliferate relative to dryland grass species and forbs.

4.2.8 Aquatic impacts

During the operational phase of the proposal the roads and bridge would be sealed, cleared areas landscaped and scour protection installed. There would be no exposed topsoil and therefore little or no risk of soil erosion and subsequent transport of sediment into nearby receiving waterways. Water quality risks that may impact aquatic biodiversity during operation would instead be associated with runoff of pollutants from new road surfaces, accidental spills, increased impervious areas and permanent structures within waterways. Through the implementation of appropriate design and management these risks are unlikely.

4.2.9 Noise, light and vibration

Considering the existing levels of noise and vibration from the existing Newell Highway and other roads by vehicles, it is unlikely there would be a significant increase in noise and vibration during operation of the road that would result in any increased impacts to biodiversity within the study area. There is however potential for impacts to fauna from noise and vibration during construction, which may result in fauna temporarily avoiding habitats adjacent to the construction. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

Lighting would be used at night to enable work to be completed that may result in impacts to nocturnal fauna. Nocturnal species such as possums and microbats may avoid the habitat in the study area during construction as temporary 'daylight' conditions would be created by the mobile lighting system. This impact is considered temporary and would not have long lasting effects on the biodiversity of the study area. The magnitude of this impact would be low and mitigation measures are not deemed necessary.

It has been assumed for the purposes of this assessment that no permanent lighting would be installed in areas that are not currently lit.

4.2.10 Groundwater dependent ecosystems

The proposed development's influence on groundwater levels is anticipated to be limited to localised changes in the area of bridge footings which are beneath the water table. Deep footings which intersect the groundwater level in the alluvial material would likely lead to some minor localised increase in groundwater level up-gradient of the footing due to flow obstruction. Such changes are not expected to affect the local groundwater flow system, alter groundwater/surface water exchange with the Macquarie River or impact surrounding bores.

The potential changes to groundwater level are considered unlikely to impact local GDEs. Potential impacts to groundwater quality could affect the health of GDEs and the quality of the groundwater discharge the Macquarie River.

Further consideration and assessment of the potential impacts to GDEs would be undertaken during detailed design.

4.3 Cumulative impacts

The potential biodiversity impacts of the proposal must be considered as a consequence of the construction and operation of the proposal within the existing environment. The proposal would not act alone in causing impacts to biodiversity. The incremental effects of multiple sources of impact (past, present and future) are referred to as cumulative impacts and provide an opportunity to consider the proposal within a strategic context.

The accumulating impacts of historic vegetation clearing for agriculture, urban development, and development and maintenance of infrastructure have contributed to the loss of biodiversity in the Brigalow Belt South Bioregion.

4.4 EPBC Act Strategic Assessment

Under the strategic assessment approval, Roads and Maritime must ensure that where a road or traffic management activity is identified through the REF process as likely to significantly impact Specified Protected Matters, measures are applied to ensure such impacts will not be unacceptable. Specified Protected Matters include nationally listed threatened species, ecological communities and migratory species. Factors that require consideration in determining whether an unacceptable impact is likely include:

1. Whether there is a real chance or possibility that the activity threatens the long-term survival of any species or community defined as a Specified Protected Matter
2. Consistency with relevant threat abatement plans and recovery plans, and related threatened species initiatives
3. Whether suitable offsets can be secured, including additional or supplementary actions that may be required
4. Any conservation advice and relevant guidelines provided by the Australian Government Department of the Environment.

This biodiversity assessment identifies that the proposal is not likely to have a significant impact on threatened biodiversity listed under the BC Act and EPBC Act (see **Section 4.5** and **Appendix B** and **C**). Unacceptable impacts on MNES would not occur and the EPBC Act environmental offsets policy does not apply.

4.5 Assessments of significance

An Assessment of Significance has been conducted for threatened species that have been positively identified within the study area or that are considered to have a moderate or high likelihood of occurring in the study area due to the presence of suitable habitat.

The proposed works have been assessed under Division 5.1 of the EP&A Act. Section 7.3 of the BC Act outlines the 'test of significance' that is to be undertaken to assess the likelihood of significant impact upon threatened species or ecological communities listed under the BC Act. As a new guideline has not been produced by the OEH, these tests of significance have been undertaken in accordance with the guidelines provided in the *Threatened Species Test of Significance Guidelines* (OEH, 2018) which outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment.

Full details of assessment of significance under the BC Act and FM Act are presented in **Appendix B**. The conclusions of the BC Act and FM Act assessments are provided in **Table 4-5** and **Table 4-6**.

For threatened biodiversity listed under the EPBC Act, significance assessments have been completed in accordance with the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of Environment, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is

affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (Department of Environment, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (Department of Environment, 2013). This advice has been considered while undertaking the assessments.

Full details of assessment of significance under the EPBC Act are presented in **Appendix C**. The conclusions of the assessment are provided in **Table 4-7**.

Table 4-5 Summary findings of the BC Act test of significance

Biodiversity Conservation Act 2016 test of significance						
Threatened species, or communities	Significance assessment question ¹					Likely significant effect?
	a	b	c	d	e	
Bats – roosting in culverts/mad-made structures						
Little Pied Bat (<i>Chalinolobus picatus</i>)	N	X	N	N	N	No
Eastern Bentwing Bat (<i>Miniopterus schreibersii oceanensis</i>)	N	X	N	N	N	No
Bats – roosting in tree hollows						
Corben's Long-eared Bat (<i>Nyctophilus corbeni</i>)	N	X	N	N	N	No
Yellow Bellied Sheath-tail Bat (<i>Saccolaimus flaviventris</i>)	N	X	N	N	N	No
Grey-headed Flying Fox (<i>Pteropus poliocephalus</i>)	N	X	N	N	N	No
Birds – Wetland						
Magpie Goose (<i>Anseranas semipalmata</i>)	N	X	N	N	N	No
Birds – Woodland						
Speckled Warbler (<i>Chthonicola sagittata</i>)	N	X	N	N	N	No
Varied Sittella (<i>Daphoenositta chrysoptera</i>)	N	X	N	N	N	No
Little Lorikeet (<i>Glossopsitta pusilla</i>)	N	X	N	N	N	No
Superb Parrot (<i>Polytelis swainsonii</i>)	N	X	N	N	N	No
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>)	N	X	N	N	N	No
Grey-crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	N	X	N	N	N	No

Biodiversity Conservation Act 2016 test of significance						
Threatened species, or communities	Significance assessment question ¹					Likely significant effect?
	a	b	c	d	e	
Diamond Firetail (<i>Stagonopleura guttata</i>)	N	X	N	N	N	No
Birds – Birds of prey						
Black Falcon (<i>Falco subniger</i>)	N	X	N	N	N	No
Spotted Harrier (<i>Circus assimilis</i>)	N	X	N	N	N	No
Little Eagle (<i>Hieraetus morphnoides</i>)	N	X	N	N	N	No
Barking Owl (<i>Ninox connivens</i>)	N	X	N	N	N	No
Flora						
Pine Donkey Orchid (<i>Diuris tricolor</i>)	N	X	N	N	N	No
Slender Darling Pea (<i>Swainsona murrayana</i>)	N	X	N	N	N	No
Threatened Ecological Communities						
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	X	N	N	N	N	No
<p>Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ? = unknown impact.</p> <p>1. Significance Assessment Questions as set out in the <i>Biodiversity Conservation Act 2016</i>:</p> <p>a in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p> <p>b in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p> <p>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p> <p>(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,</p> <p>c in relation to the habitat of a threatened species or ecological community:</p> <p>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p> <p>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p> <p>(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.</p> <p>d whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),</p> <p>e whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process</p>						

Table 4-6 Summary findings of the FM Act tests of significance

Fisheries Management Act 2016 test of significance								
Fish								
Silver Perch (<i>Bidyanus bidyanus</i>)	N	N	X	N	N	N	N	No
Olive Perchlet (<i>Ambassis agassizii</i>)	N	N	X	N	N	N	N	No
Trout Cod (<i>Maccullochella macquariensis</i>)	N	N	X	N	N	N	N	No
Eel Tailed Catfish (<i>Tandanus Tandanus</i>)	N	N	X	N	N	N	N	No
Threatened Aquatic Ecological Communities								
Lowland Darling River aquatic ecological community	X	X	N	N	N	N	N	No
<p>Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ? = unknown impact.</p> <p>2. Significance Assessment Questions as set out in the <i>Fisheries Management Act 1994</i>:</p> <ul style="list-style-type: none"> a in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction, b In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction, c in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: <ul style="list-style-type: none"> (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction, d in relation to the habitat of a threatened species, population or ecological community: <ul style="list-style-type: none"> (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality, e whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly), f whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan, <p>whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.</p>								

Table 4-7 Summary findings of the EPBC Act significance assessments

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population +	Likely Significant Impact
	1	2	3	4	5	6	7	8	9		
Ecological communities											
None	-	-	-	-	-	-	-	NA	NA	-	-
Species											
Grey-headed Flying Fox (<i>Pteropus poliocephalus</i>)	N	N	N	N	N	N	N	N	N	No	No
Superb Parrot (<i>Polytelis swainsonii</i>)	N	N	N	N	N	N	N	N	N	No	No
Trout Cod (<i>Maccullochella macquariensis</i>)	N	N	N	N	N	N	N	N	N	No	No
Murray Cod (<i>Maccullochella peelii</i>)	N	N	N	N	N	N	N	N	N	No	No
Silver Perch (<i>Bidyanus bidyanus</i>)	N	N	N	N	N	N	N	N	N	No	No
Corben's Long-eared Bat (<i>Nyctophilus corbeni</i>)	N	N	N	N	N	N	N	N	N	No	No

Species/Ecological Community	*Assessment of significance questions (EPBC Act)									Important Population +	Likely Significant Impact
	1	2	3	4	5	6	7	8	9		
<p>Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact. An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:</p> <ol style="list-style-type: none"> 1) reduce the extent of an ecological community 2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines 3) adversely affect habitat critical to the survival of an ecological community 4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns 5) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting 6) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: <ul style="list-style-type: none"> -- assisting invasive species, that are harmful to the listed ecological community, to become established, or -- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or 7) interfere with the recovery of an ecological community. <p>An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:</p> <ol style="list-style-type: none"> 1) Lead to a long-term decrease in the size of a population 2) Reduce the area of occupancy of the species 3) Fragment an existing population into two or more populations 4) Adversely affect habitat critical to the survival of a species 5) Disrupt the breeding cycle of a population 6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline 7) Result in invasive species that are harmful to a species becoming established in the species' habitat 8) Introduce disease that may cause the species to decline 9) Interfere with the recovery of the species. <p>An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:</p> <ol style="list-style-type: none"> 1) lead to a long-term decrease in the size of an important population of a species 2) reduce the area of occupancy of an important population 3) fragment an existing important population into two or more populations 4) adversely affect habitat critical to the survival of a species 5) disrupt the breeding cycle of an important population 6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline 7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat 8) introduce disease that may cause the species to decline, or 9) interfere substantially with the recovery of the species. <p>An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source populations either for breeding or dispersal, is likely to be necessary for maintaining genetic diversity, or is at or near the limit of the species range. The Grey-headed Flying-fox exists as one interconnected population along the east coast of Australia. Therefore, it is considered an important population for the purposes of this assessment.</p>											

Assessments of significance completed for migratory has found that the proposal is unlikely to significantly impact on any migratory species.

The list of species which are considered to have a moderate chance of occurring in the study area is shown below. The background searches and field investigations found no evidence to suggest that an area of 'important habitat' exists at the site for a migratory species, or that the study area is occupied by an ecologically significant proportion of the populations of these migratory species. It is therefore unlikely that the proposed works would impact on any listed migratory species.

An area of 'important habitat' for a migratory species is:

- Habitat used 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 used by a migratory species which is at the limit of the species range
- Habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species. Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates). These factors have been considered in the following assessment.

4.6 Summary of potential impacts

Potential impacts to biodiversity values are summarised in Table 4-8.

Table 4-8 Summary of potential impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
Removal of native vegetation	All terrestrial Plant Communities types	Reduction in extent of communities	0.72 ha	Permanent	Clearing of native vegetation
	Threatened plants	A reduction in potential habitat size and extent	<i>Diuris tricolor</i> = 0.19 ha	Permanent	

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
Removal of threatened fauna habitat	Threatened hollow-dependant fauna	Loss of habitat and a reduction in population size	<p>Owls moderately likely to occur across whole proposal. Impacts to associated habitat include moderately likely to occur across whole proposal:</p> <ul style="list-style-type: none"> • Barking Owl = 0.47 ha <p>Hollow dependent birds moderately likely to occur across whole proposal. Impacts to associated habitat include:</p> <ul style="list-style-type: none"> • Little Lorikeet = 0.47 ha • Superb Parrot = 0.72 ha <p>Hollow-roosting insectivorous bats moderately likely to occur across whole proposal. Impacts to associated habitat include moderately likely to occur across whole proposal:</p> <ul style="list-style-type: none"> • Yellow-bellied Sheath-tail-bat = 0.72 ha • Corben's Long-eared Bat = 0.72 ha <p>Arboreal mammals moderately likely to occur across whole proposal. Impacts to associated habitat include:</p> <ul style="list-style-type: none"> • Squirrel Glider = 0.72 ha 	Permanent	<ul style="list-style-type: none"> • Clearing of native vegetation • Removal of dead wood and dead trees
	All other threatened fauna	Loss of habitat and a reduction in population size	<p>Species identified during surveys:</p> <p>Birds moderately likely to occur across whole proposal. Impacts to associated habitat include:</p> <ul style="list-style-type: none"> • Painted Honeyeater = 0.47 ha • Dusky Woodswallow = 0.72 ha • Varied Sittella = 0.72 ha • Spotted Harrier = 0.53 ha 	Permanent	<ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
			<ul style="list-style-type: none"> • Little Eagle = 0.72 ha • Grey-crowned Babbler = 0.66 ha • Diamond Firetail = 0.72 ha • Hooded Robin (south-eastern form) = 0.72 ha • Speckled Warbler = 0.66 ha • Square-tailed Kite = 0.72 ha • Grey Falcon = 0.72 ha • Black Falcon = 0.72 ha <p>Cave-roosting insectivorous bats moderately likely to occur across whole proposal. Impacts to associated habitat include moderately likely to occur across whole proposal:</p> <ul style="list-style-type: none"> • Little Pied Bat = 0.72 ha • Eastern Bentwing-bat = 0.72 ha 		
Aquatic impacts	Threatened Fish	<p>A reduction habitat size and extent</p> <p>Decreased movement ability</p>	Difficult to quantify	Long term	Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
Injury and mortality of fauna	Threatened microbats Threatened woodland birds (nestlings) Threatened arboreal mammals	A reduction in population size	Difficult to quantify	Long term	-
Fragmentation of identified biodiversity links and habitat corridors	Threatened terrestrial mammals Threatened plants	Reduced genetic interaction of sub-populations Reduced ability for species to re-establish after local extinction.	Difficult to quantify	Long term	-
Edge effects on adjacent native vegetation and habitat	All threatened species and communities	A reduction in habitat condition due increased light and wind penetration and other changes to microclimatic conditions	Difficult to quantify	Long term	-

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
Invasion and spread of weeds	Threatened terrestrial animals	A reduction in habitat condition changes to floristics and vegetation structure	Difficult to quantify	Long term	<ul style="list-style-type: none"> Invasion and establishment of exotic vines and scramblers Invasion of native plant communities by African Olive (<i>Olea europaea</i> L. subsp. <i>cuspidata</i>) Invasion of native plant communities by exotic perennial grasses
	Threatened plants	A reduction in habitat condition due competitive exclusion of native species			
Invasion and spread of pests	Unlikely to occur with adequate mitigation	N/A	N/A	Long term	N/A
Invasion and spread of pathogens and disease	Unlikely to occur with adequate mitigation	N/A	N/A	Long term	<ul style="list-style-type: none"> Infection of native plants by <i>Phytophthora cinnamomi</i> Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae Infection of frogs by amphibian chytrid causing the disease chytridiomycosis

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
Noise, light and vibration	Minimal impact with adequate mitigation	N/A	N/A	Short term	-
Groundwater dependent ecosystems	All threatened species habitat and communities	N/A	Difficult to quantify	Permanent	N/A

5 Avoid, minimise and mitigate impacts

In managing biodiversity, Roads and Maritime aims to achieve a balanced outcome, taking account of environmental considerations together with economic and community objectives. This includes a balanced approach to examining the particular environmental consequences of an activity, recognising that achieving an optimal outcome often requires compromise and decisions regarding environmental values. A key part of Roads and Maritime's management of biodiversity for this proposal is the application of the 'avoid, minimise, mitigate and offset' hierarchy as follows:

1. Avoid and minimise impacts as the highest priority
2. Mitigate impacts where avoidance is not feasible or practicable in the particular circumstance
3. Offset where residual, significant unavoidable impacts would occur.

5.1 Avoidance and minimisation

Avoiding environmental impacts as the first step is consistent with the application of the precautionary principle. Roads and Maritime's first priority is to avoid impacts to the environment. This can be achieved by early consideration of environmental issues from identification of constraints at proposal inception through to options analysis and selection of a preferred option, design investigation and assessment of the preferred option, detailed design, and implementation of on-ground safeguards during construction and operation and maintenance of the activity.

The primary method to avoid impacts is to locate activities away from areas of known or potential high biodiversity value and it is evident that the road alignment and bridge design has been located to avoid impacts to native vegetation. In identifying suitable work sites, the first preference is to locate existing cleared and disturbed areas that have good access, are not within immediate proximity to waterways, and that support good site management practices (for example, management of material stockpiles). Proposal compound sites have been proposed in highly disturbed areas to avoid impacts to biodiversity.

5.2 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented at the detailed design phase, mitigation measures would be implemented to lessen the potential ecological impacts of the proposal. Mitigation measures are to be undertaken during the construction and operational phases. The Roads and Maritime guidelines and procedures identify a range of mitigation techniques to be applied, including managing the vegetation clearing process, re-establishment of native vegetation at the end of a project, weed management, provision of supplementary fauna habitat (such as nest boxes for appropriate species), and installation of erosion and sediment controls as appropriate.

The following mitigation measures as outlined in the *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011a) are recommended for implementation (see **Table 5-1**). The NSW DPI (Fisheries) document *Policy and Guidelines for fish habitat conservation and management (2013 update)* (NSW Department of Primary Industries, 2013) has also been used.

Table 5-1 Proposed mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	Native vegetation removal would be minimised through detailed design.	Detailed design	Effective	The predicted residual impact to native vegetation is estimated at the estimated clearing of native vegetation is about 0.74 hectares.
	Pre-clearing surveys would be undertaken in accordance with <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Prior to construction	Effective	
	Vegetation removal would be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	
	Native vegetation would be re-established in accordance with <i>Guide 3: Re-establishment of native vegetation</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Post construction	Effective	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Effective	
	Exclusion zones would be set up at the limit of clearing (ie the edge of the impact area) in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	Before construction	Effective	
Removal of threatened species habitat and habitat features	Habitat removal would be minimised through detailed design.	Detailed design	Effective	The predicted residual impact to threatened species habitat is estimated at the estimated clearing of native vegetation is about 0.72 hectares.
	The hollow bearing trees on the western boundary of Ancillary Facility 4 (shown on Figure 3-1) will be retained and protected	Before construction	Effective	
	Habitat removal would be undertaken in accordance with <i>Guide 4: Clearing of vegetation and removal of bushrock</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	Habitat would be replaced or re-instated in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). This is particularly relevant given the likely loss of hollow-bearing trees from riparian habitat near the bridge location.	During construction	Proven	
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened fauna, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
Removal of threatened plants	Pre-clearing surveys would be undertaken in accordance with <i>Guide 1: Pre-clearing process</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Proven	None
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened flora species, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
Aquatic impacts	Aquatic habitat would be protected in accordance with <i>Guide 10: Aquatic habitats and riparian zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) and Section 3.3.2 <i>Standard precautions and mitigation measures</i> of the <i>Policy and guidelines for fish habitat conservation and management Update 2013</i> (DPI (Fisheries NSW) 2013).	During construction	Effective	None
	Activities and areas which present a higher risk of impacting on the receiving waters would be outlined in the Soil and Water Quality Management Plan (PS271) (SWQMP), along with specific controls to reduce the risk of these impacts occurring. The SWQMP would be prepared as part of the overall Construction Environmental Management Plan (CEMP). These management plans would specify mitigation measures in accordance with Best Management Practices (BMPs) set out in 'Soils and Construction: Managing Urban Stormwater' (Landcom 2009).	During construction	Effective	
Groundwater dependent ecosystems	No specific measures are considered necessary as the GDEs in the study area are facultative terrestrial ecosystems.	Detailed design	Effective	As per PCT impacts

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Fragmentation of identified habitat corridors	No specific measures are considered necessary as no further increase to fragmentation would occur.	Detailed design, during construction and post construction	Effective	No residual impact is anticipated
Edge effects on adjacent native vegetation and habitat	Exclusion zones would be set up at the limit of clearing in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	Residual impacts are expected to all edges new road.
Injury and mortality of fauna	Fauna would be managed in accordance with <i>Guide 9: Fauna handling</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction and operation	Effective	The mitigation measures should be effective but injury or death may still occur due to road kill
	Investigate the potential benefits and drawbacks of installing fauna fencing	During construction	Effective	The mitigation measures should be effective but injury or death may still occur due to road kill
Invasion and spread of weeds	Weed species would be managed in accordance with <i>Guide 6: Weed management</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Invasion and spread of pests	Pest species would be managed within the proposal area.	During construction	Effective	None expected
Invasion and spread of pathogens and disease	Pathogens would be managed in accordance with <i>Guide 2: Exclusion zones</i> of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011).	During construction	Effective	None as the proposed control measures are known to be effective
Noise, light and vibration	Shading and artificial light impacts would be minimised through detailed design.	Detailed design	Effective	Impacts from noise and light spill would remain

6 Offset strategy

6.1 Quantification of impacts

Although efforts have been made to avoid, minimise and mitigate potential ecological impacts from the proposal, some residual impacts would occur.

The Roads and Maritime *Guideline for Biodiversity Offsets* (November 2016) indicates that offsets are to be considered where there is any clearing of national or NSW listed critically endangered ecological communities in moderate to good condition. There will be no clearing critically endangered ecological communities for this proposal.

In addition, this biodiversity assessment identifies that the proposal is not likely to have a significant impact on threatened biodiversity listed under the BC Act and EPBC Act (see Section 4.5 and Appendix B and C). Unacceptable impacts on MNES would not occur and the EPBC Act environmental offsets policy does not apply.

Roads and Maritime would provide biodiversity offsets or where offsets are not reasonable or feasible, supplementary measures for impacts that exceed the thresholds in **Table 6-1**. The proposal is below the threshold for applying an offset under the Roads and Maritime policy, and therefore biodiversity offsets are not required.

Table 6-1 Roads and Maritime offset thresholds

Description of activity or impact	Consider offsets or supplementary measures	Applicability to proposal
Activities in accordance with Roads and Maritime Services Environmental assessment procedure: Routine and Minor Works (RTA 2011)	No	N/A
Works on cleared land, plantations, exotic vegetation where there are no threatened species or habitat present	No	Applies to areas mapped as 'not native'.
Works involving clearing of vegetation planted as part of a road corridor landscaping program (this includes where threatened species or species comprising listed ecological communities have been used for landscaping purposes)	No	Applies to the planted eucalypts vegetation only
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	No	N/A
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	No	N/A
Works involving clearing of NSW endangered or vulnerable ecological community	No	N/A
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing > 1ha or where the species is the subject of an SIS	Applies to multiple species of plants and animals. However clearing is less than 1 ha.

Description of activity or impact	Consider offsets or supplementary measures	Applicability to proposal
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database (TSPD)	Where clearing > 5ha or where the species is the subject of an SIS	Applies to multiple species of plants and animals. However clearing is less than 1 ha.
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	There will be no net loss of habitat

7 Conclusion

This biodiversity assessment has investigated the potential impacts to terrestrial and aquatic flora and fauna associated with the proposed bridge in Dubbo. The investigation has involved desktop investigation and field surveys to build on the previous Preliminary Environmental Assessment for the proposal. The outcomes of this work were used to assess potential impacts on biodiversity associated with preferred options design.

Four Plant Community Types have been identified in the study area based on floristic composition, geological substrate, and landscape position, these are described with reference to the NSW Vegetation Classification System. Portions of each PCT have been stratified according to condition classes and identify areas that are in poor and moderate condition. Planted native and exotic vegetation also occurs that cannot be matched to a PCT. The remainder of the study area were classified as highly disturbed areas of exotic grassland and pasture grazing and cropping land.

One of the PCTs identified is consistent with threatened ecological communities listed under the NSW BC Act, 2016, namely Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act)

Based on the proposed road alignment and current design, the estimated clearing of native vegetation for the proposal as a whole is about 0.74 hectares. The proposal will not impact on the listed EEC described.

A background review and general surveys were conducted for threatened flora and fauna species listed under the BC Act and EPBC Act. No threatened flora and fauna were detected during surveys. There is potential habitat in the study area for one plant (*Diuris tricolor*) and seventeen fauna with a moderate likelihood of occurrence.

The Macquarie River forms part of *The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* (Lowland Darling River aquatic ecological community) which is listed as an endangered ecological community under the FM Act. The aquatic habitats in the study area were identified as providing potential habitat for five listed species:

- Eel Tailed Catfish (Endangered species FM Act)
- Trout Cod (Endangered species EPBC Act)
- Murray Cod (Vulnerable EPBC Act)
- Olive Perchlet (Vulnerable BC Act and Endangered FM Act)
- Silver Perch (Endangered species EPBC Act and BC Act; Vulnerable FM Act).

An assessment of significance was prepared in accordance with the BC Act (Section 7.3) and EPBC Act (Significant Impact Guidelines 1.1) for the identified TEC as a precaution. The assessment was based on the current proposal and has concluded that the proposal would not have a significant impact threatened species or ecological communities.

The proposal design has sought to avoid and minimise impacts to biodiversity. However, as there will be residual impacts to biodiversity, mitigation measures would need to be implemented during the construction and operational phases to further lessen the potential ecological impacts of the proposal. The Roads and Maritime *Biodiversity Guidelines: Protecting and managing biodiversity of RTA projects* (NSW Roads and Traffic Authority, 2011a) identify a range of mitigation techniques to be applied and these techniques must be implemented during construction.

It is Roads and Maritime policy that biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) would be provided for impacts that exceed predetermined thresholds. These thresholds were assessed and were not exceeded by the proposal and therefore biodiversity offsets are not required.

During the detailed design phase the proposal area may change from that assessed in the current report which may result in a different range and area of impacts. Further quantification of impacts may be required at this stage.

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Appendix A – Flora species list

Family	Scientific Name	Common Name	Status
ALLIACEAE	<i>Allium triquetrum</i>	Three-corned Garlic	i
ANACARDIACEAE	<i>Schinus areira</i>	Pepper tree	i
APIACEAE	<i>Conium maculatum</i>	Hemlock	i
APIACEAE	<i>Foeniculum vulgare</i>	Fennell	i
ARAUCARIACEAE	<i>Araucaria cunninghamii</i>	Hoop Pine	n
ASPHODELACEAE	<i>Asphodelus fistulosus</i>	Onion Weed	i
ASTERACEAE	<i>Arctotheca calendula</i>	Cape Dandelion	i
ASTERACEAE	<i>Carthamus lanatus</i>	Saffron Thistle	i
ASTERACEAE	<i>Conyza bonariensis</i>	Fleabane	i
ASTERACEAE	<i>Silybum marianum</i>	Variegated Thistle	i
ASTERACEAE	<i>Sonchus oleraceus</i>	Common Sow-thistle	i
ASTERACEAE	<i>Taraxacum officinale</i>	Dandelion	i
ASTERACEAE	<i>Vittadenia cuneata</i>	Fuzzweed	
BIGNONIACEAE	<i>Dolichandra unguis-cati</i>	Cats claw creeper	ix
BORAGINACEAE	<i>Echium plantagineum</i>	Pattersons Curse	i
BRASSICACEAE	<i>Capsella bursa-pastoris</i>	Shepherds Purse	i

Family	Scientific Name	Common Name	Status
BRASSICACEAE	<i>Hirschfeldia incana</i>	Buchan Weed	i
BRASSICACEAE	<i>Sisymbrium irio</i>	London Rocket	i
BRASSICACEAE	<i>Sisymbrium orientale</i>	Indian Hedge Mustard	i
CACTACEAE	<i>Harrisia tortuosa</i>	Harrisia Cactus	ix
CASUARINACEAE	<i>Casuarina cunninghamiana</i>	River Oak	
CHENOPODIACEAE	<i>Atriplex semibaccata</i>	Creeping Saltbush	
CHENOPODIACEAE	<i>Enchylaena tomentosa</i>	Ruby Saltbush	
CHENOPODIACEAE	<i>Maireana microphylla</i>	Small-leaf Bluebush	
CHENOPODIACEAE	<i>Sclerolaena muricata</i> var. <i>semiglabra</i>	Black Rolypoly	
EUPHORBIACEAE	<i>Ricinus communis</i>	Castor Oil Plant	i
FABACEAE-CAESALPINIOIDEAE	<i>Senna artemisioides</i> subsp. <i>zygophylla</i>		p
FABACEAE-CAESALPINIOIDEAE	<i>Senna</i> sp.	Cassia	i
FABACEAE-FABOIDEAE	<i>Medicago arabica</i>	Spotted Burr Medic	i
FABACEAE-FABOIDEAE	<i>Medicago minima</i>	Wooly Burr Medic	i
FABACEAE-FABOIDEAE	<i>Robinia pseudoacacia</i>	Black Locust	i
FABACEAE-MIMOSOIDEAE	<i>Acacia buxifolia</i>	Box-leaf Wattle	p
FABACEAE-MIMOSOIDEAE	<i>Acacia decora</i>	Western Silver Wattle	p

Family	Scientific Name	Common Name	Status
FABACEAE-MIMOSOIDEAE	<i>Acacia decurrens</i>	Fine-leaf Green Wattle	p
FABACEAE-MIMOSOIDEAE	<i>Acacia salicina</i>	Sally Wattle	p
LAMIACEAE	<i>Ajuga australis</i>	Austral Bugle	
LAMIACEAE	<i>Lamium amplexicaule</i>	Henbit	i
LAMIACEAE	<i>Marrubium vulgare</i>	White Horehound	i
LAMIACEAE	<i>Salvia verbenaca</i>	Vervain	i
MALVACEAE	<i>Malva parviflora</i>	Small-flower Mallow	i
MALVACEAE	<i>Sida rhombifolia</i>	Paddys Lucerene	i
MELIACEAE	<i>Melia azedarach</i>	White Cedar	n
MYRTACEAE	<i>Callistemon citrinus</i>	Crimson Bottlebrush	n
MYRTACEAE	<i>Eucalyptus blakelyi</i>	Blakelys Red Gum	p
MYRTACEAE	<i>Eucalyptus camaldulensis</i>	River Red Gum	
MYRTACEAE	<i>Eucalyptus concia</i>	Fuzzy Box	
MYRTACEAE	<i>Eucalyptus melliodora</i>	Yellow Box	p
OLEACEAE	<i>Olea europaea</i> subsp. <i>europaea</i>	Common Olive	i
OXALIDACEAE	<i>Oxalis perennans</i>		
PLANTAGINACEAE	<i>Plantago lanceolata</i>	Plantain	i

Family	Scientific Name	Common Name	Status
POLYGONACEAE	<i>Rumex brownii</i>	Swamp Dock	
POLYGONACEAE	<i>Rumex crispus</i>	Curled Dock	i
RUBIACEAE	<i>Galium aparine</i>	Cleavers	i
SALICACEAE	<i>Salix babylonica</i>	Weeping Willow	i
SAPINDACEAE	<i>Alectryon oleifolius</i>	Western Rosewood	
SAPINDACEAE	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	Wedge-leaf Hop-bush	p
SOLANACEAE	<i>Datura ferox</i>	Fierce Thornapple	i
SOLANACEAE	<i>Lycium ferocissimum</i>	African Boxthorn	ix
STERCULIACEAE	<i>Brachychiton populneus</i>	Kurrajong	p
URTICACEAE	<i>Urtica incisa</i>	Scrub Stinging Nettle	
VERBENACEAE	<i>Glandularia aristigera</i>	Mayne's Pest	i
VERBENACEAE	<i>Verbena bonariensis</i>	Purple Top	i
ZYGOPHYLLACEAE	<i>Tribulus terrestris</i>	Cat-head	i
*i = exotic, ix = priority weed, n = non-indigenous native, p = planted native			

Appendix B - Habitat assessment table

Habitat assessment table – Threatened Flora

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Likelihood of occurrence
FLORA					
<i>Androcalva procumbens</i> (<i>Commersonia procumbens</i>)		V	V	Endemic to NSW, mainly confined to the Dubbo-Mendooran-Gilgandra region, but also in the Pilliga and Nymagee areas. Recent collections made from the Upper Hunter region, and additional populations found in Goonoo SCA in response to the 2007 fires. Grows in sandy sites, often along roadsides. Recorded in <i>Eucalyptus dealbata</i> and <i>Eucalyptus sideroxylon</i> communities, <i>Melaleuca uncinata</i> scrub, under mallee eucalypts with a <i>Calytrix tetragona</i> understorey, and in a recently burnt Ironbark and <i>Callitris</i> area. Also in <i>Eucalyptus fibrosa</i> subsp. <i>nubila</i> , <i>Eucalyptus dealbata</i> , <i>Eucalyptus albens</i> and <i>Callitris glaucophylla</i> woodlands north of Dubbo. Other associated species include <i>Acacia triptera</i> , <i>Callitris endlicheri</i> , <i>Eucalyptus melliodora</i> , <i>Allocasuarina diminuta</i> , <i>Philotheca salsolifolia</i> , <i>Xanthorrhoea</i> species, <i>Exocarpos cupressiformis</i> , <i>Leptospermum parvifolium</i> and <i>Kunzea parvifolia</i> .	Low – species recorded from Mount Kaputar National Park in the Pilliga.
<i>Austrostipa wakoolica</i>		E		Confined to the floodplains of the Murray River tributaries of central-western and south-western NSW, with localities including Manna SF, Matong, Lake Tooim, Merran Creek, Tulla, Cunninyeuk and Mairjimmy State Forest (now part of South West Woodland Nature Reserve). Grows on floodplains, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise. Associated species include <i>Callitris glaucophylla</i> , <i>Eucalyptus microcarpa</i> , <i>E. populnea</i> , <i>Austrostipa eremophila</i> , <i>A. drummondii</i> , <i>Austrodanthonia eriantha</i> and <i>Einadia nutans</i> .	Low - not known within the study area
<i>Calotis glandulosa</i>	Mauve Burr-daisy	V	V	Centered on the Monaro and Kosciuszko regions, with three known sites in the upper Shoalhaven catchment. Prefers montane and subalpine grasslands in the Australian Alps. Colonises bare patches, often occurring on roadsides.	Low – records from the Dubbo area are old and unconfirmed.

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Likelihood of occurrence
<i>Diuris tricolor</i>	Pine Donkey Orchid		V	Sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the north of NSW. Localities in the south include Red Hill north of Narrandera, Coolamon, and several sites west of Wagga Wagga. Condobolin-Nymagee road, Wattamondara towards Cowra, Eugowra, Girilambone, Dubbo and Cooyal, in the Central West. Pilliga SCA, Pilliga National Park and Bibblewindi State Forest in the north and Muswellbrook in the east. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include <i>Callitris glaucophylla</i> , <i>Eucalyptus populnea</i> , <i>Eucalyptus intertexta</i> , Ironbark and <i>Acacia</i> shrubland. The understorey is often grassy with herbaceous plants such as <i>Bulbine</i> species. Usually flowers between early September to late October. The species is a tuberous, deciduous terrestrial orchid and the flowers have a pleasant, light sweet scent. The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (<i>Callitris</i> spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW.	Moderate – known to occur in the Macquarie-Bogan subregion
<i>Homoranthus darwinioides</i>		V	V	<i>Homoranthus darwinioides</i> occurs between Dubbo and Denman (west of Muswellbrook) on the western slopes and central tablelands of New South Wales (NSW). Occurs in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include; flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand. Associated species include Black Cypress-pine (<i>Callitris endlicheri</i>), Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>), Red Ironbark (<i>E. fibrosa</i>), Brown Bloodwood (<i>E. trachyphloia</i>), <i>E. beyeri</i> subsp. <i>illaquens</i> , Dwyer's Mallee Gum (<i>E. dwyeri</i>), Scribbly Gum (<i>E. rossii</i>), <i>Leptospermum divaricatum</i> , Broom Honey-myrtle (<i>Melaleuca uncinata</i>), Fringe Myrtle (<i>Calytrix tetragona</i>), <i>Allocasuarina</i> spp. and <i>Micromyrtus</i> spp.	Low – study area not woody or shrubby enough.
<i>Indigofera efoliata</i>	Leafless Indigo	E	E	This species is in the Data Deficient stream as there is no known extant population in NSW.	Low – species is possibly now extinct, known only from collections. Sites were previously located along to Dubbo to Minore railway line and road, but the species has not been recorded in the wild since 1955.
<i>Philothea ericifolia</i>		V		Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 km between West Wyalong and the Pilliga Scrub. Site localities include Pilliga East State Forest, Goonoo State Forest, Hervey Range, Wingen Maid Nature Reserve, Toongi, Denman, Rylestone district and Kandos Weir. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include <i>Melaleuca uncinata</i> , <i>Eucalyptus crebra</i> , <i>E. rossii</i> , <i>E. punctata</i> , <i>Corymbia trachyphloia</i> , <i>Acacia triptera</i> , <i>A. burrowii</i> , <i>Beyeria viscosa</i> , <i>Philothea australis</i> , <i>Leucopogon muticus</i> and <i>Calytrix tetragona</i> . Flowering time is in the spring. Fruits are produced from November to December	Low – species not known from locality or relevant IBRA subregions. Some areas in study area may offer marginal habitat features.

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Likelihood of occurrence
<i>Prasophyllum</i> sp. <i>Wybong</i>	Leek-orchid	CE		Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. A perennial orchid, appearing as a single leaf over winter and spring. Flowers in spring and dies back to a dormant tuber over summer and autumn. Known to occur in open eucalypt woodland and grassland.	Low – Some areas in study area may offer marginal habitat features but it has not been recorded in the locality or relevant IBRA subregions.
<i>Swainsona murrayana</i>	Slender Darling Pea	V	V	Found throughout NSW, it has been recorded in the Jerilderie and Deniliquin areas of the southern riverine plain, the Hay plain as far north as Willandra National Park, near Broken Hill and in various localities between Dubbo and Moree. The species has been collected from clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions and is often found with <i>Maireana</i> species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat.
<i>Swainsona recta</i>	Small Purple-pea, Mountain Swainson-pea, Small Purple Pea	E		Small Purple-pea was recorded historically from places such as Carcoar, Culcairn and Wagga Wagga where it is probably now extinct. Populations still exist in the Queanbeyan and Wellington-Mudgee areas. Over 80% of the southern population grows on a railway easement. Before European settlement Small Purple-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum Eucalyptus blakelyi, Yellow Box E. melliodora, Candlebark Gum E. rubida and Long-leaf Box E. goniocalyx. Grows in association with understorey dominants that include Kangaroo Grass Themeda australis, poa tussocks Poa spp. and spear-grasses Austrostipa spp.	Low – Species is not known to exist in the study locality.
<i>Tylophora linearis</i>		E		Majority of records occur in the central western region. Records from Goonoo, Pilliga West, Pilliga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie NR, Goobang NP and Beni SCA. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii. Also grows in association with Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum species and Casuarina species.	Low – Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat.

Habitat assessment table – Threatened Fauna

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
Fish					
<i>Maccullochella macquariensis</i>	Trout Cod	E	E	The Trout Cod is a riverine species, inhabiting a variety of flowing waters in the mid to upper reaches of rivers and streams. Trout Cod use river positions where large cover, in the form of woody debris and boulders, is present in high quantity, close to deeper water and high surface velocity, further from the river bank. At present only two potentially sustainable populations are known; a naturally occurring population in the Murray River (NSW) downstream of the Yarrowonga Weir between Yarrowonga and Barmah and the translocated population in Seven Creeks below Polly McQuinns Weir (Vic). There have been no recent records in the Murray River downstream from Echuca (NSW, SA), Macquarie River (NSW), Murrumbidgee River (NSW, ACT), and the Goulburn, Broken, Campaspe, Ovens, King, Buffalo and Mitta Mitta Rivers (Vic). The wild populations formerly occurring in these rivers are now probably extinct. Trout Cod and Murray Cod translocated into Cataract Dam (Nepean River NSW) have hybridised, and the cod population existing there is composed largely of hybrids.	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
<i>Maccullochella peelii</i>	Murray Cod	V		The Murray Cod occurs naturally in the waterways of the Murray-Darling Basin (ACT, SA, NSW and Vic) and is known to live in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and larger billabongs of inland plains. Within these broad habitat types, it is usually found associated with complex structural cover such as large rocks, large snags and smaller structural woody habitat, undercut banks and over-hanging vegetation. It will use floodplain channels when these are inundated. While nursery habitats for post-larval fish have not been identified, juveniles less than one year-old have been found in main river channels.	Moderate likelihood of occurrence
<i>Macquaria australasica</i>	Macquarie Perch	E	E (FM Act)	The Macquarie Perch is a riverine species that prefers clear water and deep, rocky holes with abundant cover cover such as aquatic vegetation, large boulders, debris and overhanging banks. In Victorian parts of the Murray-Darling, only small natural populations remain in the upper reaches of the Mitta Mitta, Ovens, Broken, Campaspe and Goulburn Rivers; translocated populations occur in the Yarra River and Lake Eildon. In NSW, natural inland populations are isolated to the upper reaches of the Lachlan and Murrumbidgee Rivers. Populations of the eastern form are confined to the Hawkesbury-Nepean and Shoalhaven river systems. Translocated populations in NSW are found in the Mongarlowe River, Queanbeyan River upstream of the Googong Reservoir and in Cataract Dam. In the ACT, it is restricted to the Murrumbidgee, Paddys and Cotter Rivers	Low – Not recorded within study area (DPI)

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Galaxias rostratus</i>	Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	CE		Flathead Galaxias is generally found mid-water in still and gently moving waters of small streams, lakes, lagoons, billabongs and backwaters. Its habitat consists of coarse sand or mud substrate and aquatic vegetation. The species is endemic to the southern tributaries of the Murray Darling River system; the Murray, Murrumbidgee and Lachlan Rivers and their tributaries and the upper Macquarie River catchment. Thought to be extinct in the lower Murray, Murrumbidgee, Macquarie and Lachlan Rivers.	Low – Not recorded within study area (DPI)
<i>Bidyanus bidyanus</i>	Silver Perch	CE	V (FM Act)	Once widespread and abundant throughout most of the Murray-Darling river system. They have now declined to low numbers or disappeared from most of their former range. Only one remaining secure and self-sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries. Silver perch show a preference for faster-flowing water, including rapids and races, and more open sections of river. Stocked silver perch appear to make little improvement to the conservation situation of wild silver perch.	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) occurs within the study area
<i>Ambassis agassizii</i>	Olive Perchlet		E FM Act)	In NSW <i>Ambassis agassizii</i> was once widespread in the Lachlan, lower Murrumbidgee, and lower Murray Rivers and throughout the Darling drainage system and in coastal streams in northern NSW. Its distribution throughout the Murray-Darling system (western population) has significantly declined in recent years and now appears to be limited to a few localities in the Darling drainage upstream from Bourke. It has not been recorded in any NSW survey of the lower Murray or lower Darling below Bourke since the 1960s. Olive Perchlet inhabit rivers, creeks, ponds and swamps. They are usually found in slow-flowing or still waters in sheltered areas such as overhanging vegetation, aquatic macrophyte beds, logs, dead branches and boulders during the day, and disperse to feed during the night.	Moderate likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
<i>Mogurnda adspersa</i>	Purple Spotted Gudgeon			It occurs in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland. The western population was previously widespread in the Murray, Murrumbidgee and Lachlan River systems and tributaries of the Darling. The western population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment. It is a benthic species that can be found in a variety of habitat types such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from river banks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams.	Low - recorded approximately 5km downstream (DPI distribution maps)

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Tandanus tandanus</i>	Eel Tailed Catfish		EP	Eel Tailed Catfish are naturally distributed throughout the Murray-Darling Basin and in the Eastern drainages NSW north of Newcastle. The western population was once highly abundant and widespread throughout the Murray-Darling River System in NSW, Queensland, Victoria and South Australia. Eel tailed catfish is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary and adults typically only move within a 5 km range. Individuals are more active at night compared with during the day	Moderate - likelihood of occurrence, recorded on DPI distribution maps (Macquarie River) said to occur within the study area
Mammals					
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat, Large Pied Bat	V		Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	Low – no favored roosting habitat in the study area. May forage in vegetation in the study area on occasion.
<i>Chalinolobus picatus</i>	Little Pied Bat		V	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress pine forest and mallee and Bimbil box woodlands. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.	Moderate – this species may forage in and around open woodland/forest and roost in buildings or tunnels within the study area.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat		V	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	Moderate – this species may forage in and around woodland/forest and roost in culverts in the study area.
<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	E	V	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Low – Some individuals may pass through the area on occasion but the generally fragmented landscape of the locality is unlikely to support a resident population.
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat, South-eastern Long-eared Bat	V	V	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bulloke <i>Allocasuarina luehmannii</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	Moderate – this species may forage and roost in hollow-bearing trees in the study area.

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat		V	Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Moderate – this species may forage and roost in hollow-bearing trees in the study area.
<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT)	Koala	V		In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Low - Associated (marginal) habitat present near the study area.
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox	V	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.	Moderate – May forage in the area, study area unlikely to support a resident population.
Reptiles					
<i>Aprasia parapulchella</i>	Pink-tailed Worm-lizard, Pink-tailed Legless Lizard	V	V	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra / Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with a predominantly native grassy groundlayer, particularly those dominated by Kangaroo Grass (<i>Themeda australis</i>). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.	Low likelihood of occurrence, site lacks suitable rocky outcrops and the preferred kangaroo grass (<i>Themeda australis</i>)
Birds					
<i>Apus pacificus</i>	Fork-tailed Swift	T		Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	Low- listed marine species (migration only)

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Anseranas semipalmata</i>	Magpie Goose	-	V	Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW.	Moderate –may use habitat in the study area after suitable rainfall on passage between more suitable habitats. Associated with PCT 181.
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	E	The Regent Honeyeater that has a patchy distribution between south-east Queensland and central Victoria. It mostly inhabits inland slopes of the Great Dividing Range, in areas of low to moderate relief with moist, fertile soils. It is most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (<i>Casuarina</i> spp) where it feeds on needle-leaved mistletoe and sometimes breeds. It sometimes utilises lowland coastal forest, which may act as a refuge when its usual habitat is affected by drought. It also uses a range of disturbed habitats within these landscapes including remnant patches in farmland and urban areas and roadside vegetation. It feeds primarily on the nectar of eucalypts and mistletoes and, to a lesser extent, lerps and honeydew; it prefers taller and larger diameter trees for foraging. It is nomadic and partly migratory with its movement through the landscape being governed by the flowering of select eucalypt species. There are four known key breeding areas: three in NSW and one in Victoria. Breeding varies between regions, and corresponds with flowering of key eucalypt and mistletoe species. It usually nests in horizontal branches or forks in tall mature eucalypts and Sheoaks.	Low – may infrequently use habitat in the study area after suitable rainfall on passage between more suitable habitats.
<i>Artamus cyanopterus</i>	Dusky Woodswallow		V	The Dusky Woodswallow has two separate populations. The eastern population is found from Atherton Tableland, Queensland south to Tasmania and west to Eyre Peninsula, South Australia. The other population is found in south-west Western Australia. The Dusky Woodswallow is found in open forests and woodlands, and may be seen along roadsides, urban parks and golf courses.	Low - may infrequently use habitat in the study area.
<i>Epthianura albifrons</i>	White-fronted Chat		V	The White-fronted Chat is found across the southern half of Australia, from southernmost Queensland to southern Tasmania, and across to Western Australia as far north as Carnarvon. Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground).	Low – species not known from the locality. Some areas of suitable habitat may be present.

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Hirundapus caudacutus</i>	White-throated Needletail	T		Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	Moderate – likely to fly over the study area during migration.
<i>Motacilla flava</i>	Yellow Wagtail	T		Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains.	Low – species not known from the locality. Some areas of suitable habitat may be present.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	T		Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	Low – species not known from the locality. Some areas of suitable habitat may be present.
<i>Actitis hypoleucos</i>	Common Sandpiper	T		Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	Low – species not known from the locality. Some areas of suitable habitat may be present.
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE		In Australia, Curlew Sandpipers occur around the coasts of all states and are also quite widespread inland, though in smaller numbers. They occur in Australia mainly during the non-breeding period but also during the breeding season when many non-breeding one year old birds remain. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh and in mangroves.	Low – Some areas of suitable habitat may be present.
<i>Calidris melanotos</i>	Pectoral Sandpiper	M		In New South Wales (NSW), the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Low – species not known from the locality. Some areas of suitable habitat may be present.

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Calidris ruficollis</i>	Red-necked Stint	M		It is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The Red-necked Stint breeds in Siberia and sporadically in north and west Alaska, probably from Taymyr region to Anadyr Territory and Koryakland. The Red-necked Stint mostly forages on bare wet mud on intertidal mudflats or sand flats, or in very shallow water; mostly in areas with a film of surface water and mostly close to edge of water. Roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle, sometimes in saltmarsh or other vegetation.	Low – may infrequently use habitat in the study area
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		M	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation; this includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. Sometimes they occur on rocky shores and rarely on exposed reefs.	Low – may infrequently use habitat in the study area after suitable rainfall on passage between more suitable habitats. Suitable habitat the study area includes ephemeral wetlands.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo		V	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, <i>Allocasuarina diminuta</i> , and <i>A. gymnanthera</i> . Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (<i>Casuarina cristata</i>).	Low – may infrequently use habitat in the study area
<i>Chthonicola sagittata</i>	Speckled Warbler		V	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.	Moderate – recent recordings within the study area

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Daphoenositta chrysoptera</i>	Varied Sittella		V	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Nests in an upright tree fork high in the living tree canopy.	Moderate – may infrequently use habitat in the study area
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo		V	Found across the arid and semi-arid inland, from south-western Queensland south to north-west Victoria, through most of South Australia, north into the south-west Northern Territory and across to the west coast between Shark Bay and about Jurien. In NSW it is found regularly as far east as about Bourke and Griffith, and sporadically further east than that. Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 km apart, with no more than one pair every 30 square kilometres.	Low – may use habitat in the study area after suitable rainfall on passage between more suitable habitats.
<i>Glossopsitta pusilla</i>	Little Lorikeet		V	In NSW it is found from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. The species forages primarily in the canopy of dry open eucalypt forest and woodland but also utilises paperbark (<i>Melaleuca</i> sp.) dominated forests. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited; riparian trees are often chosen, including non-eucalypt species such as she-oaks.	Moderate – lower reaches of distribution range, may use habitat in the study area
<i>Polytelis swainsonii</i>	Superb Parrot		V	Found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree.	Moderate – may use habitat in the study area after suitable rainfall on passage between more suitable habitats.
<i>Falco subniger</i>	Black Falcon		V	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	Moderate - may infrequently use habitat in the study area

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Circus assimilis</i>	Spotted Harrier		V	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Moderate - may infrequently use habitat in the study area
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)		V	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting.	Low – may infrequently use habitat in the study area. Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
<i>Gallinago hardwickii</i>	Latham's Snipe, Japanese Snipe	T		Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level.	Low – may infrequently use habitat in the study area. Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
<i>Ninox connivens</i>	Barking Owl		V	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	Moderate – may infrequently use habitat in the study area. Recorded within the study locality.
<i>Numenius minutus</i>	Little Curlew, Little Whimbrel	T		Little Curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast. The Little Curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated.	Low – species not known within the study area
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)		V	Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E. blakelyi</i>) and Forest Red Gum (<i>E. tereticornis</i>). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	Low – may infrequently use habitat in the study area

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)		V	In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.	Moderate – may infrequently use habitat in the study area
<i>Merops ornatus</i>	Rainbow Bee-eater	M		Distributed across much of mainland Australia, and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	Moderate – may infrequently use habitat in the study area
<i>Petroica boodang</i>	Scarlet Robin		V	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.	Low - may infrequently use habitat in the study area, area likely not forested enough.
<i>Phaethon rubricauda</i>	Red-tailed Tropicbird	C	V	Ranges throughout tropical and subtropical zones of the Indian and West Pacific Oceans, breeding on oceanic islands. Lord Howe Island is said to have the greatest breeding concentration in the world. Breeds in coastal cliffs and under bushes in tropical Australia. Nests on cliffs of the northern hills and southern mountains on the main island at Lord Howe Island.	Low – may infrequently use habitat in the study area
<i>Philomachus pugnax</i>	Ruff (Reeve)	T	M	The Ruff is a rare but regular non-breeding visitor to Australia, being recorded in all States and Territories. In NSW the species has been recorded at Kurnell, Tomki, Casino, Ballina, Kooragang Island, Broadwater Lagoon and Little Cattai Creek. The Ruff is found on generally fresh, brackish or saline wetlands with exposed mudflats at the edges.	Low – may infrequently use habitat in the study area
<i>Hieraaetus morphnoides</i>	Little Eagle		V	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.	Moderate – may infrequently use habitat in the study area.
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)		V	The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.	Low – may infrequently use habitat in the study area

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Petroica phoenicea</i>	Flame Robin		V	The Flame Robin ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgeland at high altitudes.	Low – may infrequently use habitat in the study area
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	Most records are from south east Australia, particularly the Murray Darling Basin, with scattered records across northern Australia. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass. Breeding habitat requirements may be quite specific; shallow wetlands with areas of bare wet mud and both low cover and canopy cover nearby; nest records nearly all from or near small islands in freshwater wetlands. Has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among cumbungi, sedges and grasses; one nest has been found in the centre of a cow-pat in a clump of long grass	Low – may infrequently be found in waterways, farm dams near the study area
<i>Stagonopleura guttata</i>	Diamond Firetail		V	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.	Moderate – may infrequently use habitat in the study area
<i>Tringa stagnatilis</i>	Marsh Sandpiper, Little Greenshank	T	M	Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	Low – may infrequently be found in waterways, farm dams near the study area
<i>Botaurus poeciloptilus</i>	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	Low - may infrequently be found in waterways, farm dams near the study area

Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	Likelihood of occurrence
<i>Grantiella picta</i>	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus <i>Amyema</i> .	Low - may use habitat in the study area after suitable rainfall on passage between more suitable habitats.
<i>Leipoa ocellata</i>	Malleefowl	E	V	The stronghold for this species in NSW is the mallee in the south west centred on Mallee Cliffs NP and extending east to near Balranald and scattered records as far north as Mungo NP. Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as Inland Grey Box, Ironbark or Bimble Box Woodlands with thick understorey, or in other woodlands such dominated by Mulga or native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers.	Low – study area does not contain the dense understorey this species prefers.

Appendix C – Assessments of Significance – BC Act

Assessment of Significance – BC Act

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, (iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.			(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),		(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
Threatened Ecological Communities							
Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	The proposed works would have no anticipated impact that would place this threatened ecological community at risk of extinction.	The proposed works would not remove any of this threatened ecological community	The proposed works would not fragment this ecological community	This community would not be removed or modified by the proposed works	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality, and this threatened ecological community would not be subject to any clearing. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	<p>(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</p>	<p>(c) in relation to the habitat of a threatened species or ecological community:</p>	<p>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,</p>	<p>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,</p>	<p>(iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.</p>	<p>(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),</p>	<p>(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
Flora							
<p>Pine Donkey Orchid Slender Darling-pea</p>	<p>Both species was not identified during field surveys, however there are some suitable areas of habitat in derived grassland f the study area. Much of this habitat was surveyed, so if the species is present within the study area, the number of individuals and the proportion of the local population affected is likely to be relatively small. Seed dispersal in the species is likely to be mainly via wind and floodwater and is unlikely to be substantially affected by the proposal. Pollination vectors (wind and insects) are also unlikely to be affected. The removal of vegetation may result in the direct mortality of a small number of individuals, however the works are unlikely to have a significant adverse effect on the life cycle of the overall local populations of the species.</p>	<p>Based on associated PCTs/habitat, the proposed works will remove 0.19 ha of habitat for both species</p>	<p>The works will not result in fragmentation of habitat for the species'. Seed dispersal in these species is likely to be mainly via wind and surface water and is unlikely to be substantially affected by the proposal. Pollination vectors (wind and insects) are also unlikely to be affected. The works will not substantially affect the level of isolation of populations of these species'.</p>	<p>The habitat to be affected is unlikely to contain a substantial proportion of any local population of any of these species. The habitat is not considered to be important to the long-term survival of these species in the locality.</p>	<p>There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.</p>	<p>The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.</p>	<p>Not significant</p>

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, (iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.			(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),		(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
Birds							
Little Lorikeet	Hollow-bearing trees are a common feature of the vegetation in the study area and are likely to present suitable roosting habitat for the species. The habitat affected may be used occasionally for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of the species.	Based on associated PCTs/habitat, the proposed works will remove 0.47 ha of habitat	The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of the species between habitat patches.	The habitat to be affected is unlikely to be used as breeding habitat, however hollow-bearing trees are common and may offer suitable nesting features. Much of the study area is likely to be used as foraging habitat by individuals passing through but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, (iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.			(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),		(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
Superb Parrot	Hollow-bearing trees across the entire study area likely present suitable roosting habitat. This species will also forage in just about all areas of the study area depending on available resources, however the study area is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of the species.	Based on associated PCTs/habitat, the proposed works will remove 0.72 ha of foraging habitat.	The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly long distances, however Superb Parrots usually move along wooded corridors, seldom crossing extensive open areas. The proposal is unlikely to fragment a major movement corridor for this species.	The habitat to be affected is unlikely to be used as breeding habitat, however hollow-bearing trees are common and may offer suitable nesting features. Much of the study area is likely to be used as foraging habitat by individuals visiting during seasonal migration in winter. However, it is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion		
	<p>(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</p>	<p>(c) in relation to the habitat of a threatened species or ecological community:</p>	<p>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,</p>	<p>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,</p>	<p>(iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.</p>	<p>(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),</p>	<p>(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>	
Magpie Goose								

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community:			(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),		(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
		(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.			
Woodland birds: <ul style="list-style-type: none"> • Diamond Firetail • Dusky Woodswallow • Speckled Warbler • Varied Sittella • Grey Crowned Babbler 	<p>These species may occur in the study area based on the presence of records and suitable habitat. The habitat affected may be used occasionally for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of these species.</p>	<p>Based on associated PCTs/habitat, the proposed works will remove:</p> <p>0.72 ha habitat for the Diamond Firetail 0.72 ha habitat for the Dusky Woodswallow 0.66 ha habitat for the Speckled Warbler 0.72 ha habitat for the Varied Sittella. 0.66 ha habitat for the Grey Crowned Babbler</p>	<p>The works will not result in fragmentation of habitat for the species. The species is highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.</p>	<p>The habitat to be affected is unlikely to be used as breeding habitat. It may be used for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.</p>	<p>There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.</p>	<p>The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.</p>	Not significant

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats						Conclusion
	(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community:			(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.	
		(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	(iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.			
Forest Owls: <ul style="list-style-type: none"> Barking Owl 	<p>Large hollow-bearing trees are scattered across the study area and may provide some nesting opportunities. The species is also likely to use the study area for perching and hunting at night. However, the habitat is unlikely to be important for these species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of these species.</p>	<p>Based on associated PCTs/habitat, the proposed works will remove: 0.47 ha of habitat for the Barking Owl</p>	<p>The works will not result in fragmentation of habitat for the species. The species are highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.</p>	<p>The habitat to be affected is unlikely to be used as breeding habitat, however some suitable nesting hollows may be present. Much of the study area is likely to be used as hunting habitat but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.</p>	<p>There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.</p>	<p>The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.</p>	<p>Not significant</p>

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	<p>(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.</p>	<p>(c) in relation to the habitat of a threatened species or ecological community:</p>	<p>(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),</p>	<p>(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>			
						<p>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,</p>	<p>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,</p>
<p>Birds of prey:</p> <ul style="list-style-type: none"> • Spotted Harrier • Little Eagle • Black Falcon 	<p>Many of the large trees in the study area may provide nesting opportunities. These species are also likely to use the study area for perching and hunting. However, the habitat is unlikely to be important for these species due to its location and level of disturbance. The works are unlikely to have a significant adverse effect on the life cycle of these species.</p>	<p>Based on associated PCTs/habitat, the proposed works will remove: 0.66 ha of habitat for the Spotted Harrier 0.72 ha of habitat for the Little Eagle 0.72 ha of habitat for the Black Falcon</p>	<p>The works will not result in fragmentation of habitat for the species. The species are highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.</p>	<p>The habitat to be affected is unlikely to be used as breeding habitat, however some large trees may be suitable for nesting. Much of the study area is likely to be used as hunting habitat but is unlikely to be important for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.</p>	<p>There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.</p>	<p>The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.</p>	<p>Not significant</p>

Species assessed	Section 7.3 of the BC Act - Test for determining whether proposed development or activity likely to significantly affect threatened species or their habitats					Conclusion	
	(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction OR (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	(c) in relation to the habitat of a threatened species or ecological community:	(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),	(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.			
		(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,	(iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species or ecological community in the locality.			
Mammals							
Insectivorous bats: <ul style="list-style-type: none"> Little Pied Bat Yellow-bellied Sheathtail-bat Corben's Long-eared Bat Eastern Bentwing-bat 	Hollow-bearing trees are common in the study area and are likely to be suitable roosting and breeding habitat for hollow-roosting species. Bridges and culverts may provide roosting opportunities. There is unlikely to be a maternity roost in the study area for cave-dwelling species. All the species are likely to forage in the vegetation in the study area. The potential breeding habitat for hollo-dependent species affected is unlikely to be important due to its location, level of disturbance, and the amount of higher quality habitat in the locality. The works are unlikely to have a significant adverse effect on the life cycle of these species.	Based on associated PCTs/habitat, the proposed works will remove: 0.72 ha habitat for the Little Pied Bat, Yellow-bellied Sheathtail-bat, Corben's Long-eared bat., and the Eastern Bentwing-bat.	The works will not result in fragmentation of habitat for these species. These species are highly mobile and will freely fly long distances over open areas to move between roost sites and foraging sites. The works will not affect the movement of these species between habitat patches.	The habitat to be affected is unlikely to be used as breeding habitat (no maternity roosts identified during surveys), however hollow-bearing trees, bridges and culverts may offer suitable roosting habitat opportunities. These are likely to be used on occasion along with many other roosts throughout the landscape. It may be used for foraging but is unlikely to be important foraging habitat for the species due to its location and level of disturbance. The habitat is not considered to be important to the long-term survival of these species in the locality.	There are no declared areas of outstanding biodiversity value within or in close proximity to the site. The proposed activity is unlikely to have an adverse effect on any declared area of outstanding biodiversity value.	The works will contribute slightly to the impact of the <i>clearing of native vegetation</i> KTP. The impact is not significant in the context of the extent of habitat in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the species.	Not significant

Assessment of Significance – FM Act

Species assessed	Section 5A of the EP&A Act (7-part test) impact significance criteria applicable to threatened ecological communities							Conclusion		
	(g) whether the action proposed constitutes or is part of a threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed		(d) In relation to the habitat of a threatened species, population or ecological community, In the case of an endangered ecological community, whether the action proposed:			(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).		(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threatened abatement plan (!)	
		i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.				
Lowland Darling River aquatic ecological community	N/A	<p>This aquatic ecological community occurs across much of the north western NSW and to the south along the floodplain for the Darling River. In the study area, this community occurs locally on floodplain and stream habitats of Tookey Creek, Tarlee Creek, Unnamed stream south of Edgeroi, Gehan Creek north of Bellata 1 north of Millie Road, Unnamed stream north of Bellata, Unnamed tributary of Tookey Creek south of Brigalow Lane and Unnamed highly modified tributary of Halls Creek.</p> <p>At these locations culvert extension work would disturb the bed ephemeral streams. Direct impacts to threatened fish habitat such as Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works.</p> <p>Potential impact on downstream water quality is possible due to turbidity and sedimentation from the works and tannins from mulch. Minimal impact on riparian or aquatic vegetation, logs or other habitat structures. Slight increase in the obstruction to fish passage and changes to hydrology due to culvert extension.</p> <p>A small area of habitat would be removed in this location due to filling of the stream channel</p>		<p>The habitat within this community is considered very important and vital to the survival of the entire catchment system. The proportion of the local occurrence affected is small when considered in the context of the known extent of the TEC within the broader locality and the known threats to this community. The proposal is also considered likely to modify the water quality and habitat features of adjacent areas of the TEC that would not be cleared, due to increased edge effects.</p>			N/A	<p>There is no recovery plan prepared by the Department of Primary Industries. There are recovery actions implemented to aid in the research, protection and recovery of the community. The works will not have a significant influence, positive or negative, on the implementation of these actions.</p>	<p>The works will contribute slightly to the impact of the clearing of native vegetation KTP. The impact is not significant in the context of the extent of the community in the locality. The works may also contribute slightly to weed-related KTPs. Weed invasion will be limited through weed control activities and is unlikely to significantly affect the community.</p>	Not significant

Species assessed	Section 5A of the EP&A Act (7-part test) impact significance criteria applicable to threatened ecological communities							Conclusion	
	(g) whether the action proposed constitutes or is part of a threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed		(d) In relation to the habitat of a threatened species, population or ecological community, In the case of an endangered ecological community, whether the action proposed:			(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).		(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threatened abatement plan (1)
		i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.			
		<p>associated with culvert extension and road widening.</p> <p>The local occurrence of the TEC subject to this assessment is already at risk of extinction due to its high edge to area ratio and susceptibility to disturbance events such as land use change (ag that has already affected, but not eliminated, the community.</p> <p>The proposal is considered unlikely to increase the likelihood of the extinction of the local occurrence of the TEC due to temporary impacts to streams and reduction of floodplain vegetation area and modification of some adjacent areas due to edge effects.</p> <p>The proportion of the local occurrence affected is small when considered in the context of the known extent of the TEC within the broader locality and the known threats to this community. The proposal is also considered likely to modify the water quality and habitat features of adjacent areas of the TEC that would not be cleared, due to increased edge effects.</p>							

Species assessed	Section 5A of the EP&A Act (7-part test) impact significance criteria applicable to threatened ecological communities									Conclusion
	(g) whether the action proposed constitutes or is part of a threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed		(d) In relation to the habitat of a threatened species, population or ecological community, In the case of an endangered ecological community, whether the action proposed:			(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threatened abatement plan (1)		
		i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or	ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and	(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and	iii) the importance of the habitat to be removed, modified fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.				
Fish <ul style="list-style-type: none"> • Silver Perch • Olive Perchlet • Eel Tailed Catfish • Trout Cod 	The proposal is unlikely to impact the life cycle of the local populations. Some short-term disruption of the riverbed may impact eggs attached to rocks or gravel, however the impacted area is anticipated to be small, and should not significantly impact the species' reproduction.	N/A	N/A	Bridge construction may disturb the river bed temporarily. Direct impacts on threatened fish are unlikely.	The proposal will not result in habitat fragmentation	A small area (0.4ha) of floodplain vegetation will be cleared. This is unlikely to impact these species as they do not rely on this vegetation as part of their life cycle.	There is the potential for impact on downstream water quality through the introduction of pollutants or sediment. It is unlikely there will be an effect on critical habitat	See note (2)	Construction of the bridge has the potential to introduce new weeds to the habitat. Weeds will be controlled through active weed management activities.	Not significant
<p>(1) With the recent advent of the Saving our Species program recovery and threat abatement plans are no longer routinely prepared for species listed under the BC Act. Species, population and ecological communities are instead assigned to either the site-managed species or landscape-managed species stream of the program and conservation management actions are developed and implemented. Many of the conservation management actions are only relevant to government conservation bodies and natural area managers and are of little or no relevance to Roads and Maritime operations. The general relationship between the works and the species' recovers requirements are considered in this assessment.</p>										

Appendix D – Assessments of Significance – EPBC Act

For threatened species and communities listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 an assessment of significance has been completed in accordance with the Matters of National Environmental Significance Significant Impact Guidelines 1.1 (Department of the Environment, 2013)

Endangered species

Trout Cod (*Maccullochella macquariensis*) and Silver Perch (*Bidyanus bidyanus*)

Lead to a long-term decrease in the size of a population

Trout Cod are found usually in rapidly flowing streams, associated with logs and debris, generally over rocky and gravel bottoms. The main aquatic habitats in the proposed works area are provided by overhanging vegetation. None of these would provide high quality habitat for Trout Cod and therefore it is highly unlikely that the species are frequently using the habitat that would be impacted by the proposed works. The proposal is considered unlikely to lead to a long term decrease in the size of the Trout Cod population of the area.

Silver Perch are found in a range of habitats, but frequently in rapid flowing conditions and below rapids and weirs (Allen et al. 2002). The habitat at the proposed works area primarily consists of overhanging vegetation, is unlikely to be critical for the species. The impact of the bridge is unlikely to lead to a long term decrease in the size of the population.

Reduce the area of occupancy of the species

The proposal will remove a very small extent of poor quality Trout Cod habitat. Therefore the proposal is considered unlikely to reduce significantly the area of occupancy of an important population.

Fragment an existing population into two or more populations

The piles for bridge construction and operation may act as a barrier to fish passage under some flows. It is not clear to what extent this structure will prevent fish movement, but it is likely under many flow scenarios that fish passage would be possible. Fish habitat in the upstream end of Macquarie River could be accessed via the downstream confluence where there are known weir barriers. As a consequence, although the piles of the bridge may act as a barrier under some flow conditions, as this habitat is still readily accessible, the impact is likely to be low.

Adversely affect habitat critical to the survival of a species

The Trout Cod preferred microhabitat consists of complex structural features in streams such as large rocks, snags, logs, branches and other woody structures. The loss of a small amount of overhanging vegetation and some impact on wooden groynes does not represent habitat critical to the survival of the species.

Disrupt the breeding cycle of a population

Trout Cod spawn in spring and lay large, adhesive eggs to hard surfaces (Allen et al. 2002). It is unlikely that Trout Cod breed in the area of the proposed works, and therefore the proposal is unlikely to disrupt the breeding cycle of the population.

Silver Perch breeding takes place in spring / summer. The proposed works is unlikely to impact the breeding of this species.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposal will remove a very small extent of poor quality Trout Cod and Silver Perch habitat. Therefore the proposal is considered unlikely to reduce significantly the availability or quality of habitat to the extent the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The proposal would be unlikely to increase invasive species abundance sufficient to affect local populations.

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to increase the potential for significant disease vectors to affect local populations.

Interfere with the recovery of the species.

A national Recovery Plan exists for the Trout Cod with 13 objectives including:

- Investigate key aspects of biology and ecology
- Determine the growth rates and viability of populations
- Identify and map habitat critical to survival
- Investigate and control threatening processes
- Manage Murray River population to ensure its continued sustainability natural and reintroduced populations to achieve self-sustainability
- Manage Seven Creeks (Vic) population to ensure its continued sustainability
- Manage Ovens River population to ensure its continued sustainability
- Manage the Murrumbidgee River and Cotter River populations (ACT) to ensure their continued sustainability
- Breed Trout Cod for reintroduction
- Undertake reintroductions to establish new populations
- Encourage community awareness and support
- Trial a stocked recreational fishery for Trout Cod in Victoria
- Manage Recovery Plan implementation.

A total of 52 recovery actions are identified to address the range of threats and meet these objectives. The proposal is unlikely to interfere with these recovery actions and would improve habitat conditions at post-construction.

There is no national Recovery Plan for the Silver Perch. However there is a NSW DPI recovery plan with eight objectives including:

- Increase awareness of the current status of silver perch throughout its range
- Increase scientific knowledge of the current distribution, ecological and habitat requirements and population genetics of silver perch
- Protect and enhance remaining natural populations of silver perch
- Ameliorate the impacts of known major threats to silver perch
- Minimise any fishing impacts on natural populations through enhanced compliance with fishing regulations and involvement of recreational fishers
- Improve management of aquaculture and stocking programs
- Encourage and support the involvement of indigenous communities in the implementation of recovery actions
- Establish a program to monitor the status of silver perch and evaluate the effectiveness of recovery actions.

A total of 20 recovery actions are identified to address the range of threats and meet these objectives. The proposal is unlikely to interfere with these recovery actions and would improve habitat conditions at post-construction.

Conclusion

In conclusion, the proposed works would have minimal impact on the species, removing only a small amount of potential foraging area and a small number of potential roosting trees. This impact would not be detrimental to the survival of the populations as a whole, therefore the proposed works would not significantly impact either of these threatened species.

Vulnerable species

Slender Darling Pea (Swainsona murrayana)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

Only known from one record in the study area but suitable habitat present in woodland and derived grassland. The removal of vegetation may result in the loss of potential habitat, however the works are unlikely to lead to a long-term decrease in the size of an important population of this species.

Reduce the area of occupancy of an important population

The proposed works would result in the loss of approximately 0.19 ha of potential habitat. These impacts are not expected to reduce the area of occupancy of the population.

Fragment an existing important population into two or more populations

The proposed works would not result in the fragmentation of the population.

Adversely affect habitat critical to the survival of the species

No habitat critical to this species will be affected.

Disrupt the breeding cycle of an important population

Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Approximately 0.19 ha of potential habitat would be removed from the area. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

Measures to minimise invasion of weeds during construction and operation would be included in the CEMP. With these measures in place, this proposal is not considered likely to result in a significant increase in the impact of invasive species.

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Interferes substantially with the recovery of the species

Recovery of this species will not be affected by the proposal.

Conclusion

In conclusion, the proposed works would have minimal impact on the species potential habitat, removing only a small amount (0.19 ha) of potential derived grassland habitat. This impact would not be detrimental to the survival of the populations as a whole, therefore the proposed works would not significantly impact either of these threatened species.

Corben's Long-eared Bat (*Nyctophilus corbeni*)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

The size of local population is not known, although expected to not to be considerably large considering the highly modified habitats in the locality. Potential foraging habitat in the study area is located in River Red Gum Forest. Impacts to these habitats would have minor impacts on the potential breeding habitat for prey species (invertebrates), however any potential overall reductions to the abundance of prey species is likely to be minimal, considering the widespread nature of these habitats in the locality.

Reduce the area of occupancy of an important population

The proposed works would result in the loss of approximately 0.47ha of foraging habitat, and the removal of eighthollow-bearing trees. These impacts are not expected to reduce the area of occupancy of the population.

Fragment an existing important population into two or more populations

The proposed works would not result in the fragmentation of the population.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

The habitat located in the proposal area does not represent habitat which is critical for the survival of the species.

Disrupt the breeding cycle of an important population

The proposed works are unlikely to disrupt the species' breeding cycle. It is not expected that bridge construction would disrupt mating. Trees and stags with hollows should be searched for roosting bats before being removed, to minimise potential impacts and mortality of individuals.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Approximately 0.47 ha of foraging habitat would be removed from the area. This reduction in foraging habitat is not expected to have a significant impact on the species. Additionally, approximately eight hollow-bearing trees would be removed from the area. These trees could provide possible roosting sites for the species. This habitat would be replaced or re-instated in accordance to the mitigation measures outlined in Section 5. The removal of this habitat is unlikely to cause the species to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

There is a possibility that the proposed works would introduce some weeds into the area where work is being undertaken. This would be managed with weed control protocols. It is unlikely that any weeds introduced would become invasive or impact upon the bat species.

Introduce disease that may cause the species to decline

It is unlikely that the proposed works would introduce diseases which would result in a species decline.

Interferes substantially with the recovery of the species

A recovery plan does not exist for the Corben's Long-eared Bat. However, the following actions have been identified by the OEH for recovery of this species:

- Retain remnant woodland and mallee vegetation.
- Retain hollow-bearing trees and provide for hollow tree recruitment.
- Minimise the use of pesticides in and adjacent to foraging areas.
- Protect roosts from damage or disturbance.

A targeted strategy for managing threatened species is also being developed under the OEH Saving Our Species program. OEH is currently developing a targeted approach for managing threatened species. The Corben's Long-eared Bat has been assigned to the Landscape species management stream under the OEH Saving our Species program.

The recovery actions listed above, and those identified in the Saving Our Species program, that have been identified by the OEH to help recover the Corben's Long-eared Bat are largely not applicable to the proposal as they are actions for the OEH to complete and focus on priority conservation lands which are outside of the study area. The proposal will not interfere with the recovery of the Corben's Long-eared Bat.

Conclusion

In conclusion, the proposed works would have minimal impact on the species, removing only a small amount of potential foraging area and a small number of potential roosting trees. This impact would not be detrimental to the survival of the populations as a whole, therefore the proposed works would not significantly impact either of these threatened species.

Superb Parrot (*Polytelis swainsonii*)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

The River Red Gum Forest in the study area provides habitat for the Superb Parrot. The proposed removal of woodland would reduce the amount of foraging habitat for Superb Parrots in the study area through the removal groundcover foraging habitat and some hollows. The proposal would remove 0.72 hectares of potential foraging habitat.

This is considered to be a small area of potential habitat removal in comparison with areas of vegetation to be avoided and suitable habitat in the wider study area. Due to the mobility and relatively large range of the Superb Parrot, it is unlikely that the proposal would lead to a long-term decrease in the size of a population of the Superb Parrot.

Reduce the area of occupancy of an important population

The proposed works would result in the loss of approximately 0.72 ha of foraging habitat, and the removal of eight hollow-bearing trees. These impacts are not expected to reduce the area of occupancy of the population.

Fragment an existing important population into two or more populations

The proposed works would not result in the fragmentation of the population.

Adversely affect habitat critical to the survival of the species

The River Red Gum Forest in the study area has the potential to facilitate the movement of Superb Parrots. The removal of vegetation would increase fragmentation in the study area, further increasing the gaps in vegetation that the species use for movement, roosting and foraging. Due to the mobility of the Superb Parrot and their large ranges, the proposal is unlikely to create any significant barriers to movement for this species. The proposal would not therefore fragment a population of this species into two or more populations.

Disrupt the breeding cycle of an important population

The proposed works are unlikely to disrupt the species' breeding cycle. It is not expected that bridge construction would disrupt mating. Trees and stags with hollows should be searched for roosting birds before being removed, to minimize potential impacts and mortality of individuals.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Approximately 0.72 ha of foraging habitat would be removed from the area. This reduction in foraging habitat is not expected to have a significant impact on the species. Additionally, approximately eight hollow-bearing trees would be removed from the area. These trees could provide possible roosting sites for the species. This habitat would be replaced or re-instated in accordance to the mitigation measures outlined in Section 5. The removal of this habitat is unlikely to cause the species to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

There is a possibility that the proposed works would introduce some weeds into the area where work is being undertaken. This would be managed with weed control protocols. It is unlikely that any weeds introduced would become invasive or impact upon the birds species.

Introduce disease that may cause the species to decline

It is unlikely that the proposed works would introduce diseases which would result in a species decline.

Interferes substantially with the recovery of the species

A recovery plan does not exist for the Superb Parrot. However, the following actions have been identified by the OEH for recovery of this species:

- Retain and protect hollow-bearing trees
- Retain and protect woodland remnants
- Ensure that impacts to Superb Parrot habitat are avoided and if this is not achievable ensure that loss of habitat is adequately offset
- Report grain spills to local authorities so they can be removed
- Report suspected illegal bird trapping, egg collection or sales to NPWS
- Cover grain trucks and check all openings are properly sealed
- Remove feral bee colonies from hollows in Superb Parrot habitat, or report them to relevant land manager (OEH, NPWS, LLS, Crown Lands, Local Government)
- Ensure that hazard reduction burns and stubble burns avoid damaging large hollow-bearing trees that provide Superb Parrot breeding habitat
- A targeted strategy for managing threatened species is also being developed under the OEH Saving Our Species program. OEH is currently developing a targeted approach for managing threatened species. The Superb Parrot has been assigned to the Landscape species management stream under the OEH Saving our Species program
- The recovery actions listed above, and those identified in the Saving Our Species program, that have been identified by the OEH to help recover the Superb Parrot are largely not applicable to the proposal

as they are actions for the OEH to complete and focus on priority conservation lands which are outside of the study area. The proposal will not interfere with the recovery of the Superb Parrot.

Conclusion

In conclusion, the proposed works would have minimal impact on the species, removing only a small amount of potential foraging area and a small number of potential roosting trees. This impact would not be detrimental to the survival of the populations as a whole, therefore the proposed works would not significantly impact either of these threatened species.

Grey-headed Flying Fox (*Pteropus poliocephalus*)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

There have been no roost camps identified in the proposal area to date and the work would not directly impact on any known breeding / maternity site. There is an active colony on the Macquarie River, about five kilometres upstream of the proposal. It is likely that the impacts would be confined to loss of feeding habitat caused by clearing or damage to native vegetation. The works would directly remove up to 0.47 ha of potential foraging habitat. This area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the proposal area (<0.01%). Given the relative widespread nature of similar vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the works are not expected to lead to a long-term decrease in the size of an important population.

Reduce the area of occupancy of an important population

The proposed works would result in the loss of approximately 0.47 ha of foraging habitat in the form of River Red Gum Trees providing nectar food resources. These impacts are not expected to reduce the area of occupancy of the population.

Fragment an existing important population into two or more populations

There is currently a high degree of habitat fragmentation across the study area. Highly mobile species such as bats are expected to be less impacted by fragmentation and the Grey-headed Flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. The work would not fragment an important population of the Grey-headed Flying-fox.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

There is an active colony on the Macquarie River, approximately five kilometres upstream of the proposal. The proposed area of habitat loss represents a small percentage of the potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of the study area and known roost camps in the region. This species typically exhibits very large home ranges and Grey-headed Flying-fox are known to travel

distances of at least 50 kilometres from roost sites to access seasonal foraging resources. No evidence of a camp site has been identified within the study area.

The draft recovery plan for the Grey-headed Flying-fox identifies critical foraging habitat for this species as:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals, within an area of 50 kilometre radius
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- Known to be continuously occupied as a camp site.

The work would temporarily remove up to 540 m² of foraging habitat however vegetation will be avoided where possible. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the proposal area. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the work is not expected to adversely affect habitat critical to the survival of the species.

Disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat identified as important during the breeding cycle of the species. The work would not directly impact on a known roost camp / breeding or maternity site.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Approximately 0.47 ha of foraging habitat would be removed from the area. This reduction in foraging habitat is not expected to have a significant impact on the species. This habitat would be replaced or re-instated in accordance to the mitigation measures outlined in Section 5. The removal of this habitat is unlikely to cause the species to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

There is a possibility that the proposed works would introduce some weeds into the area where work is being undertaken. This would be managed with weed control protocols. It is unlikely that any weeds introduced would become invasive or impact upon the bat species.

Introduce disease that may cause the species to decline

It is unlikely that the proposed works would introduce diseases which would result in a species decline.

Interferes substantially with the recovery of the species

The Draft National Recovery Plan for the Grey-headed Flying-fox (*Pteropus poliocephalus*) outlines the following actions:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps

- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan

The recovery actions listed above are largely not applicable to the work as they focus on priority conservation lands which are outside of the study area.

Given the relative widespread nature of similar vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the works are not expected to interfere substantially with the recovery of the species.

Conclusion

The Grey-headed Flying-fox will suffer a very small reduction in extent of suitable foraging habitat from the works. No roosting camps or other important habitat will be impacted. The works are unlikely to reduce the population size of the Grey-headed Flying-fox or decrease the reproductive success of this species. The work will not interfere with the recovery of the Grey-headed Flying-fox. Based on the above, it is considered that the work is unlikely to result in a significant impact to the Grey-headed Flying-fox.

Murray Cod (*Maccullochella peelii*)

Lead to a long-term decrease in the size of a population

The construction of the bridge across the Macquarie River will see the loss of a very small amount of potential quality habitat for Murray Cod. Murray Cod are most often found in deep water around logs and woody debris and undercut banks (Allen et al. 2002). The main aquatic habitats in the proposed works area are provided by overhanging vegetation. None of these would provide high quality habitat for Murray Cod and therefore it is highly unlikely that Murray Cod are frequently using the habitat that would be impacted by the proposed works. The proposal is considered unlikely to lead to a long term decrease in the size of the Murray Cod population of the area.

Reduce the area of occupancy of an important population

The proposal will remove a very small extent of potential habitat Murray Cod habitat. Therefore the proposal is considered unlikely to reduce significantly the area of occupancy of an important population.

Fragment an existing important population into two or more populations

The piles for bridge construction and operation may act as a barrier to fish passage under some flows. It is not clear to what extent this structure will prevent fish movement, but it is likely under many flow scenarios that fish passage would be possible. Fish habitat in the upstream end of Macquarie River could be accessed via the downstream confluence where there are known weir barriers. As a consequence, although the piles of the bridge may act as a barrier under some flow conditions, as this habitat is still readily accessible, the impact is likely to be low.

Adversely affect habitat critical to the survival of the species

The Murray Cod preferred microhabitat consists of complex structural features in streams such as large rocks, snags, overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. The loss of a small amount of overhanging vegetation does not represent habitat critical to the survival of the species.

Disrupt the breeding cycle of an important population

Murray Cod breeding takes place in spring / summer. The proposal is unlikely to impact the breeding of this species.

Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that *the species is likely to decline*

The proposal will remove a very small extent of potential habitat for Murray Cod habitat. Therefore the proposal is considered unlikely to reduce significantly the availability or quality of habitat to the extent the species is likely to decline.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The proposal would be unlikely to increase invasive species abundance sufficient to affect local populations.

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to increase the potential for significant disease vectors to affect local populations.

Interferes substantially with the recovery of the species

A national Recovery Plan exists for the Murray Cod with seven objectives including:

- Determine the distribution, structure and dynamics of Murray Cod populations across the MDB.
- Manage river flows to enhance recruitment to Murray Cod populations.
- Evaluate the risks of threats and benefits of recovery options on Murray Cod populations for each management unit.
- Determine the habitat requirements of Murray Cod life stages and populations.
- Manage the recreational fishery for Murray Cod in a sustainable manner while recognising the social, economic and recreational value of the fishery.
- Encourage community ownership for Murray Cod conservation.
- Manage Recovery Plan implementation

A total of 71 recovery actions are identified to address the range of threats and meet these objectives. The proposal is unlikely to interfere with these recovery actions and would improve habitat conditions at post-construction.

Conclusion

In conclusion, the proposed works would have minimal impact on the species, removing only a small amount of potential fish habitat. This impact would not be detrimental to the survival of the populations as a whole, therefore the proposed works would not significantly impact either of these threatened species.

Migratory species

Assessments of significance completed for migratory has found that the proposal is unlikely to significantly impact on any migratory species.

The list of species which are considered to have a moderate chance of occurring in the study area is shown below:

- *Ardea alba* (Great Egret)
- *Rhipidura rufifrons* (Rufous Fantail)
- *Tringa nebularia* (Common Greenshank)
- *Ardea ibis* (Cattle Egret)

- *Merops ornatus* (Rainbow Bee-Eater)
- *Apus pacificus* (Fork-tailed Swift)
- *Hirundapus caudacutus* (White-throated Needletail)

The background searches and field investigations found no evidence to suggest that an area of 'important habitat' exists at the site for a migratory species, or that the study area is occupied by an ecologically significant proportion of the populations of these migratory species. It is therefore unlikely that the proposed works would impact on any listed migratory species.

An area of 'important habitat' for a migratory species is:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at particular life-cycle stages, and/or
- Habitat used by a migratory species which is at the limit of the species range, and/or
- Habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species. Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates). These factors have been considered in the following assessment.

Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

The proposed temporary removal of regrowth vegetation provides only marginal habitat for these migratory birds species and are very unlikely to support important habitat. This is further supported by the generally poor condition of vegetation within.

There are no breeding records from the site or surrounds and the extent of habitat remaining in the study area would provide sufficient resources to sustain future visitation. The proposal would not reduce populations of a migratory species nor substantially reduce the extent of potential habitat in the region.

Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species

There is no evidence to suggest that an area of important habitat exists in the study area for any listed migratory species. Suitable measures would be incorporated into the proposal to control the spread of weeds during the construction and operation and these are to be detailed in a habitat restoration plan.

Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

There is no evidence to suggest that an area of important habitat exists or that the study area is occupied by an ecologically significant proportion of a population of a migratory species.



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