Newell Highway Heavy Duty Pavements, Narrabri to Moree

Biodiversity Assessment

Roads and Maritime Services | June 2018

NSW GOVERNMENT

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Roads and Maritime Services

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June 2018

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Executive summary

The proposal

Roads and Maritime Services (Roads and Maritime) proposes to carry out major road upgrades to five segments of the Newell Highway between Narrabri and Moree (the highway) in north west NSW, within the existing road corridor (the proposal).

The proposal forms part of the Newell Highway Corridor Strategy (Transport for NSW, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the Newell Highway.

The proposal would be delivered in five segments with a combined length of about 33.8 kilometres of upgrades along the highway.

Key features of the proposal include:

- Upgrading and resurfacing five segments of the existing highway to a heavy duty (HD) pavement
- Road widening to provide 3.5 metre wide lanes and two metre shoulders
- Provision of one metre wide painted medians
- Provision of 1.5 kilometre long overtaking lanes at five locations (three northbound and two southbound)
- Upgrading of the existing intersections along the highway to dedicated right hand turn intersections, with additional left hand turn intersection treatments
- Provision of a central two-way right turn lane at Bellata
- Provision of three metre wide shoulders for 30 metres on either side of property accesses
- Improving the Newell Highway flood immunity to a minimum of five year average recurrence interval (ARI) where feasible and reasonable
- Property acquisitions as required
- Utility relocations as required
- Establishing temporary facilities, including construction compounds, stockpile sites and erosion and sedimentation measures within the road corridor as required.

Need for the proposal

The section along the highway has substantial road surface and structural deficiencies. The road was built in the 1960s. Today, 98 per cent of the road along this section of the highway has a remaining life of 10 years or less. Due to its structural limitations, the road is also at heightened risk of surface failure caused by rainfall.

These road surface deficiencies, coupled with a strong freight demand, are affecting travel reliability and travel times for freight movements between Victoria and Queensland, as well as increasing maintenance costs and reducing road safety.

Proposal objectives

The objectives of the proposal are:

- Reduce vehicle operating costs on the Newell Highway
- Reduce the costs of maintaining the Newell Highway
- Improve the safety of the Newell Highway
- Improve flood reliability of the Newell Highway
- Reduce travel times on the Newell Highway.

Options considered

Roads and Maritime considered the following alternatives:

- Do nothing – business as usual
- Replace existing road with a heavy duty pavement entirely within the existing road corridor
- Replace existing road with a heavy duty pavement mostly within the existing road corridor, but with some new sections of road to ease curves.

Roads and Maritime found the cost of the do nothing alternative would be marginal when compared with the heavy duty pavement alternative, but it would not meet the proposal objectives. For this reason, it was no longer considered.

Providing a heavy duty pavement with new sections of road to ease curves would best meet the proposal objectives, and is therefore the preferred option.

Statutory and planning framework

Clause 94 of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) permits development, on any land, for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent.

As the proposal meets the definitions of 'road infrastructure facilities' provided for by clauses 93 and 94(2) of the ISEPP, and is being carried out by Roads and Maritime, it is permissible without consent under the ISEPP. Accordingly, it can be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and development consent is not required.

This review of environmental factors (REF) fulfils Roads and Maritime's obligations to consider the environmental impacts of the proposal under section 5.5 of the EP&A Act, and has been prepared in accordance with the provisions of clause 228 of the Environmental Planning and Assessment Regulation 2000. This REF also addresses the relevant considerations of the *Biodiversity Conservation Act 2016, Fisheries Management Act 1994, Heritage Act 1977, National Parks and Wildlife Act 1974*, and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Community and stakeholder consultation

A Communications and Engagement Plan (CEP) (Roads and Maritime, 2018) has been prepared for the development and delivery of the proposal. The CEP describes the communication and consultation approach and activities for the proposal. It also outlines the proposed communications approach to keep key stakeholders and the community informed during the development of the proposal.

Roads and Maritime also formally consulted with Narrabri Shire and Moree Plains Shire Councils in accordance with the requirements of the ISEPP.

Roads and Maritime invites comments on this REF. Submissions received during the public display period will be addressed in a formal submissions report and, if a decision is made to proceed with the proposal, will be considered during detailed design of the project.

Environmental impacts

Roads and Maritime has engaged technical experts to assess the potential environmental impacts of the proposal and to identify mitigation and management measures. The key adverse impacts of the proposal are summarised below.

Biodiversity

The proposal would require the removal of about 47 hectares of native vegetation. This includes about eight hectares of state listed threatened ecological communities (TECs) and 16 hectares of nationally listed TECs. In many instances, the same patches of vegetation are part of both a state listed and a commonwealth listed TEC. An assessment of significance was carried out for threatened species and ecological communities that would be likely to occur in the proposal area. The assessments concluded that, the proposal would not have a significant impact on any species, population or TEC listed under the NSW Biodiversity Conservation Act 2016 (BC Act) and NSW Fisheries Management Act 1994 (FM Act)

However, the proposal may have a significant impact on two threatened species and a TEC listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The proposal would require the removal of 11 hectares of the TEC Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland TEC which is listed as a critically endangered ecological community under the EPBC Act.

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. The strategic assessment approval means that most Roads and Maritime Division 5.1 activities do not require referral to the Department of the Environment and Energy provided that impacts are assessed using Commonwealth guidelines and the avoid, mitigate and offset hierarchy applied through project determinations. This is the case even if the activity is likely to have a significant impact.

Further assessment to confirm the presence of this community and species within the study area, and therefore the significance of the impact, would be carried out in consultation with the Department of the Environment and Energy if required. The outcomes of this assessment would be provided in the submissions report prepared for the proposal. If the proposal is confirmed to have a significant impact on this ecological community and these species described below, then the proposal would be subject to the EPBC Act strategic assessment approval.

Biodiversity impacts have been reduced through the adoption of a design and construction option that would affect less native vegetation. Impacts on threatened biodiversity would be avoided or further minimised through the design process and implementation of management and mitigation measures identified in the REF.

Biodiversity offsets would be required for residual impacts to threatened biodiversity in accordance with the EPBC Act strategic assessment approval and the Roads and Maritime Guideline for Biodiversity Offsets (2016).

Noise and vibration

During construction, there would be noise impacts at some nearby sensitive receivers where noise management levels (NMLs) are predicted to be exceeded. Most of these receivers where noise during some stages of construction may be in the moderate to high range are in the villages of Edgeroi and Bellata, where the proposed work is closest to sensitive receiver locations. Measures have been developed to mitigate and manage potential noise impacts during construction, including programming of activities generally within day time hours. Where activities involving vibration-generating equipment occur within the vicinity of residents and other sensitive areas, work methods have been developed to avoid the potential for human discomfort and any building damage. Noise from additional traffic generated during construction was also assessed and determined to be negligible.

Regarding noise resulting from traffic along the upgraded road segments, levels would not be noticeably different from current noise levels and would not result in levels above the accepted noise criteria. The road surface would be improved as part of the upgrades which would improve wheel-road related noise emissions compared with existing conditions.

Aboriginal

As part of Roads and Maritime's Stage 2 Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI), a survey of the study area was carried out in conjunction with three Aboriginal groups (Gomeroi People Native Title Claim Group, Narrabri and Moree Local Aboriginal Land Councils). This survey found that the study area is largely disturbed due to the existing roadway and road shoulders. The survey identified a number of Aboriginal heritage items.

The assessment concluded that the construction of the proposal may impact on one potential archaeological deposit (PAD) (BC-HW17-PAD1). If during further development of the design impacts to items of Aboriginal heritage become unavoidable, further assessment in accordance with Stages 3 and 4 of PACHCI and an Aboriginal Heritage Impact Permit (AHIP) under the National Parks and Wildlife Act 1974 would be required.

Socio-economic and property issues

The proposal would require a strip acquisition of privately and publicly owned land. Affected properties would be partially acquired by Roads and Maritime and consultation would be carried out with any affected owners. This may result in the relocation or demolition of rural infrastructure. In addition, temporarily leases may be required, for the use as ancillary facilities during construction of the proposal.

During construction, temporary adverse changes in local amenity may be experienced by communities and businesses near the proposal due to increased noise, dust and construction traffic. The proposal may also require temporary changes to access and connectivity within the proposal area.

Once completed, the proposal would provide long-term positive impacts to access and connectivity for local communities, businesses and industry in the proposal area and wider region. Roads and Maritime would continue to consult with the community and stakeholders during development of the proposal.

Traffic and access

The proposal would cause temporary disruptions to traffic, including reduced speed limits through construction zones, potential changes to property accesses and increased heavy vehicle movements on the existing road network.

The proposal would improve road safety and travel efficiency along the corridor by providing overtaking lanes, one metre wide painted medians, improved flood immunity and a new road surface.

Justification and conclusion

The proposal is considered to be consistent with a number of relevant strategies and plans including:

- National Road Safety Strategy 2011–2020
- Melbourne–Brisbane Corridor Strategy: Building our National Transport Future
- NSW State Plan 2021: A Plan to Make NSW Number One
- NSW Long Term Transport Master Plan
- State Infrastructure Strategy
- NSW Freight and Ports Strategy
- NSW Road Safety Strategy 2012–2021
- New England North West Regional Transport Plan
- Newell Highway Corridor Strategy
- New England North West Strategic Regional Land Use Plan.

While there would be some environmental impacts as a consequence of the proposal, they have been avoided or minimised wherever possible through design and site specific safeguards. The beneficial effects are considered to outweigh the mostly temporary adverse impacts and risks associated with the proposal.

This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity in accordance with Division 5.1 of the EP&A Act. The proposal would be unlikely to cause a significant impact on the environment. Accordingly, neither an environmental impact statement is required to be prepared, nor approval from the Minister for Planning under Division 5.2 of the EP&A Act.

While the proposal is likely to have a significant impact on matters of national environmental significance within the meaning of the EPBC Act, a referral to the Department of the Environment and Energy is not required, because requirements for considering impacts to these biodiversity matters are the subject of a strategic assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Contents

Glossary of terms

Definitions

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).
Local occurrence	The ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
Local population	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area, according to the following definitions: • The local population of a threatened plant species comprises those individuals occurring in the study area or the cluster of individuals that extend into habitat adjoining and contiguous with the study area that could reasonably be expected to be cross-pollinating with those in the study area • The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) that are known or likely to utilise habitats in the study area • The local population of migratory or nomadic fauna species comprises those individuals that are likely to occur in the study area from time to time. In cases where multiple populations occur in the study area, each population should be assessed separately.
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.

Abbreviations

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
EIS	Environmental Impact Statement

Definitions

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

The section of road along the Newell Highway between Narrabri and Moree has significant road surface and structural deficiencies. The road was built in the 1960s Today, 98 per cent of the road along this section of the highway has a remaining asset life of 10 years or less. Due to its structural limitations, the road is also at heightened risk of surface failure caused by rainfall.

These road surface deficiencies, coupled with a strong freight demand, are affecting travel reliability and travel times for freight movements between Victoria and Queensland, as well as increasing maintenance costs and reducing road safety.

1.2 The proposal

Roads and Maritime Services (Roads and Maritime) proposes to carry out major pavement upgrades to five segments of the Newell Highway between Narrabri and Moree (the highway) in north west NSW within the existing road corridor (the proposal).

The proposal is located in the Narrabri Shire and Moree Plains Shire Local Government Areas (LGAs).

The proposal forms part of the *Newell Highway Corridor Strategy* (Transport for NSW, 2015) to provide an efficient and sustainable corridor that caters for increasing growth and improves safety along the Newell Highway. The Newell Highway carries substantial freight volumes, large volumes of inter-regional and local freight traffic, and is increasingly catering for substantial volumes of tourist traffic. The strategy identified that a large portion of the northern section of the Newell Highway is nearing its end of life, with regular failures occurring with structural pavement, as well as large sections not meeting desired cross section dimensions.

Key features of the proposal include:

- Upgrading and resurfacing five segments of the existing highway to a heavy duty (HD) pavement
- Road widening to provide 3.5 metre wide lanes and two metre shoulders
- Provision of a one metre wide painted median
- Provision of 1.5 kilometre long overtaking lanes at five locations (three northbound and two southbound)
- Upgrading of the existing intersections along the highway to channelised intersection right hand turn, with an axillary left hand turn intersection treatments
- Provision of a central two-way right turn lane at Bellata
- Provision of three metre wide shoulders for 30 metres on either side of property accesses
- Improving the Newell Highway flood immunity to a minimum of five year average recurrence interval (ARI) where feasible and reasonable
- Property acquisitions as required
- Utility relocations as required
- Temporary construction ancillary facilities, including construction compounds, stockpile sites and erosion and sedimentation measures within the road corridor as required.

The proposal would be delivered in five segments with a combined length of about 33.9 kilometres of upgrades along the Newell Highway between Narrabri and Moree. The five segments and indicative work locations are described in Table 1-1.

Table 1-1 Segment and proposed works

Segment	Location	Proposed works
N2MS1	6.4 kilometres to 12.9 kilometres north of Narrabri	• Upgrading 6.5 kilometres of the Newell Highway
N2MS2	15.6 kilometres to 25.9 kilometres north of Narrabri at Edgeroi	• Upgrading 10.3 kilometres of the Newell Highway • Two overtaking lanes – northbound and southbound
N2MS3	46.8 kilometres to 51.3 kilometres north of Narrabri at Bellata	• Upgrading 4.5 kilometres of the Newell Highway • One northbound overtaking lane
N2MS4	52.4 kilometres to 58.3 kilometres north of Narrabri, north of Bellata	• Upgrading 5.9 kilometres of Newell Highway
N2MS5	88.4 kilometres to 96.3 kilometres north of Narrabri, south of Moree	• Upgrading 7.9 kilometres of the Newell Highway • Two overtaking lanes – northbound and southbound

Construction of the proposal would be staged to enable work to be completed safely while maintaining traffic flows at all times.

To minimise impacts on threatened species and EEC, Table 1-2 presents the options for each segment that were recommended to progress the design. These segments are considered the recommended option and have been assessed in this assessement as the proposal.

Table 1-2 Recommended horizontal alignments to be progressed

Segment	Option description recommended to avoid significant impacts on threatened species and EEC
N2MS1	Option 3: Offline within in the existing corridor where possible and existing pavement replaced with heavy duty pavement with curve easing
N2MS2	Option 2: Alternative Option: Online where the existing pavement is replaced with a heavy duty pavement
N2MS3	Option 3: Offline within in the existing corridor where possible and existing pavement replace with heavy duty pavement with curve easing
N2MS4	Option 2: Alternative Option: Online option where the existing pavement is replaced with a heavy duty pavement
N2MS5	Option 2: Alternative Option: Online option where the existing pavement is replaced with a heavy duty pavement

1.2.1 Study area

The study area for the purposes of this biodiversity assessment (see Figure 1.2) includes the five segments of the Newell Highway and adjacent land to account for the area that would be directly and indirectly impacted by construction and operation of the proposal. It includes the construction footprint and the locations of any compound sites, stockpile sites and any other areas that would be disturbed within areas of native vegetation in road reserves and travelling stock routes. The locations of the main compound and stockpile sites are yet to be determined

but the intention at this stage is that they would be located in areas devoid of native vegetation on adjacent private property under a leasing arrangement.

The following areas are discussed throughout the report and are defined as:

- Proposal area: this area comprises the limits of the 50% concept design footprint for the 'recommended' and 'alternative alignment' option including and a four metre construction buffer and including minor ancillary sites; main compound and stockpile sites are yet to be determined but the intention at this stage is that they would be located in areas devoid of native vegetation on adjacent private property under a leasing arrangement (refer to Figure 1.2)
- Study area: includes the proposal area and the surrounding area (see Figure 1.2) that may be indirectly impacted
- Survey area: refers to the area that was surveyed during the biodiversity site assessment and included representative sites within and immediately adjacent to the two concept design options ('recommended' and 'alternative') which were assessed in the field. No private property was accessed during the field surveys
- Locality: This is defined as the area within a 30 kilometre radius surrounding the proposal area and used in the analysis of the known local distribution of threatened species; refer to S.2.2 of this report for further discussion of database searches and search area selected
- Bioregion: The study area is located in the Brigalow Belt South bioregion (Thackway and Cresswell, 1995) and crosses the Northern Basalts and Northern Outwash sub-regions.

1.3 Legislative context

1.3.1 Environmental Planning and Assessment Act

A Review of Environmental Factors (REF) has been prepared to fulfil Roads and Maritime obligations under s.111 of the *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.112 in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF prepared for the Newell Highway Heavy Duty Pavements, Narrabri to Moree proposal, and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Under s.111 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* (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 species, 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

The stated purpose of the 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

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 for the proposal, 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 species impact statement (SIS) must be prepared in accordance with the Environment Agency Heads requirements.

1.3.4 Environment Protection and Biodiversity Conservation Act 1999

The *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 Part 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.

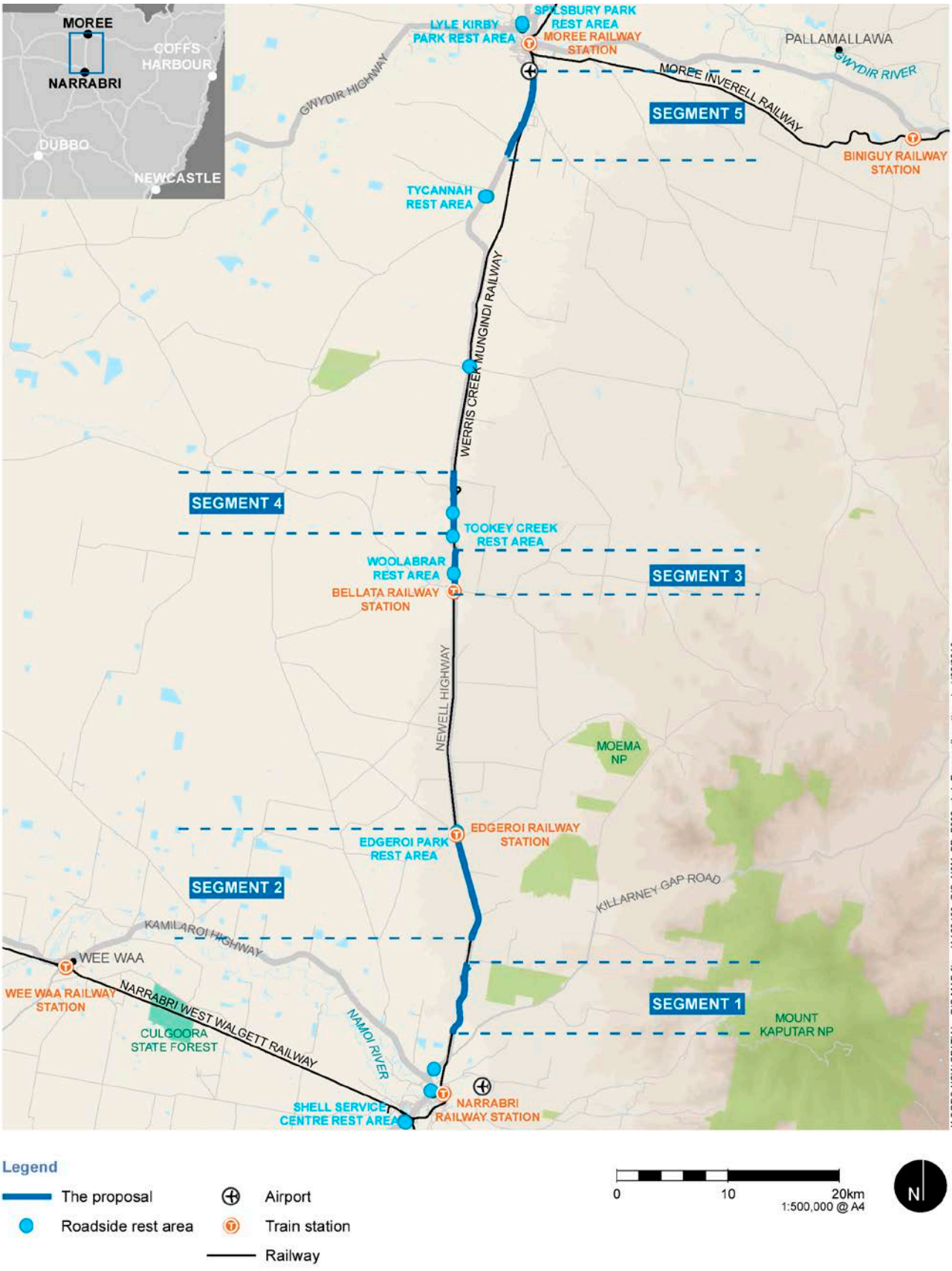


Figure 1.1 Proposal location

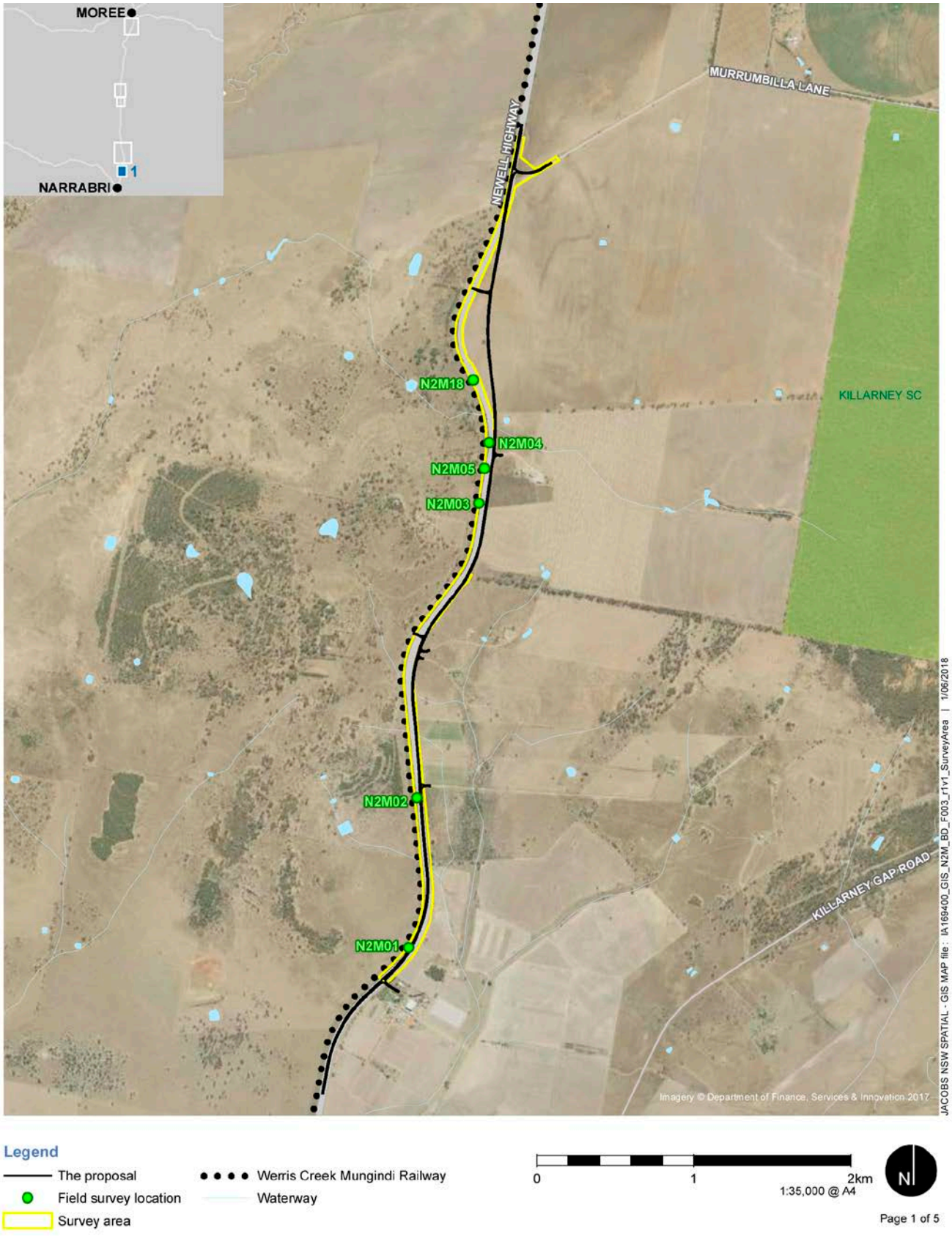


Figure 1.2 The proposal and study area, Page 1 of 5

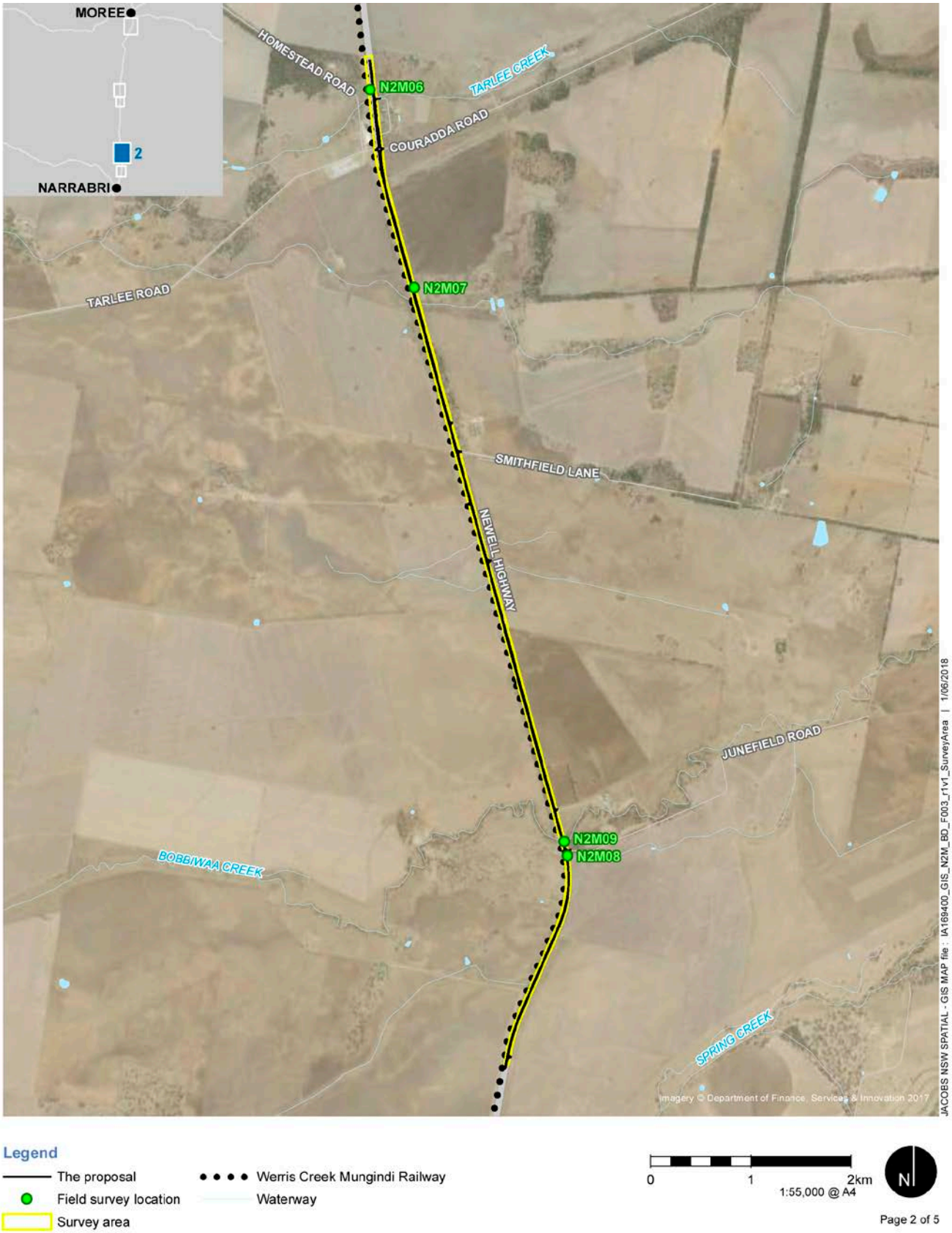


Figure 1.2 The proposal and study area, Page 2 of 5

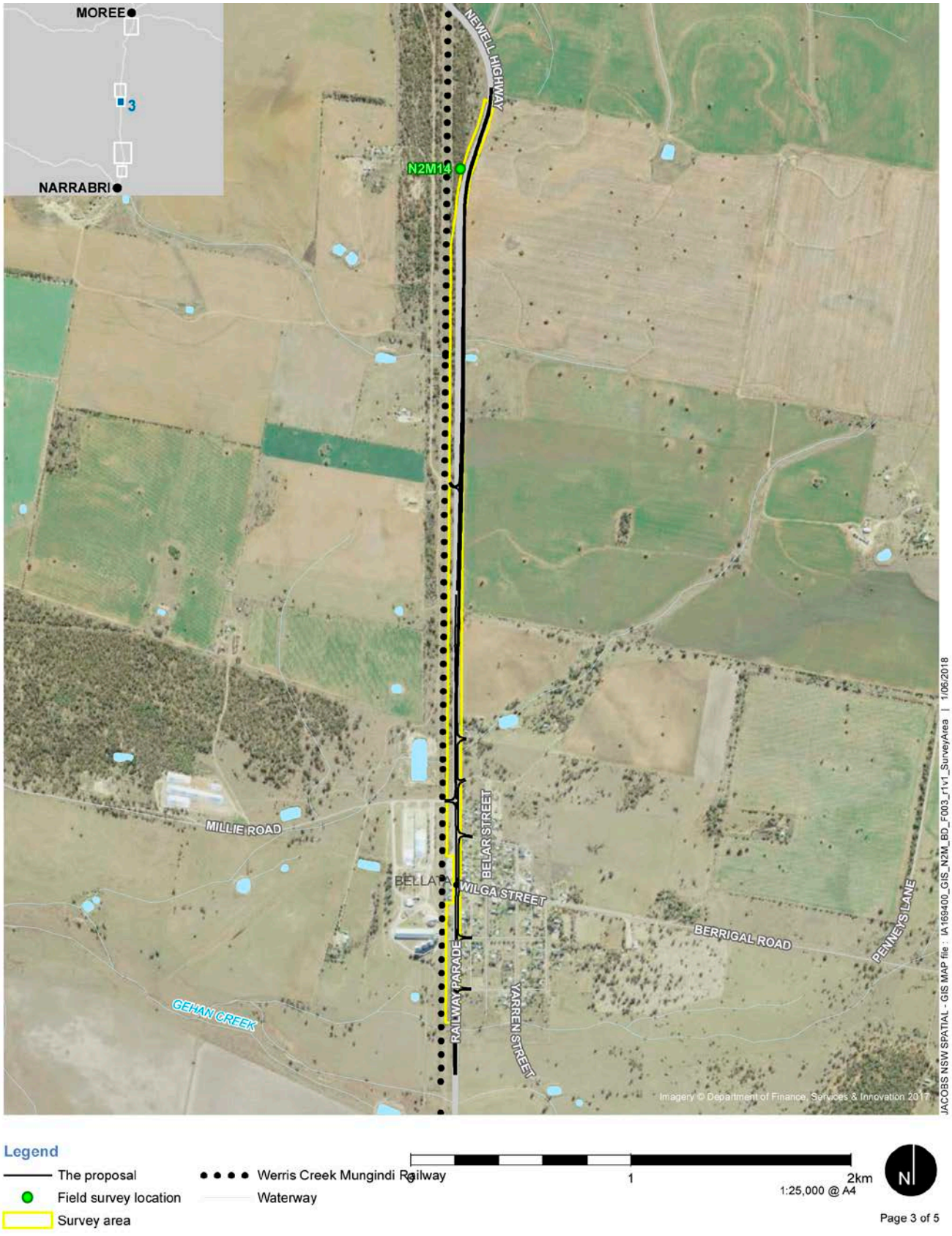


Figure 1.2 The proposal and study area, Page 3 of 5

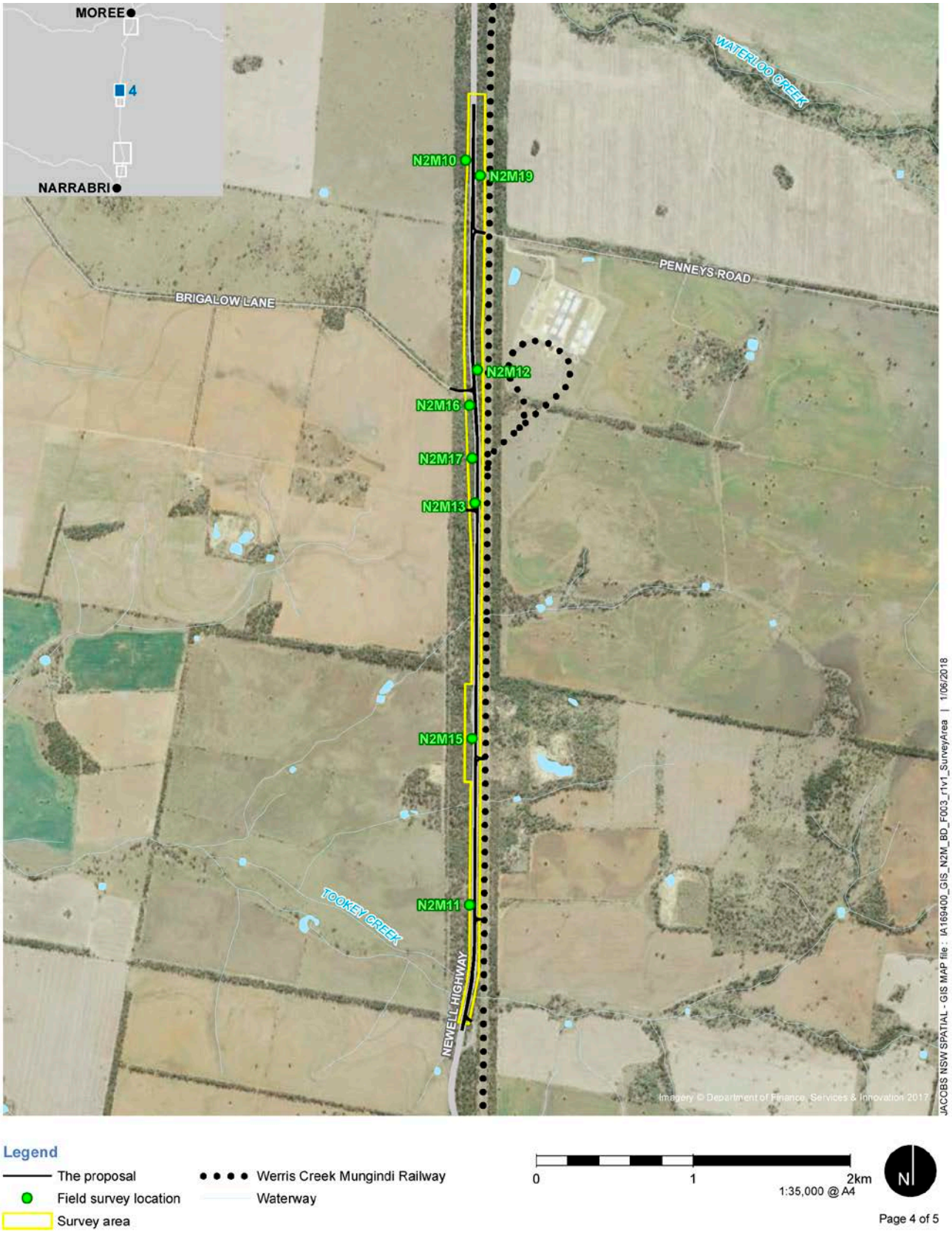


Figure 1.2 The proposal and study area, Page 4 of 5

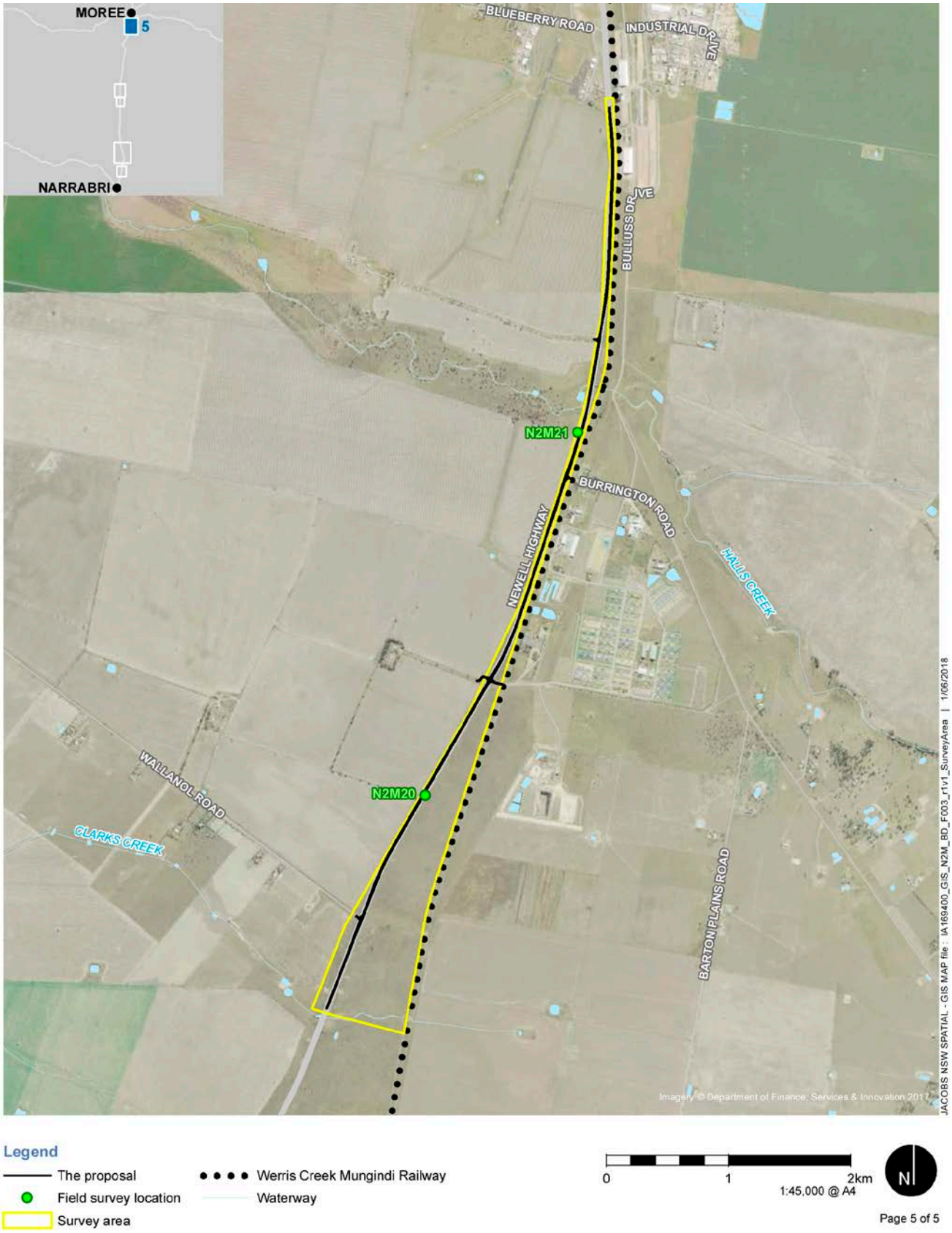


Figure 1.2 The proposal and study area, Page 5 of 5

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
Paul Rossington	Senior Ecologist - Technical lead, ecology surveys, reporting	Bachelor of Science (Biology) Master of Wildlife Management Biodiversity Assessment Method trained and approved for accreditation
Brenton Hays	Ecologist – Field survey, reporting	Bachelor of Environmental Science and Management (honours)
Lukas Clews	Senior Ecologist – reporting assistance	Master of Scientific Studies Graduate Certificate in Applied Science Bachelor of Science Diploma in Conservation and Land Management Biodiversity Assessment Method accredited
Chris Thomson	Technical Director (ecology) - Technical review	Bachelor of Applied Science (Env Mgt) Graduate Certificate in Natural Resources Biodiversity Assessment Method accredited

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 30 kilometres. The larger, 30 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
- NSW Department of Primary Industries (DPI) freshwater threatened species distribution maps
- The federal Department of Environment and Energy Protected Matters Search Tool
- OEH BioNet Vegetation Classification System database
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE)
- Department of Environment and Energy directory of important wetlands

- Department of Planning and Environment SEPP 14 wetlands spatial data
- Atlas of Living Australia
- Register of Declared areas of Outstanding Biodiversity Value.

Regional vegetation mapping projects including the *Border Rivers Gwydir / Namoi 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 was 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.

The annual Final Priority Assessment List of nominated species and ecological communities that have been approved for assessment by the Minister responsible for the EPBC Act was reviewed (period commencing 1 October 2017) (Department of the Environment and Energy, 2017).

2.3 Preliminary 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 make an assessment of the likelihood of the species being present in the study area (i.e. subject species). The habitat assessment formed the basis for targeted surveys 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.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently or frequently 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

A field survey was undertaken within the study area over four days in early December (7-10th) to ground-truth the results of the background research and habitat assessment.

2.4.1 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 m^2 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 m^2 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 m^2 plot.

The survey was stratified and targeted to assess environmental variation. Due to the large size of the study area, field surveys were focussed on areas within the bounds of the two concept design options 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 (mapped as ‘not native’) 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 1.2.

Table 2-3 Summary of survey effort

Plant community type (PCT)	Condition class	Area (ha)in proposal area	Plot requirement based on the BAM	No. plots sampled in proposal area and broader study area
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	0.98	1 plot	3 plots (N2M03) (N2M10, N2M19)
	Moderate to Poor (Derived Grassland)	0.22	-	-
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	0.66	1 plot	3 plots (N2M12, N2M13, N2M17)
	Moderate to Poor (Derived Grassland)	0.53	-	-
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	2.98	2 plots	2 plots (N2M08, N2M09)
	Moderate to Poor (Derived Grassland)	0.04	-	-

Plant community type (PCT)	Condition class	Area (ha)in proposal area	Plot requirement based on the BAM	No. plots sampled in proposal area and broader study area
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)	Moderate to Good (Relatively Intact)	0.08 ha	1 plot	1 plot (N2M16)
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	3.64	2 plots	3 plots (N2M11, N2M14, N2M15)
	Moderate to Poor (Derived Grassland)	1.05	-	-
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	8.21	3 plots	4 plots (N2M02, N2M04, (N2M05), N2M18)
	Moderate to Poor (Derived Grassland)	5.35		-
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	11.31	3 plots	2 plots (N2M20, N2M21)
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	3.17	2 plots	1 plot (N2M06)
	Moderate to Poor (Derived Grassland)	11.06	3 plots	1 plot (N2M07)
Not native	-	10.65	-	1 plot (N2M01)

2.4.2 Targeted flora surveys

The surveys undertaken for all identified candidate flora species initially 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) with random meander surveys through the habitat undertaken. The floristic plot surveys also provided opportunity to record threatened species in discreet areas if they were present.

Details of the targeted threatened flora species surveys are outlined in Table 2.3. The location of transects is shown on Figure 1.2.

The survey design for the proposal was based on the findings of the Preliminary environmental investigation (PEI) (WSP, 2017) which identified the following threatened plant species as likely to occur in the study area and therefore to require targeted survey:

- *Desmodium campylocaulon*
- *Dichanthium setosum*
- *Digitaria porrecta*
- *Swainsona murrayana.*

However, detailed analysis of vegetation, habitat attributes, existing mapping and the known and predicted distribution of threatened species revealed that the vegetation of the site is far more varied and of better condition than indicated by the PEI. Re-evaluation of the likelihood of occurrence of threatened species based on site conditions and a thorough desktop study indicated that there are a number of additional species that may be present in the proposal area which could not be targeted during the field surveys due seasonal, time and resource constraints. Such species are therefore assumed to be present in areas of suitable habitat and are assessed on this basis.

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

Threatened flora species	Status		Recommended survey timing	Recommended survey effort for proposal area	Survey completed in early December (7-10th)	Additional surveys completed in May 2018
	BC Act	EPBC Act				
Cyperus conicus	E	-	Year-round but likely to be dependent on rainfall	12 plots and 30-minute threatened plant searches in associated vegetation communities	10 plots and 30-minute threatened plant searches in associated vegetation communities	4 person hours across potential habitat in proposal area (concurrently with other species).
Desmodium campylocaulon	E	-	December to May	4 plots and 30-minute threatened plant searches in associated vegetation communities	4 plots and 30-minute threatened plant searches in associated vegetation communities	8 person hours across potential habitat in proposal area (concurrently with other species).
Dichanthium setosum	V	V	December to May	14 plots and 30-minute threatened plant searches in associated vegetation communities	15 plots and 30-minute threatened plant searches in associated vegetation communities	8 person hours across potential habitat in proposal area (concurrently with other species).
Digitaria porrecta	E	-	December to May	12 plots and 30-minute threatened plant searches in associated vegetation communities	13 plots and 30-minute threatened plant searches in associated vegetation communities	8 person hours across potential habitat in proposal area (concurrently with other species).
Homopholis belsonii	E	V	December to May	12 plots and 30-minute threatened plant searches in associated vegetation communities	13 plots and 30-minute threatened plant searches in associated vegetation communities	8 person hours across potential habitat in proposal area (concurrently with other species).
Lepidium aschersonii	V	V	September to May but likely to be responsive to seasonal conditions	7 plots and 30-minute threatened plant searches in associated vegetation communities	8 plots and 30-minute threatened plant searches in associated vegetation communities	4 person hours across potential habitat in proposal area (concurrently with other species).
Swainsona murrayana	V	V	September to January	12 plots and 30-minute threatened plant searches in associated vegetation communities	13 plots and 30-minute threatened plant searches in associated vegetation communities	n/a
Diuris tricolor	V	-	September to late October	12 plots and 30-minute threatened plant searches in associated vegetation communities	None. Survey timing not suitable for species.	n/a

Threatened flora species	Status		Recommended survey timing	Recommended survey effort for proposal area	Survey completed in early December (7-10th)	Additional surveys completed in May 2018
	BC Act	EPBC Act				
Lepidium monoplocoides	E	E	January to December but highly dependent on seasonal conditions.	5 plots and 30-minute threatened plant searches in associated vegetation communities	6 plots and 30-minute threatened plant searches in associated vegetation communities	n/a
Polygala linariifolia	E	-	Year-round but highly responsive to seasonal conditions.	3 plots and 30-minute threatened plant searches in associated vegetation communities	4 plots and 30-minute threatened plant searches in associated vegetation communities	4 person hours across potential habitat in proposal area (concurrently with other species).
Sida rohlenae	E	-	September to December	5 plots and 30-minute threatened plant searches in associated vegetation communities	7 plots and 30-minute threatened plant searches in associated vegetation communities	n/a
Tylophora linearis	V	E	September to May	3 plots and 30-minute threatened plant searches in associated vegetation communities	4 plots and 30-minute threatened plant searches in associated vegetation communities	4 person hours across potential habitat in proposal area (concurrently with other species).
Pterostylis cobarensis	V	-	September to November	3 plots and 30-minute threatened plant searches in associated vegetation communities	-	n/a

2.4.3 Targeted fauna surveys

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:

- Koala
- Yellow-bellied Sheathtail-bat and Little Pied Bat
- Five-clawed Worm-skink
- Threatened bird species including Dusky Woodswallow, Glossy Black-Cockatoo, Spotted Harrier, Brown Treecreeper, Varied Sittella, Black Falcon, Brolga, Little Eagle, Square-tailed Kite, Turquoise Parrot, Superb Parrot, Barking Owl, Masked Owl, Grey-crowned Babbler, Diamond Firetail.

The findings of the PEI were initially considered reliable for the purposes of field study design as they were based on both a desktop study and two days of site inspection by two ecologists. However, detailed analysis of vegetation, habitat attributes, existing mapping and the known and predicted distribution of threatened species revealed that the habitats of the site are far more varied and of better condition than indicated by the PEI. Re-evaluation of the likelihood of occurrence of threatened species based on site conditions and a thorough desktop study indicated that there are a number of additional species that may be present in the proposal

area which could not be targeted during the field surveys due to time and resource constraints. Such species are therefore assumed to be present in areas of suitable habitat and are assessed on this basis.

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 in early December (7-10th)
	BC Act	EPBC Act			
Koala	V	V	All year	Surveys should include: • 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. Species-specific requirements according to Commonwealth guidelines include: • 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).

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed in early December (7-10th)
	BC Act	EPBC Act			
Five-clawed Worm-skink	E	-	Late September through to late March	Surveys should include general reptile survey techniques: • Habitat search: 30-minute search on two separate days per 200 ha stratification unit. • Pitfall traps with drift nets; 24 trap nights, preferably using six traps for a minimum of four consecutive nights. • Spotlighting: 30-minute search on two separate nights per 200 ha stratification unit. Species-specific requirements according to Commonwealth guidelines include: • Searching sheltering sites (not suitable on cracking-clay soils) • Pitfall trapping using a series of pitfall trap lines each comprising six 20 litre 500mm deep buckets spread along a 30 metre fence • Artificial shelter sites; Hay bales and other decomposable materials in strategically placed, 4 m x 4 m fenced plots; over 6 months • if the targeted species is not detected using all of the recommended survey techniques, at least one replicate survey should be conducted.	Actively searched all suitable habitat types within the study area (i.e. Searching of fallen logs, litter, fallen bark, rock outcrops and dumped rubbish). Equated to 6 person hours
Pale-headed Snake	V	-	November to March	Surveys should include: • Habitat search: 30-minute search on two separate days per 200 ha stratification unit. • Search loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. • Spotlighting: 30-minute search on two separate nights per 200 ha stratification unit.	Actively searched all suitable habitat types within the study area (i.e. searching hollows and loose/decorticating bark). Equated to 6 person hours
Black Falcon	V	-	All year	Suggested minimum effort is not specified but the following methods are recommended for diurnal birds in general: • Area searches; 20 minute surveys of 2 hectare plots, noting that a study has shown that 3 x 20 minute censuses of a 2ha block revealed only 53% of the species present. • A 20-minute census at dawn or dusk, for each identified water source.	20 minute dedicated surveys of approx. 2 hectares plots by in 21 locations across all habitat types. Opportunistic surveys during all other site activities (particularly looking for soaring and perched birds while driving). 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	-			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed in early December (7-10th)
	BC Act	EPBC Act			
Brolga	V	-	All year	Surveys should include: • 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. Species-specific requirements for the Australian Painted Snipe according to Commonwealth guidelines, include: • 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 and able to be effectively surveyed for Brolga, Black-necked Stork and Magpie Goose by visually scanning both when on foot and driving past. 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 All year	Suggested minimum effort is not specified but the following methods are recommended for diurnal birds in general: • Area searches; 20 minute surveys of 2 hectare plots, noting that a study has shown that 3 x 20 minute censuses of a 2ha block revealed only 53% of the species present. • A 20-minute census at dawn or dusk, for each identified water source. Species-specific requirements according to Commonwealth guidelines for the Superb Parrot include: • Area searches or transect surveys; 12 hours over 4 days per 50 hectares • Targeted searches; 12 hours over 4 days; targeting areas of hollow-bearing trees during breeding season.	Twenty-one 20 minute dedicated surveys of approx. 2 hectares plots plus opportunistic surveys during all other site activities. Search for evidence of feeding i.e. chewed cones of *Casuarina* and *Allocasuarina* species for black-cocakatoos.
Bush-stone Curlew	E	-			
Grey-crowned Babbler	V	-			
Speckled Warbler	V	-			
Dusky Woodswallow	V	-			
Hooded Robin	V	-			
Diamond Firetail	V	-			
Brown Treecreeper	V	-			
Varied Sittella	V	-			
Turquoise Parrot	V	-			
Superb Parrot	V	V			
Little Lorikeet	V	-			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed in early December (7-10th)
	BC Act	EPBC Act			
Painted Honeyeater	V	V			
Glossy Black-Cockatoo	V	-			
Barking Owl	V	-	All year	Suggested minimum effort is: • 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).	Call playback surveys could not be effectively undertaken in the study area due to traffic noise. Large areas of suitable habitat for the Bush Stone-Curlew were traversed Habitat assessment (i.e. presence of possibly suitable large nesting hollows or dense grass/sedge patches) and searches for pellets and evidence of feeding.
Masked Owl	V	-			
Eastern Grass owl	V	-			
Bush Stone-curlew	E	-			
Yellow-bellied Sheathtail-bat	V	-	October to March	Suggested survey methods include: • Roost site identification – hollows, caves and artificial structures; all species • 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 Sheathtail-bat. Species-specific requirements according to Commonwealth guidelines for Corben's Long-eared Bat include: • 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,	Habitat assessment, including assessment of existing bridges, culverts and and recording hollow treesas potential roost sites. Call detection – One bat call detector used for 5 full nights recording from 2000 hours to 0500 hours at 5 different sites.
Little Pied Bat	V	-			
Large-eared Pied Bat	V	V			
Corben's Long-eared Bat	V	V			

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed in early December (7-10th)
	BC Act	EPBC Act			
Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	V	-		then significant effort should be given to trapping over the water; 20 trap nights over 5 nights for proposal areas <50 ha over. 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: • 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.	
Eastern Cave Bat	V	-			
Rufous Bettong	V	-	All year	Surveys should include: • 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.	No targeted surveys were undertaken for these species. Survey effort was limited to habitat assessment.
Black-striped Wallaby	E	-			
Squirrel Glider	V	-	All year	Surveys should include: • 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.	
Stripe-face Dunnart	V	-	All year	Surveys should include: • Pitfall 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. • Pits should be 23-28cm in diameter and at least 60cm deep Evidence for other dunnart species has shown them to be trap-shy and deep pitfall traps much more effective for detecting the species. Refer: • https://nt.gov.au/__data/assets/pdf_file/0016/208330/butlers-dunnart-survey-protocol.pdf) • http://gvdbiodiversitytrust.org.au/wp-content/uploads/2016/05/SHD_SurveyGuidelines_2016_05_12_LG.pdf.	

Threatened fauna species	Status		Recommended survey timing	Recommended survey effort (see Note 1)	Survey completed in early December (7-10th)
	BC Act	EPBC Act			
Pale Imperial Hairstreak	CE	-	Late summer; two months after heavier rains; typically, in February and March but also at other times between October to and April depending on conditions (Eastwood et al. 2008).	Meandering search pattern along transects within Brigalow woodland. Netting all butterflies for identification. Between 8:30 am and 5:30 pm and only after butterflies are observed to be active	No targeted surveys were undertaken for this species. Surveys effort was limited to habitat assessment.

Note 1: Based on *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft, 2004* for NSW BC Act listed species and the following guidelines for Commonwealth species:

- *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*
- A Survey of the Pale Imperial Hairstreak *Butterfly Jalmenus eubulus in New South Wales* (Taylor, 2014)

2.4.4 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; nor was water quality sampling undertaken. 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 for threatened species were undertaken at representative locations only; they did not cover the entire proposal area or the entire study area; 32 kilometres long and typically 50 – 100 metres wide (up to around 600 metres wide in one location).

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 Interim Biogeographic Regionalisation for Australia (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 crosses two catchment areas:

- Namoi catchment – Segment N2MS1 and the south end of Segment N2MS2
- Gwydir River catchment – north end of Segments N2MS2 and all of Segments N2MS3 to N2MS 5.

Surrounding landuse

The area surrounding the proposal is characterised by a rural environment which is predominately cleared of native vegetation and replaced with cropping and grazing. The retention of remnant vegetation has been greatest in the road reserve which has been traditionally used as a travelling stock reserve (TSR). Specifically, the landscape surrounding each segment comprises the following:

- N2MS1 – Mostly grazing and some cropping
- N2MS2 – Mostly cropping, some grazing
- N2MS3 – Mostly grazing, some cropping
- N2MS4 – Mostly grazing, some cropping
- N2MS5 - Mostly cropping, some grazing.

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
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.	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.	Sandstone areas support various forests and woodlands of ironbarks (*Eucalyptus* spp.), cypress pines (Callitris spp.), apples/gums (*Angophora* spp.). Boxes (*Eucalyptus populnea*, E. *pilligaensis* etc.) occur on coarser soils with occasional silver-leaved ironbark (*E. melanophloia*). River red gum *(E. camaldulensis*) 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 (*E. microcarpa*), yellow box (*E. melliodora*) and rough-barked apple (*Angophora floribunda*) occur on valley floors, while river red gum lines larger streams and river oak (*Casuarina cunninghamiana*) 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 (*Acacia pendula*) 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, silver top stringybark (*E. laevopinea*), manna gum (*E. viminalis*) and mountain gum (*E. dalrympleana*) are found with snow gum (*E. pauciflora*) in cold air drainage hollows. Tallow wood (*E. microcorys*), blackbutt (*E. pilularis*) and blue gum (*E. saligna*) 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 (*Corymbia maculata*), cypress pine (*Callitris glaucophylla*), Bloodwoods (e.g. *Corymbia trachyphloia*), Brigalow-Belah forests (*Acacia harpophylla*, *Casuarina cristata*) and semi-evergreen vine thicket.

Brigalow Belt South IBRA subregions

The study area crosses two subregions within the Brigalow Belt South IBRA bioregion, 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	Segments where bioregion is mapped
Northern Basalts subregion Geology: Tertiary basalts over Jurassic quartz sandstones and alluvial sediments derived from these Landform: Undulating low stony hills, long slopes with sandy wash and heavy clays in the valley floors Soils: Black loams on basalt ridges, deep sands on sandstone and texture contrast soils on slopes. Heavy grey clay on alluvial flats. Vegetation: Brigalow, belah, whitewood, wilga, budda and poplar box on basalt hills. Silver-leaved ironbark, spotted gum and smooth-barked apple on stony hills. River red gum, belah, myall and poplar box on basalt flats. Silver-leaved ironbark and white cypress pine in sandstone rocks, smooth-barked apple, white cypress, Blakely's red gum, Moreton Bay ash, poplar box, wilga, rough-barked apple, bull oak, on lower sandstone slopes. White box, with silver-leaved ironbark, white wood, bull oak and brigalow on alluvial clays. River red gum on all streams.	Most of N2MS1
Northern Outwash subregion Geology: Tertiary and Quaternary alluvial fans and stream terraces. Landform: Sloping plains with alluvial fans that are coarser and steeper than the Gwydir Fans downstream. Soils: Red loams and heavy brown clays. Vegetation: Poplar box with white cypress pine, wilga and budda on red soils, belah and brigalow on brown clays.	Northern end of N2MS1. All of Segments N2MS2- N2MS5.

NSW Landscape Regions (Mitchell Landscapes)

The study area crosses three NSW Landscape Regions, the characteristics of which are described in Table 3.3 and shown on Figure 3.1.

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

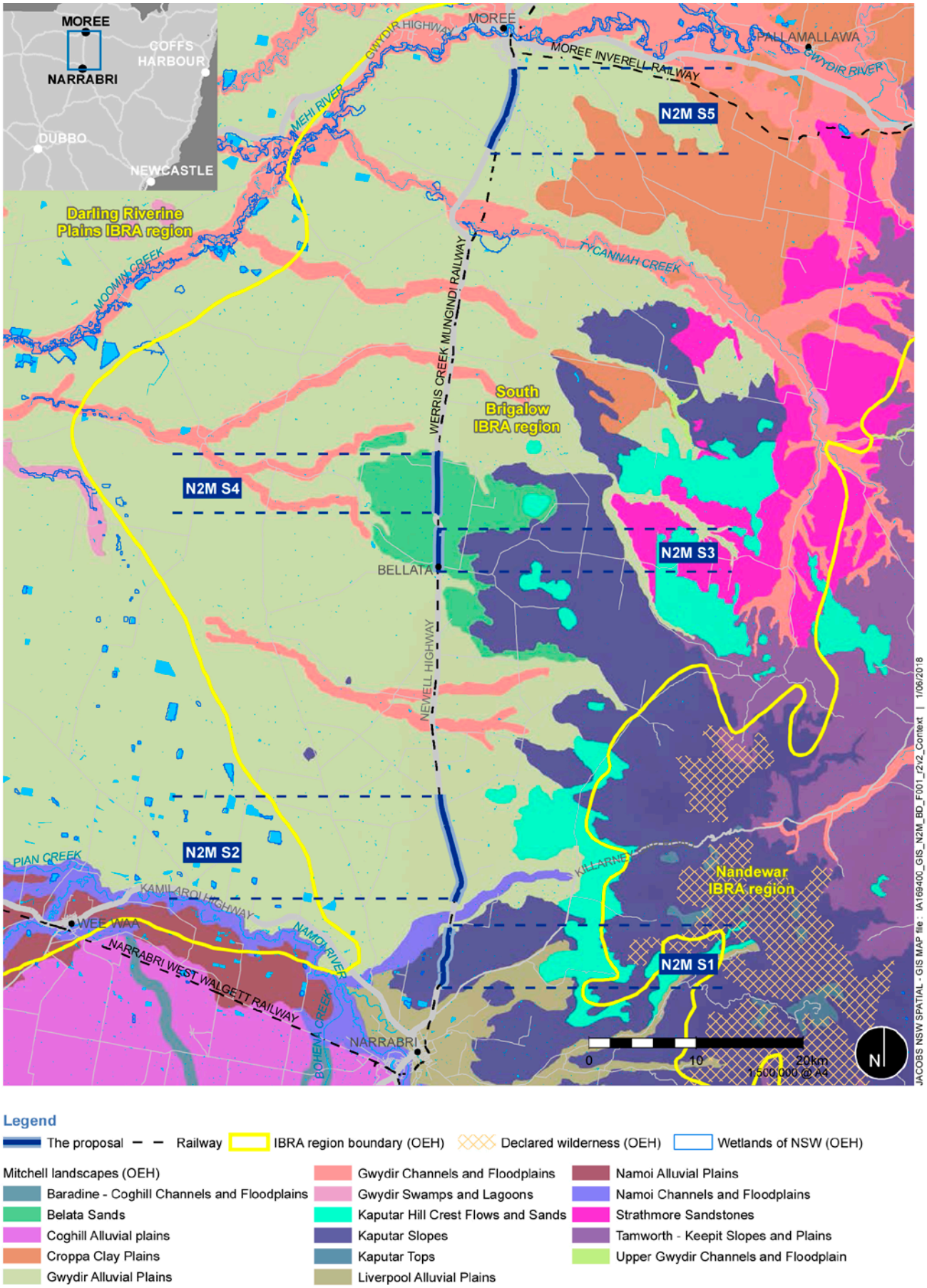
NSW Landscape Regions	Segments where landscape occurs
Kaputar Slopes Landform and geology: Lower slopes of the Kaputar volcanic complex with radiating finger-like ridges capped by basalt over lower Permian and Triassic quartz sandstone, lithic sandstone, silty sandstone, conglomerate and thin coal measures. General elevation 300 to 500m, local relief 80m. Soils: Shallow stony red-brown loam and clay loam in uniform profiles on basalt, yellow and yellow-brown texture-contrast profile on sandstone, deep black earths in lowest valleys. Vegetation Kurrajong (*Brachychiton populneus*), yellow box (*Eucalyptus melliodora*), white box (*Eucalyptus albens*), rough-barked apple (*Angophora floribunda*) and Blakely's red gum (*Eucalyptus blakelyi*) on lower slopes and valleys.	This landscape is mapped in most of N2MS1. However, the landform, soil and vegetation (e.g. presence of *Callitris glaucophylla*, *E. populnea*, and *E. pilligaensis*) in
Gwydir Alluvial Plains Landform and geology: Holocene fluvial sediments of backplain and channelised backplain facies on the Gwydir River fan, relief 2 to 5m. Soils: Grey and brown silty clay deposited from suspended sediments in floodwater, often with gilgai. Elevated margins with red-brown texture-contrast soils. Vegetation: Open to scattered myall (*Acacia pendula*), rosewood (*Alectryon oleifolius*), coolibah (*Eucalyptus microtheca*), belah (*Casuarina cristata*), wilga (*Geijera parviflora*), bimble box (*Eucalyptus populnea*), whitewood (*Atalaya hemiglauca*), leopardwood (*Flindersia maculosa*), gidgee (*Acacia cambagei*), thorny saltbush (*Rhagodia spinescens*), Mueller's saltbush (*Atriplex muelleri*), wild orange (*Capparis mitchellii*), buck bush (*Salsola kali*), warrior bush (*Apophyllum anomalum*), budda (*Eremophila mitchellii*), nepine (*Capparis lasiantha*), Mitchell grasses (*Astrebla* spp.), neverfail (*Eragrostis setifolia*), goathead burr (*Sclerolaena bicornis*), copperburr (*Sclerolaena* sp.), and Warrego summer-grass (*Paspalidium jubiflorum*), on lower clay plains and drainage lines. Coolibah, black box (*Eucalyptus largiflorens*), river cooba (*Acacia stenophylla*), eurah (*Eremophila bignoniflora*), and flowering lignum (*Eremophila polyclada*) in depressions and channels. Dense to moderate white cypress pine (*Callitris glaucophylla*), bimble box, leopardwood, belah (*Casuarina* cristata), wilga, sandplain wattle (*Acacia murrayana*), prickly wattle (Acacia victoriae), budda, quinine bush (*Alstonia constricta*), sandhill riceflower (*Pimelea penicillaris*) and grasses on sandy rises. Extensively cleared, cropped and grazed.	North end of N2MS1, N2MS2, south end of N2MS3, north end of N2MS4 and N2MS5.
Bellata Sands Landform and geology: Westward sloping plains and downs with ephemeral creek channels. General elevation 220 to 260m, local relief <10m. Soils: Tertiary poorly cemented gravels, sand and clay. Redbrown to red-yellow earths uniform or gradational profiles. Vegetation: Belah (*Casuarina cristata*) woodlands with grasses and patches of bimble box (*Eucalyptus populnea*).	The bulk of N2MS3 and N2MS4.

3.1.2 Local soil data

Soil data from samples taken 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 types 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	N2MS1	N2MS2	N2MS3	N2MS4	N2MS5
Black Earth (Black Vertosol) Texture: light medium clay Cracking: nil Parent Material: light medium clay at 0.82m	-	Yes	Yes	-	-
Brown Clay Texture: clay loam Cracking: evident (width <5 mm) Parent Material: residual, sandstone, Tertiary beds	Yes	Yes	-	-	-
Brown Clay Texture: heavy clay Cracking: evident (width <5 mm) Parent Material: second terraced fan	-	Yes	-	-	-
Brown Clay Texture: light medium clay Cracking: evident (width <5 mm) Parent Material: alluvial sediment, mixed texture, non-calcareous, second terraced fan	-	Yes	-	-	-
Dark brown loam Texture: light clay Cracking: nil Parent Material: medium heavy clay at 1.36m	-	-	-	Yes	-
Dark reddish brown clay Texture: light clay Cracking: nil Parent Material: not reported	-	-	-	Yes	-
Grey Clay Texture: silty clay loam Cracking: evident (width <5 mm) Parent Material: alluvial sediment, sand, second terraced fan	-	Yes	-	-	-
Grey Clay (Grey Vertosol) Texture: medium to medium-heavy clay Cracking: +/- cracking when described, expected to be self-mulched when dry Parent Material: alluvial sediment, clay, from sandstone, clay and basalt	Yes	Yes	Yes	Yes	Yes
Red-brown Earth Texture: coarse clay loam sandy Cracking: nil Parent Material: conglomerate, sandstone lithic, sedimentary	Yes	-	-	Yes	-
Yellow Earth Texture: sandy clay Cracking: nil Parent Material: gravelly medium clay at 1.5m	-	-	-	Yes	-



Legend

The proposal — Railway — IBRA region boundary (OEH) — Declared wilderness (OEH) — Wetlands of NSW (OEH)

Mitchell landscapes (OEH)

- Baradine - Coghill Channels and Floodplains
- Belata Sands
- Coghill Alluvial plains
- Croppa Clay Plains
- Gwydir Alluvial Plains
- Gwydir Channels and Floodplains
- Gwydir Swamps and Lagoons
- Kaputar Hill Crest Flows and Sands
- Kaputar Slopes
- Kaputar Tops
- Liverpool Alluvial Plains
- Namoi Alluvial Plains
- Namoi Channels and Floodplains
- Strathmore Sandstones
- Tamworth - Keepit Slopes and Plains
- Upper Gwydir Channels and Floodplain

Figure 3.1 Environmental context

3.2 Plant community types

The identified distribution and identity of plant community types (PCTs) in this report differs substantially from that shown in the pre-existing vegetation mapping.

While pre-existing vegetation mapping correctly identified that *Poplar Box - Belah woodland* (PCT 56) is widespread in the study area, it did not show the complexity of vegetation present, including the presence of:

- Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT 445) in the vicinity of Brigalow Lane in N2MS4
- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (PCT 147) in N2MS4
- Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (PCT 52) located on the clay plains at the north end of N2MS1 and throughout N2MS5
- Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55), present in small areas of N2MS1 but mostly in N2MS4.
- Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397) characterised by abundant White Cypress Pine (*Callitris glaucophylla)* and different understorey composition, found on the sandier soils and more elevated landscape in N2MS1.
- Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (PCT 628); this vegetation was classified in the PEI as River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion (PCT 78) but the floristic composition of the vegetation on the site does not match that PCT. While the vegetation on site contains Eucalyptus camaldulensis (River Red Gum), it does not contain any of the other tree species associated with PCT 78. The vegetation on site contains three of the tree species associated with PCT 628 (including Eucalyptus camaldulensis, E. coolabah and E. populnea) and has middle and ground strata more consistent with that PCT. Although *Corymbia tessellaris* (Carbeen) was not recorded in the study area, it was seen in adjacent lands. The vegetation containing Eucalyptus camaldulensis recorded along small waterways has therefore been interpreted as representative of small scale variation within an area of PCT 628 due to slightly different environmental conditions along these waterways.

The PCTs identified within the survey area are shown in Figure 3-2.

Table 3-5 Plant community types

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) in proposal area
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – BC Act) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered – EPBC Act).	0.98
	Moderate to Poor (Derived Grassland)		0.22
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered – BC Act) Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered – EPBC Act).	0.66
	Moderate to Poor (Derived Grassland)	No (See note 1)	0.53
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act)	2.98
	Moderate to Poor (Derived Grassland)		0.04
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)	Moderate to Good (Relatively Intact)	Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – BC Act) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered – EPBC Act)	0.08
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No (But There is a preliminary listing of Endangered for this community under the EPBC Act).	3.64
	Moderate to Poor (Derived Grassland)		1.05
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No (But There is a preliminary listing of Endangered which may include this community under the EPBC Act).	8.21
	Moderate to Poor (Derived Grassland)		5.35

Plant community type (PCT)	Condition class	Threatened ecological community?	Area (ha) in proposal area
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered – EPBC Act)	11.31
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered – BC Act) Weeping Myall Woodlands (Endangered – EPBC Act)	3.17
	Moderate to Poor (Derived Grassland)	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered – BC Act) Derive grasslands do not meet EPBC Act condition thresholds.	11.06
Total			49.28 ha

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

Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (PCT 55)

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

Vegetation class: North-west Floodplain Woodlands

PCT: 55

Conservation status: Not listed as threatened in general but parts of the PCT are consistent with a number of threatened ecological communities which occur as small patches within broader areas of this PCT. This situation exists in the study area where this community forms a fine-scaled mosaic of areas dominated by exclusively by Belah (*Casuarina cristata*) and areas dominated by mesic trees, shrubs and vines. Moderate to Good condition areas dominated by mesic trees, shrubs and vines are consistent with the *Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions* endangered ecological community listed under the BC Act and the *Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions* listed under the EPBC Act.

Estimate of percent cleared: 83%

Condition: Moderate to Good (relatively intact canopy areas), Poor (derived grassland).

Plots completed in vegetation zone: P03, P10

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	8 (3-11)	40 (15-65)	*Casuarina cristata*
Small trees	4 (2-6)	20 (5-40)	*Alectryon oleifolius* *Capparis mitchellii* *Geijera parviflora*
Shrubs	2 (1-3)	15 (5-30)	*Myoporum montanum* *Notelaea microcarpa* *Pimelea pauciflora* **Lycium ferocissimum* **Opuntia aurantiaca*
Ground covers	0.4 (0.1-1)	40 (20-65)	*Abutilon oxycarpum* *Austrostipa scabra* *Enchylaena tomentosa* *Eremophila debilis* *Homopholis belsonii* *Rytidosperma bipartita* *Sclerolaena birchii* *Tetragonia moorei* **Heliotropium amplexicaule* **Megathyrsus maximus*
Vines & climbers	3 (0.5-70	2 (1-10)	*Jasminum lineare* *Capparis lasiantha*

BioNet Vegetation Classification Description

Tall woodland of about 12 m high, dominated by Belah (*Casuarina cristata*). Other tree species include Black Box (*E. largiflorens*) and Coolabah (*E. coolabah*) in depressions and on higher ground Western Grey Box (*Eucalyptus microcarpa*) and Poplar Box (*E. populnea subsp. bimbil*). Weeping Myall (*Acacia pendula*) may be present as an associate but not as a dominant species.

Tall shrubs include Wilga (*Geijera parviflora*), Western Rosewood (*Alectryon oleifolius*), Budda (*Eremophila mitchellii*), Warrior Bush (*Apophyllum anomalum*), Wild Orange (*Capparis mitchellii*) and Supplejack (*Ventilago viminalis*). Shrubs include Western Boobialla (*Myoporum montanum*), Thorny Rhagodia (*Rhagodia spinescens*), *Maireana enchylaenoides*, Spotted Fuchsia Bush (*Eremophila maculata*) and *Eremophila deserti*. Lignum (*Muehlenbeckia florulenta*) may be present in frequently flooded areas.

Ground cover includes the low shrubs such as Ruby Saltbush (Enchylaena tomentosa), many species of copperburrs including Galvanized Burr (Sclerolaena birchii), Sclerolaena divaricata, grasses such as Curly Windmill Grass (Enteropogon acicularis), wallaby grasses including Monachather paradoxus and Austrodanthonia setacea, Austrostipa scabra, Austrodanthonia fulva, Austrostipa aristiglumis, Austrostipa verticillata, Aristida leptopoda, Paspalidium gracile, Sporobolus caroli and Panicum queenslandicum.

Forbs include Einadia nutans, Oxalis chnoodes, Vittadinia cuneifolia, Boerhavia dominii, Goodenia fascicularis and Solanum esuriale. Sedges such as Eleocharis pallens, rushes such as Juncus radula and Nardoo (Marsilea drummondii) occur in depressions. Common weed species include Rapistrum rugosum, Carthamus lanatus and Medicago polymorpha.

Occurs on alluvial brown or grey clay soils on floodplains and alluvial plains and on black loam soils derived from basalt. Often lines intermittent drainage lines or on flats. Distributed in the northern and central wheatbelt of NSW mainly in the Darling Riverine Plains and Brigalow Belt South Bioregions but extending south into the NSW South-western Slopes Bioregion. Mostly cleared and an endangered community.

Photograph 2: Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (PCT 55)

Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT 445)

Vegetation formation: Rainforests

Vegetation class: Western Vine Thickets

PCT: 445

Conservation status:

- Moderate to Good areas are part of Brigalow within the Brigalow Belt South, Nandewar and *Darling Riverine Plains* Bioregions BC Act listed endangered ecological community.
- Moderate to Good areas are part of *Brigalow (Acacia harpophylla dominant and co-dominant)* EPBC Act listed endangered ecological community.

Estimate of percent cleared: 90%

Condition: Moderate to Good (relatively intact canopy areas), Poor (derived grassland).

Plots completed in vegetation zone: P12, P17

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	10 (8-17)	35 (15-70)	*Acacia harpophylla* *Casuarina cristata* *Eucalyptus populnea* (on periphery)
Small trees	5 (2-6)	15 (5-40)	*Acacia harpophylla* *Alectryon oleifolius* *Eremophila mitchellii* *Geijera parviflora*
Shrubs	1.5 (1-3)	10 (5-20)	*Myoporum montanum* *Rhagodia spinescens* *Santalum acuminatum* *Solanum ferocissimum* **Lycium ferocissimum*
Ground covers	0.5 (0.1-1)	15 (10-25)	*Abutilon oxycarpum* *Austrostipa scabra* *Austrostipa verticillata* *Brunoniella australis* *Einadia nutans* *Enchylaena tomentosa* *Eremophila debilis* *Homopholis belsonii* *Rytidosperma bipartita* *Tetragonia moorei* **Cenchrus ciliaris*
Vines & climbers	4 (0.5-8)	10 (5-25)	*Jasminum suavissimum* *Parsonsia eucalyptoides* *Capparis lasiantha* *Marsdenia viridiflora*

BioNet Vegetation Classification Description:

Very tall mid-dense to dense open forest or very tall shrubland dominated by Brigalow (*Acacia harpophylla*) with other trees including Belah (*Casuarina cristata*), *Eucalyptus melanophloia* or *Eucalyptus populnea subsp. bimbil*.

The shrub layer may be mid-dense to sparse and contains semi-evergreen vine thicket shrub species such as *Notelaea microcarpa var. microcarpa*, *Carissa ovata, Spartothamnella juncea, Jasminum lineare, Breynia cernua, Psydrax odorata, Santalum acuminatum and Croton phebalioides*. Other common shrubs include *Pimelea neo-anglica, Myoporum montanum,*

Dodonaea sinuolata subsp. sinuolata, Rhagodia spinescens, Enchylaena tomentosa and Capparis mitchellii.

Vines include *Parsonsia eucalyptophylla, Clematis microphylla var. leptophylla* and *Marsdenia viridiflora*.

The ground cover is usually sparse or very sparse with substantial areas of bare earth. Grass species include *Austrostipa scabra, Austrostipa verticillata, Austrodanthonia (Rytidosperma) bipartita* and *Aristida personata*.

Forb species include *Einadia nutans subsp. linifolia, Einadia hastata, Brunoniella australis, Eremophila debilis, Chenopodium pumilio, Einadia polygonoides, Sida corrugata, Oxalis perennans* and *Goodenia hederacea*.

Sedges include *Cyperus gracilis* and *Gahnia aspera*. Occurs on red to brown loam to light clay soils on plains or footslopes in low hills and hills landform patterns in the Terry Hie Hie, Bingara and North Star regions of the Brigalow Belt South Bioregion.

Grades into dry scrub or semi-evergreen vine thicket on hills. Grades into the more widespread ID35 Brigalow open forest on heavy clay soils on alluvial plains to the west. Mostly cleared and highly threatened. Part of the NSW BC Act Brigalow EEC.

Photograph 3: Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (PCT 445)

Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (PCT 628)

Vegetation formation: Grassy Woodlands

Vegetation class: Floodplain Transition Woodlands

PCT: 628

Conservation status:

- Moderate to Good areas are part of *Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions* BC Act listed endangered ecological community.
- The community is not EPBC Act listed endangered ecological community.

Estimate of percent cleared: 90%

Condition: Moderate (relatively intact canopy areas), Poor (derived grassland).

Plots completed in vegetation zone: P08, P09

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	16 (8-20)	20 (15-25)	*Eucalyptus camaldulensis* *Eucalyptus coolabah* (on periphery) *Acacia salicina*
Small trees	5 (4-6)	5 (1-10)	*Geijera parviflora* *Melia azedarach*
Shrubs	1.5 (1-2)	0.5 (0.2-1)	*Pittosporum angustifolium* *Notelaea microcarpa* **Sida rhombifolia*
Ground covers	0.5 (0.1-1)	3 (0.5-6)	*Austrostipa verticillata* *Cynodon dactylon* *Einadia nutans* *Eriochloa crebra* *Paspalidium jubiflorum* *Urtica incisa* **Bidens pilosa* **Megathyrsus maximus* **Sorghum halepense*
Vines & climbers	1.5 (1-4)	1 (0.5-2)	*Clematis microphylla*

Note: Exotic species are excluded from height and cover values.

BioNet Vegetation Classification Description:

Mid-high to tall open woodland or woodland dominated by Carbeen (Corymbia tessellaris) often with Coolabah (Eucalyptus coolabah subsp. coolabah), River Red Gum (Eucalyptus camaldulensis subsp. camaldulensis), Poplar Box (Eucalyptus populnea subsp. bimbil) or Weeping Myall (Acacia pendula).

Shrubs are absent or very sparse and include Geijera parviflora, Acacia salicina, Sclerolaena muricata var. muricata and Enchylaena tomentosa.

The ground cover may be dense after flooding or rain but is usually mid-dense to sparse. Species include Enteropogon acicularis, Panicum decompositum, Eriochloa crebra, Einadia nutans subsp. nutans and Chloris truncata. Occurs on brown or grey clay loam to loam soils on slightly elevated parts of floodplains in the Moree - Wee Waa and Walgett regions mainly in the Darling Riverine Plains Bioregion.

Highly restricted, occurring in small patches and mostly cleared. Grades into Coolabah grassy woodland (ID40) on heavy clay soils and into Poplar Box grassy woodland (ID244) on sandy loam soils. Differs in species composition from Carbeen woodland on sand rises (prior streams) near the Queensland border or Carbeen - cypress pine woodland on sandstone in forests near Narrabri.

Photograph 4: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)

Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)

Vegetation formation: Rainforests

Vegetation class: Western Vine Thickets

PCT: 147

Conservation status:

- Moderate to Good areas are part of *Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions* BC Act listed endangered ecological community.
- Moderate to Good areas are part of *Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions* EPBC Act listed endangered ecological community.

Estimate of percent cleared: 83%

Condition: Moderate to Good (relatively intact canopy areas), Poor (derived grassland).

Plots completed in vegetation zone: P16

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	10 (8-14)	1 (0-10)	*Casuarina cristata* *Eucalyptus populnea*
Small trees	5 (3-8)	33 (30-60)	*Atalaya hemiglauca* *Geijera parviflora* *Ehretia membranifolia* *Ventilago viminalis*
Shrubs	2 (1-3)	15 (5-25)	*Abutilon oxycarpum* *Carissa ovata* *Notelaea microcarpa* *Rhagodia spinescens* *Solanum ferocissimum* **Lycium ferocissimum*
Ground covers	0.4 (0.1-1)	10 (5-25)	*Austrostipa scabra* *Austrostipa verticillata* *Brunoniella australis* *Enchylaena tomentosa* *Plectranthus parviflorus* *Rytidosperma bipartita* *Tetragonia moorei* **Glandularia aristigera*
Vines & climbers	3 (0.5-8)	8 (5-25)	*Capparis lasiantha* *Jasminum suavissimum*

BioNet Vegetation Classification Description:

Mid-high to low closed or open forest known as "semi-evergreen vine thicket" dominated by rich diversity of low trees and shrubs to about 6 m high. Low tress includes Mock Olive (*Notelaea microcarpa var. microcarpa*), Wilga (*Geijera parviflora*), Peach Bush (*Ehretia membranifolia*) along with *Elaeodendron australe var. integrifolia*, *Ventilago viminalis, Psydrax oleifolia, Alectryon subdentatus* and *Alstonia constricta*. Some tree species are facultatively deciduous. Emergent trees to 15 m high are often present including White Box (*Eucalyptus albens*), Silver-leaved Ironbark (*Eucalyptus melanophloia*), White Cypress Pine (*Callitris glaucophylla*) and Belah (*Casuarina cristata*).

The shrubs layer may be mid-dense or dense and includes *Carissa ovata, Beyeria viscosa, Spartothamnella juncea, Solanum parvifolium, Rhagodia parabolica, Olearia elliptica, Senna coronilloides, Indigofera adesmiifolia, Indigofera brevidens, Breynia cernua, Solanum semiarmatum, Cassinia laevis, Myoporum montanum, Capparis lasiantha, Pimelea neo-anglica* and *Phyllanthus subcrenulatus*.

Vines are common and include Wonga Vine (*Pandorea pandorana*), *Parsonsia eucalyptophylla, Clematis microphylla var. microphylla, Cayratia clematidea* and *Jasminum lineare*.

Mistletoes include *Lysiana exocarpi, Lysiana subfalcata* and *Amyema miraculosum*.

The ground cover is mid-dense in open areas or sparse under dense tree or shrub canopies. Common grass species include *Austrostipa verticillata, Leptochloa asthenes, Poa sieberiana* var*. hirtilli, Elymus scaber Panicum queenslandicum var. queenslandicum, Chloris ventricosa, Austrodanthonia bipartita, Paspalidium gracile* and *Cymbopogon refractus*.

The sub-shrub *Desmodium brachypodum* is often abundant. Forbs include *Boerhavia dominii* and *Dichondra sp. A.* Sedges such as *Carex inversa* may be present along with the rock fern *Cheilanthes sieberi subsp. sieberi*.

Occurs on dark chocolate brown to black loam soils on basalt hills or flats on the North Western Slopes of NSW mainly in the Brigalow Belt South Bioregion. This is a "dry" rainforest type adapted to low rainfall areas west of the Great Dividing Range. The Yetman to Blue Knobby region originally contained most of the largest patches on basalt hills that have mostly been cleared and cropped. Remnants also occur further south on hills above the Liverpool Plains near Gunnedah and near Bingara and on alluvial flats east of Narrabri. Grades into White Box shrubby woodland and shrubby Belah woodland.

Photograph 5: Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (PCT 147)

Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)

Vegetation formation: Grassy Woodlands

Vegetation class: Floodplain Transition Woodlands

PCT: 56

Conservation status:

- Moderate to Good areas, subject to patch size and condition criteria, would be part of the *Poplar Box Grassy Woodland on Alluvial Plains* community which, according to the draft conservation and listing advice from the EPBC Act scientific committee, merits listing as Endangered under the EPBC Act.
- Not listed under the BC Act nor the subject of a preliminary determination.

Estimate of percent cleared: 78%

Condition: Moderate to Good (relatively intact canopy areas), Poor (derived grassland).

Plots completed in vegetation zone: P11, P14, P15

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	11 (7-14)	30 (20-35)	*Casuarina cristata* *Eucalyptus populnea*
Small trees	5 (4-10)	15 (5-25)	*Alectryon oleifolius* *Eremophila mitchelli* *Geijera parviflora*
Shrubs	2 (1-3)	10 (5-25)	*Abutilon oxycarpum* *Rhagodia spinescens* *Solanum ferocissimum* *Santalum lanceolatum* *Pittosporum angustifolium* **Lycium ferocissimum*
Ground covers	0.4 (0.1-1)	10 (5-25)	*Austrostipa scabra* *Austrostipa verticillata* *Brunoniella australis* *Enchylaena tomentosa* *Einadia nutans* *Chloris truncata* *Rytidosperma bipartita* *Maireana coronata* *Tetragonia moorei* **Glandularia aristigera* **Cenchrus ciliaris*
Vines & climbers	3 (0.5-8)	8 (5-25)	*Capparis lasiantha* *Jasminum suavissimum* *Parsonsia eucalyptoides*

BioNet Vegetation Classification Description:

Tall to mid-high woodland dominated by Poplar Box (*Eucalyptus populnea subsp. bimbil*) and Belah (*Casuarina cristata*) commonly with the small tree Western Rosewood (*Alectryon oleifolius*).

Tall shrubs are sparse and include Wilga (*Geijera parviflora*), Warrior Bush (*Apophyllum anomalum*), *Capparis spp., Citrus glauca* and Thorny Rhagodia (*Rhagodia spinescens*). Low shrubs include Galvanized Burr (*Sclerolaena birchii*), Black Roly Poly (*Sclerolaena muricata*), other copperburs, *Maireana coronata, Maireana decalvans* and *Enchylaena tomentosa*.

The ground cover is sparse during dry times but mid-dense after rain and includes grasses such as *Chloris truncata, Enteropogon acicularis* and *Austrostipa scabra subsp. scabra*. Forb

species include *Einadia nutans subsp. nutans, Oxalis chnoodes, Bulbine alata, Erodium crinitum, Wahlenbergia fluminalis* and *Brachyscome heterodonta*.

Generally occurring on pink to brown loamy sand or light clay in the transition zone between the floodplain and the peneplain in the central and northern plains of the NSW wheatbelt in the temperate (no dry season - hot summer) and dry subtropical climate zones with annual precipitation between 300 and 550 mm. As of 2008, more than half of this community had been cleared. On-going threats include clearing, weed invasion and lack of recruitment of some species due to grazing pressure.

Photograph 6: Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)

Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)

Vegetation formation: Grassy Woodlands

Vegetation class: Floodplain Transition Woodlands

PCT: 397

Conservation status:

- Moderate to Good areas, subject to patch size and condition criteria, would be part of the *Poplar Box Grassy Woodland on Alluvial Plains* community which, according to the draft conservation and listing advice from the EPBC Act scientific committee, merits listing as Endangered under the EPBC Act.
- Not listed under the BC Act nor the subject of a preliminary determination.

Estimate of percent cleared: 45%

Condition: Moderate to Good (relatively intact canopy areas), Poor (derived grassland).

Plots completed in vegetation zone: P02, P04,

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	12 (8-14)	35 (15-45)	*Callitris glaucophylla* *Casuarina cristata* *Eucalyptus melanophloia* *Eucalyptus pilligaensis* *Eucalyptus populnea*
Small trees	5 (1-10)	5 (1-10)	*Alectryon oleifolius* *Eremophila mitchelli* *Geijera parviflora*
Shrubs	2 (1-3)	15 (5-25)	*Acacia deanei* *Dodonaea viscosa* *Senna artemisioides subsp. zygophylla* *Pittosporum angustifolium* **Lycium ferocissimum*
Ground covers	0.4 (0.1-1)	45 (25-65)	*Austrostipa scabra* *Austrostipa verticillata* *Brunoniella australis* *Carex inversa* *Cheilanthes sieberi* *Chloris truncata* *Einadia nutans* *Enchylaena tomentosa* *Evolvulus alsinoides* *Glycine tabacina* *Goodenia cycloptera* *Oxalis perennans* *Sida corrugata* *Solanum esuriale* **Glandularia aristigera* **Gomphrena celosioides* **Melinus repens*
Vines & climbers	1 (0.5-3)	1 (0-5)	*Jasminum suavissimum*

BioNet Vegetation Classification Description:

Tall woodland dominated by Poplar Box (*Eucalyptus populnea subsp. bimbil*) and White Cypress Pine (*Callitris glaucophylla*) with other trees including Buloke (*Allocasuarina*

luehmannii), Silver-leaved Ironbark (*Eucalyptus melanophloia*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Whitewood (*Atalaya hemiglauca*) and Pilliga Box (*Eucalyptus pilligaensis*).

The shrub layer is sparse to mid-dense but may be dense in places. Shrub species include *Geijera parviflora, Notelaea microcarpa, Acacia ixiophylla, Dodonaea viscosa subsp. spatulata, Maireana microphylla, Myoporum montanum, Psydrax odorata, Santalum acuminatum, Capparis mitchellii, Hakea tephrosperma, Alectryon oleifolius subsp. elongatus, Ventilago viminalis, Acacia oswaldii, Maytenus cunninghamii* and *Eremophila longifolia*.

The ground cover is sparse and dominated by grasses such as *Austrostipa scabra subsp. scabra, Panicum queenslandicum, Aristida ramosa, Enteropogon acicularis, Eragrostis lacunaria and Austrodanthonia bipartita*. Grey Copperburr (*Sclerolaena diacantha*) may be present.

Forb species include *Chenopodium desertorum subsp. microphyllum, Calotis cuneifolia, Einadia hastata, Dianella revoluta var. revoluta, Vittadinia cuneata, Vittadinia sulcata, Oxalis perennans, Calotis lappulacea, Solanum tetrathecum, Boerhavia dominii, Goodenia cycloptera, Scleria mackaviensis, Sida corrugata* and the twiner Evolvulus alsinoides var. decumbens.

Occurs on brown sandy loam soils on outwash plains mainly on the western edge of the Pilliga forests and to north of Warialda. Well sampled in West Pilliga reserves. Grades into similar but more grassy Poplar Box woodland ID244 on heavier soils on alluvial plains mainly in the Darling Riverine Plains Bioregion. Occurs on grey to brown sandy loam to clay loam soils on plains on stagnant alluvial plains and peneplain landforms in the west Pilliga region and to the north in the Brigalow Belt South bioregion. Partly cleared and logged for Callitris but large areas remain in the Pilliga forests. Grades into grassy Poplar Box woodland on clay loam soils in the wheatbelt (ID244) to the west and north of the Pilliga Scrub and into Narrow-leaved Ironbark and Pilliga Box forests in the Pilliga.

Photograph 7: Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)

Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (PCT 52)

Vegetation formation: Grasslands

Vegetation class: Semi-arid Floodplain Grasslands

PCT: 52

Conservation status:

- Moderate to Good areas are part of Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland EPBC Act listed critically endangered ecological community.

Estimate of percent cleared: 70%

Condition: Moderate to Good (relatively areas), Poor (derived grassland).

Plots completed in vegetation zone: P20, P21

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	7 (6 -10)	<1 (0-5)	*Eucalyptus populnea*
Small trees	4 (2-6)	<1 (0-5)	*Acacia stenophylla*
Shrubs	1 (1-1.5)	10 (5-20)	*Vachellia farnesiana*
Ground covers	0.5 (0.1-1)	65 (50-80)	*Anthosachne (Elymus) plurinervis,* *Aristida leptopoda* *Astrebla elymoides* *Astrebla lappacea* *Austrostipa aristiglumis* *Bothriochloa biloba* *Bothriochloa bladhii* *Carex inversa* *Chamaesyce drummondii* *Chloris truncata* *Cullen tenax* *Desmodium campylocaulon* *Dichanthium sericeum* *Digitaria divaricatissima* *Digitaria porrecta* *Eriochloa crebra* *Homopholis belsonii* *Leiocarpa panaetioides* *Neptunia gracilis* *Panicum decompositum* *Rhynchosia minima* *Solanum esuriale* *Vachellia farnesiana* *Vittadinia pterochaeta* **Cenchrus ciliaris* **Chloris gayana* **Eragrostis curvula* **Glandularia aristigera* **Gomphrena celosioides*
Vines & climbers	-	-	none

BioNet Vegetation Classification Description:

Mixed tussock grassland dominated by Queensland Bluegrass (*Dichanthium sericeum*), Cup Grass (*Eriochloa crebra*), Windmill Grass (Chloris truncata) and after summer rains Mitchell Grass (*Astrebla elymoides, A squarrosa* or *A. pectinata*). Other common grass species include Native Millet (*Panicum decompositum*), *Aristida leptopoda, Digitaria divaricatissima*, Curly Windmill Grass (*Enteropogon acicularis*) and *Sporobolus* spp., *Monachather paradoxus* and *Austrostipa aristiglumis*. Forbs include *Solanum esuriale, Oxalis chnoodes, Hibiscus trionum, Alternanthera denticulata, Leiocarpa brevicompta, Pycnosorus globosus, Vittadinia pterochaeta, Plantago debilis* and *Einadia polygonoides*.

A sparse shrub cover may be present including the tall shrub *Vachellia (Acacia) farnesiana* and the low shrubs Roly Poly (*Sclerolaena muricata* sens lat.), Galvanized Burr (*Sclerolaena birchii*) and *Maireana decalvans*. Sedges include *Cyperus bifax, Carex inversa* and *Eleocharis plana*. The aquatic fern Nardoo (*Marsilea drummondii*) is common.

Occurs on grey cracking clay, brown clay, or black earth soils. Distributed on periodically flooded floodplains of major rivers including the Barwon and Gwydir Rivers extending into Queensland. Occurs mainly on alluvial grey clays on alluvial plains in the eastern section of the Darling Riverine Plains Bioregion and western section of the Brigalow Belt South Bioregion including south of Yetman. Small patches occur as far south as Warren on the Bogan and Macquarie River floodplains. Large areas would have occurred around Moree but they have mostly been cleared and cropped. This community has affinities to grasslands further west including Mitchell Grasslands on the Darling and Culgoa River floodplains (ID43). It also grades into a Windmill Grass-dominated grassland on brown clay (ID49).

Photograph 8: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)

Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (PCT 27)

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

Vegetation class: Riverine Plain Woodlands

PCT: 27

Conservation status:

- Moderate to Good areas are part of Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions BC Act listed endangered ecological community.
- Moderate to Good areas, subject to patch size and condition, are part of Weeping Myall Woodlands EPBC Act listed endangered ecological community.

Estimate of percent cleared: 86%

Condition: Moderate to Good (relatively areas), Poor (derived grassland).

Plots completed in vegetation zone: P06, P07

Structure	Average height and height range (m)	Average cover and cover range	Typical species
Trees	5 (4 -9)	15 (0-35)	*Acacia pendula* *Casuarina cristata*
Small trees	3 (2-4)	-	*Acacia pendula* *Geijera parviflora*
Shrubs	1.5 (1-2)	10 (0-15)	*Acacia pendula* *Myoporum montanum* *Notelaea microcarpa* *Pittosporum angustifolium* **Lycium ferocissimum*
Ground covers	0.5 (0.1-1)	45 (40-65	*Einadia nutans* *Eremophila debilis* *Enchylaena tomentosa* *Cynodon dactylon* *Boerhavia dominii* *Tribulus micrococcus* *Aristida leptopoda* *Austrostipa aristiglumis* *Carex inversa* *Dichanthium sericeum* *Digitaria porrecta* *Eriochloa pseudoacrotricha* *Chloris truncata* *Neptunia gracilis* *Panicum decompositum* *Solanum esuriale* **Eragrostis curvula* **Glandularia aristigera* **Gomphrena celosioides*
Vines & climbers	-	-	none

BioNet Vegetation Classification Description:

Mid-high and low woodland to open woodland to about 10 m high dominated by Drooping Myall (*Acacia pendula*) often with Belah (*Casuarina cristata*) and Wild Orange (*Capparis mitchellii*). Poplar Box (*Eucalyptus populnea subsp. bimbil*), Western Rosewood (*Alectryon oleifolius*), Whitewood (*Atalaya hemiglauca*) or Black Box (*Eucalyptus largiflorens*) may also occur.

Shrubs are sparse and include Wilga (*Geijera parviflora*), *Rhagodia spinescens*, *Capparis lasiantha, Acacia oswaldii, Acacia salicina, Myoporum montanum* and *Pimelea neo-anglica*. Small shrubs include species of copperburrs including *Sclerolaena brachyptera*, *Sclerolaena muricata var. muricata* and *Sclerolaena stelligera*. Other small shrubs include *Maireana aphylla, Atriplex stipitata, Leiocarpa panaetioides* and *Enchylaena tomentosa*.

The ground cover may be dense after rain but normally is mid-dense to sparse. It contains many species of grasses and forbs. Forbs include *Einadia nutans subsp. nutans*, *Leiocarpa tomentosa, Marsilea hirsuta, Solanum esuriale, Daucus glochidiatus, Goodenia fascicularis, Oxalis perennans, Eryngium paludosum* and *Craspedia variabilis*. The most common grass species are *Monachather paradoxus, Chloris truncata, Enteropogon acicularis, Astrebla lappacea, Astrebla pectinata, Walwhalleya proluta*, *Dichanthium sericeum subsp. sericeum, Sporobolus caroli, Austrodanthonia setacea* and *Aristida leptopoda*.

Occurs on grey to brown cracking clay, black earth or clay loam soils, on flats or undulating rises on broad alluvial plains or outer floodplains that rarely flood. Mainly in the Darling Riverine Plains and Brigalow Belt South Bioregions with some outliers beyond these regions. It is estimated that > 75% has been cleared due to it occurrence on arable alluvial soils. Some remnants are in good condition where they are not continuously or heavily grazed such as on roadsides or in travelling stock reserves. May have contained more of a chenopod understorey prior to European settlement in some places.

Photograph 9: Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)

LEGEND SHEET

Threatened fauna species

- Glossy Black-cockatoo
- Grey-crowned Babbler
- Latham's Snipe
- Little Eagle

Threatened flora species

- *Desmodium campylocaulon*
- *Digitaria porrecta*
- *Homopholis Belsonii*

BC Act listed threatened vegetation communities

EBPC Act listed threatened vegetation communities

Plant community types

- Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions
- Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt Soth Bioregion
- Carbeen +/- Coolabah grassy woodland on floodplain caly loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion
- Derived Grassland (PCT 27 – Weeping Myall open woodland)
- Derived Grassland (PCT 397 – Poplar Box – White Cypress Pine shrub grass tall woodland)
- Derived Grassland (PCT 445 – Brigalow viney scrub open forest)
- Derived Grassland (PCT 55 – Belah woodland on alluvial plains and low rises)
- Derived Grassland (PCT 56 – Poplar Box – Belah woodland on clay-loam soils on alluvial plains)
- Derived Grassland (PCT 628 – Carbeen +/- Coolabah grassy woodland on floodplain clay loam)
- Mock Olive – Wilga – Peach Bush – Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion
- Non-Indigenous Trees
- Planted Eucalypts
- Poplar Box – Belah woodland on clay-loam soils on alluvial plains of north-central NSW
- Poplar Box – White Cypress Pine shrub grass tall woodland of the Pilliga – Warialda region, Brigalow Belt South Bioregion
- Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion
- Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion
- Not Native

Figure 3.2 Plant Community types, Page 1

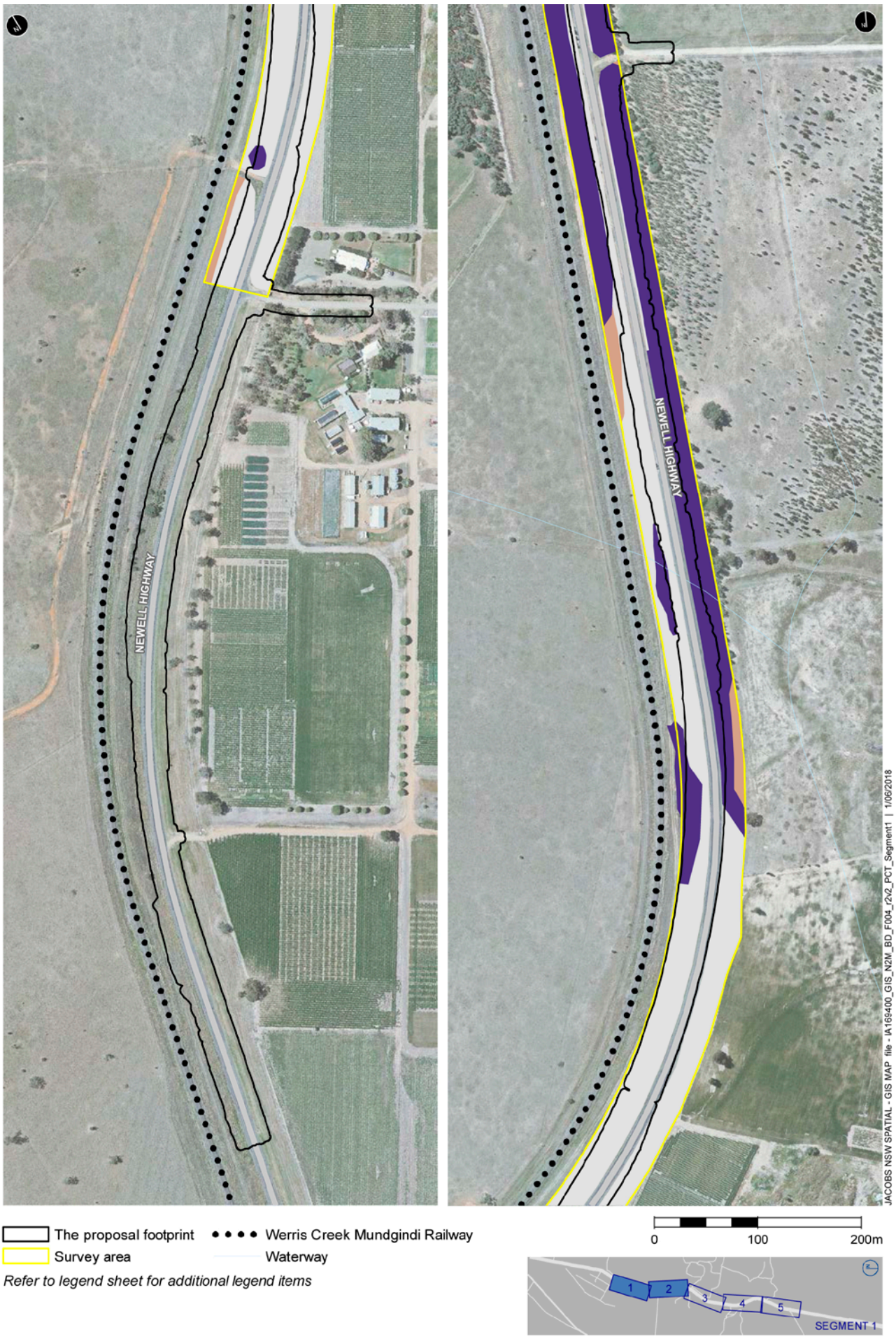


Figure 3.2 Plant Community types, Page 2

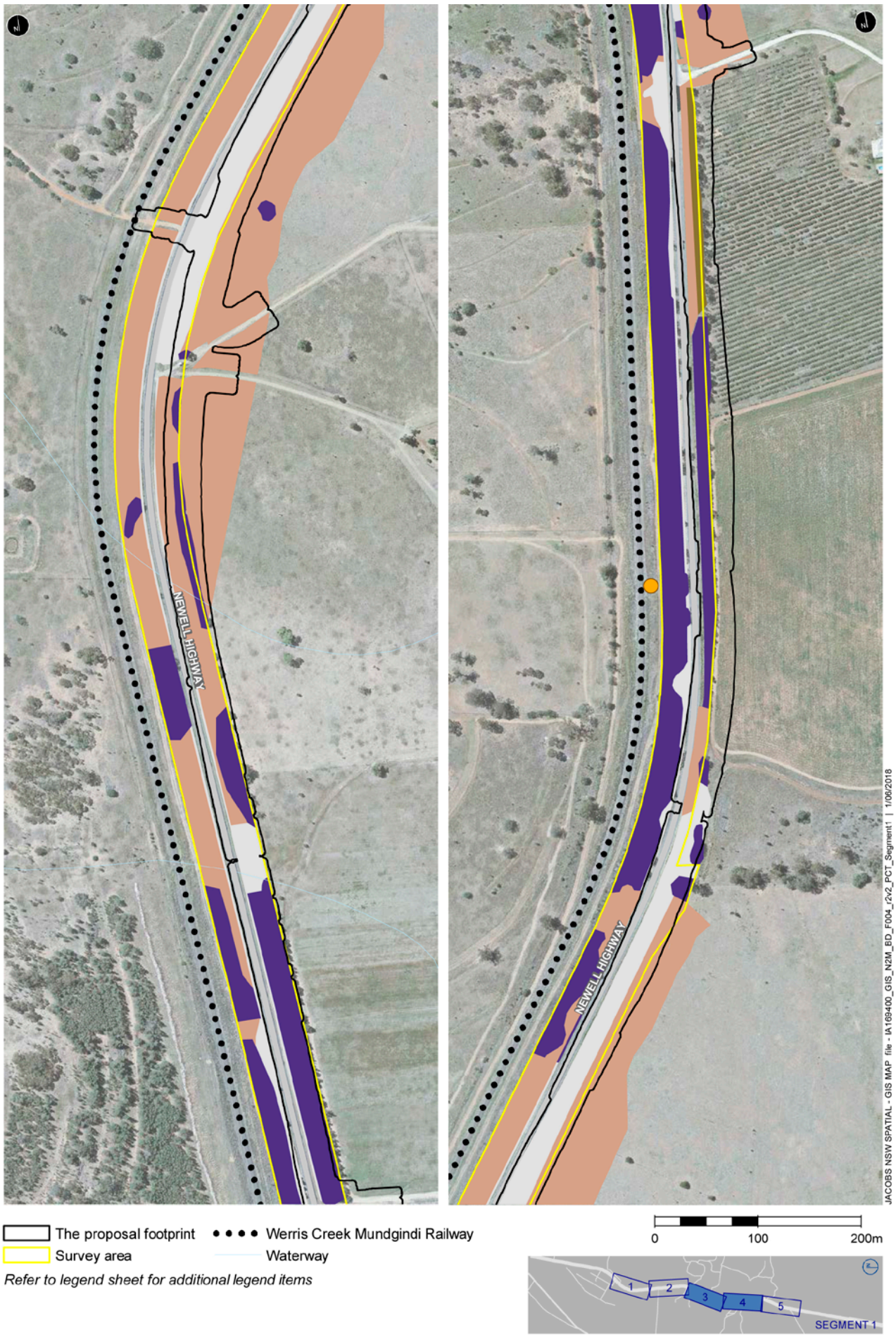


Figure 3.2 Plant Community types, Page 3

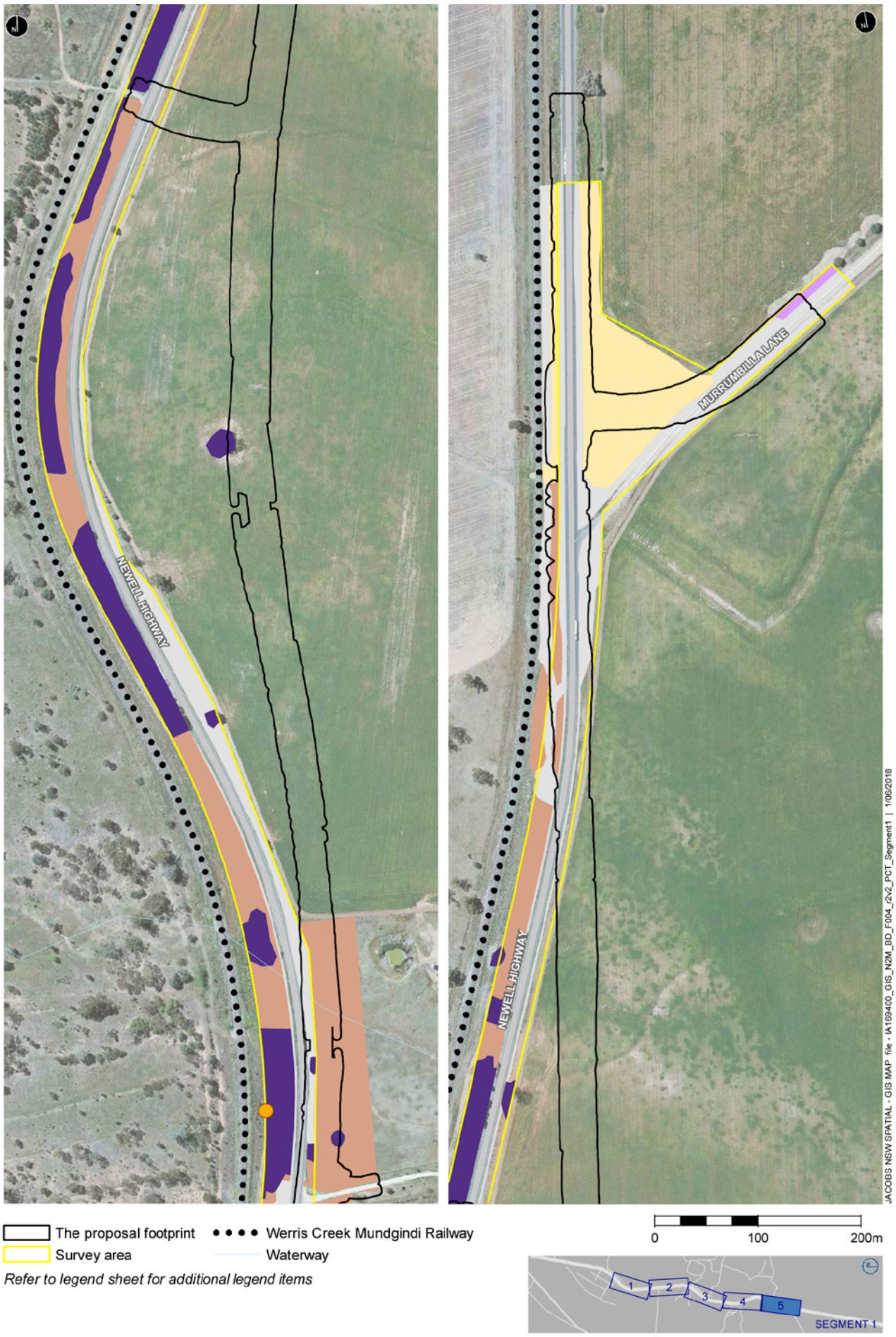


Figure 3.2 Plant Community types, Page 4

Figure 3.2 Plant Community types, Page 5

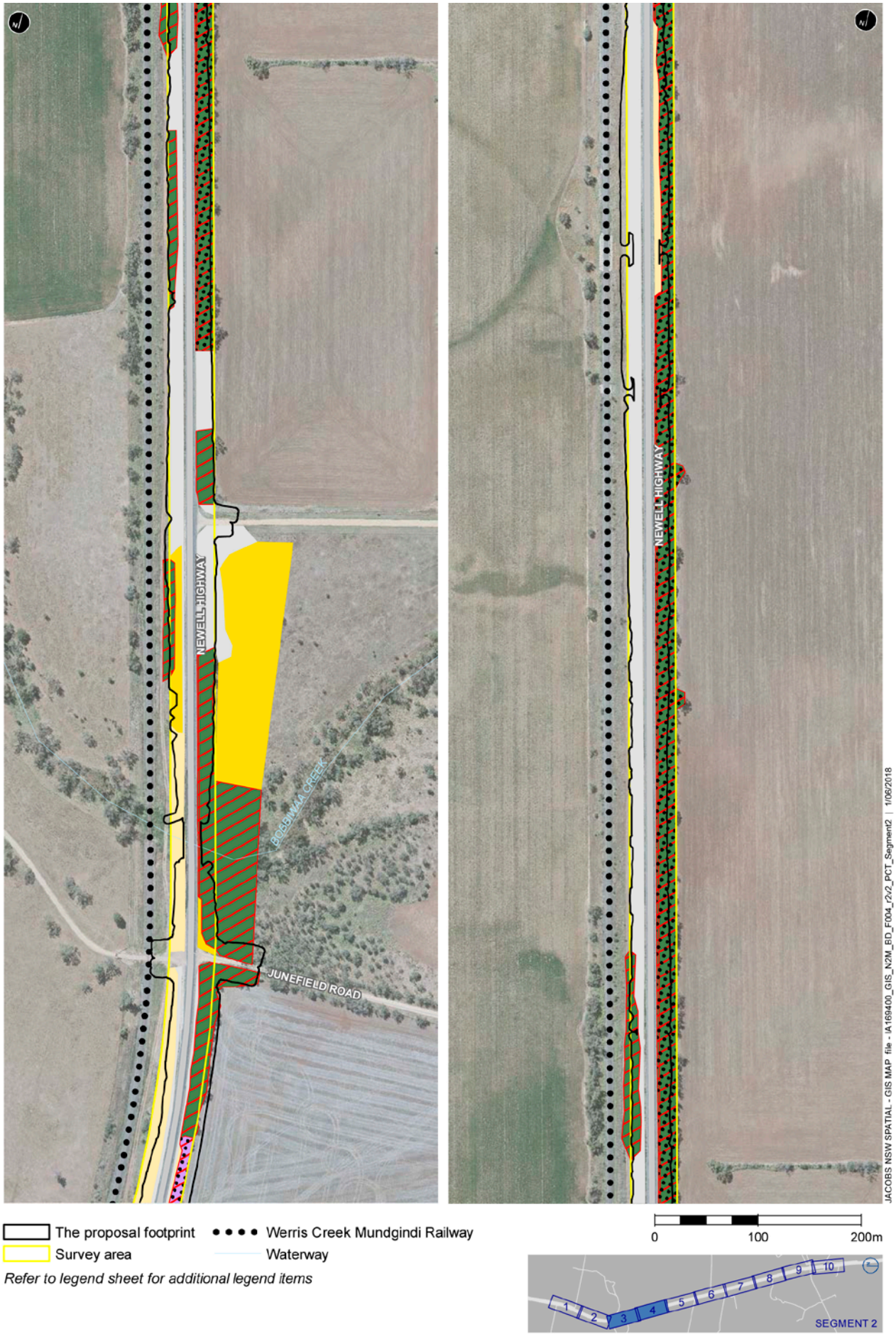


Figure 3.2 Plant Community types, Page 6

Figure 3.2 Plant Community types, Page 7

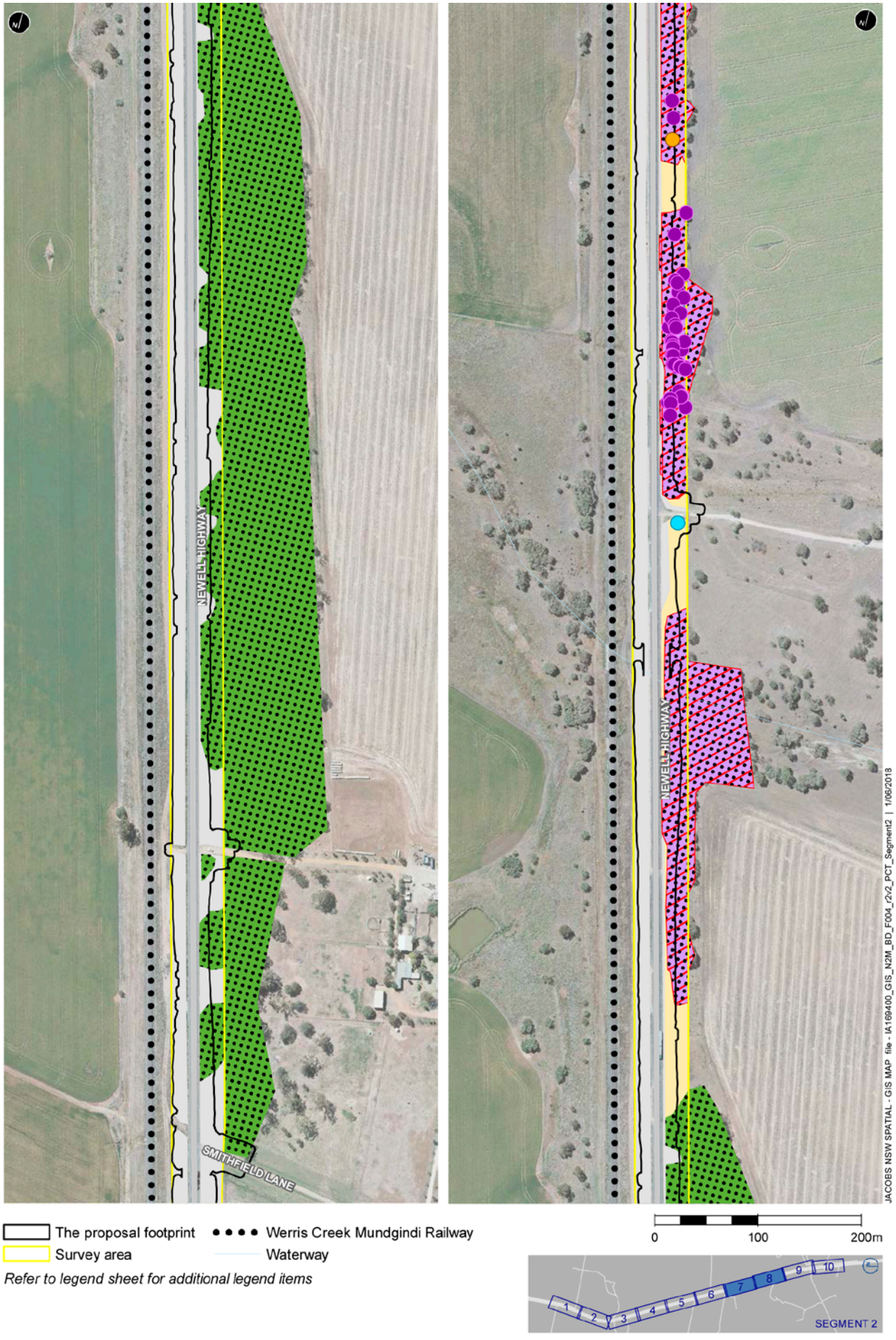


Figure 3.2 Plant Community types, Page 8

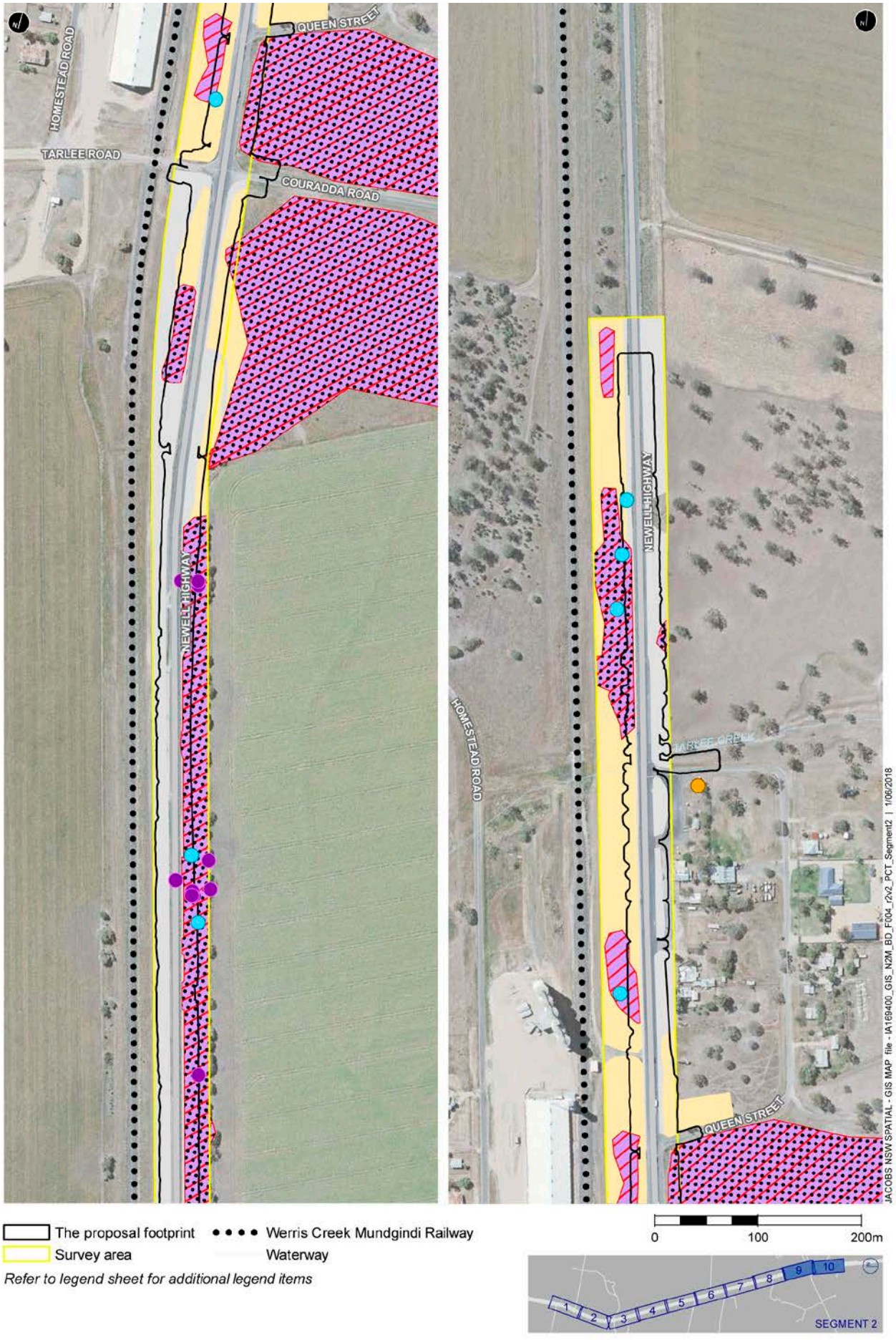


Figure 3.2 Plant Community types, Page 9

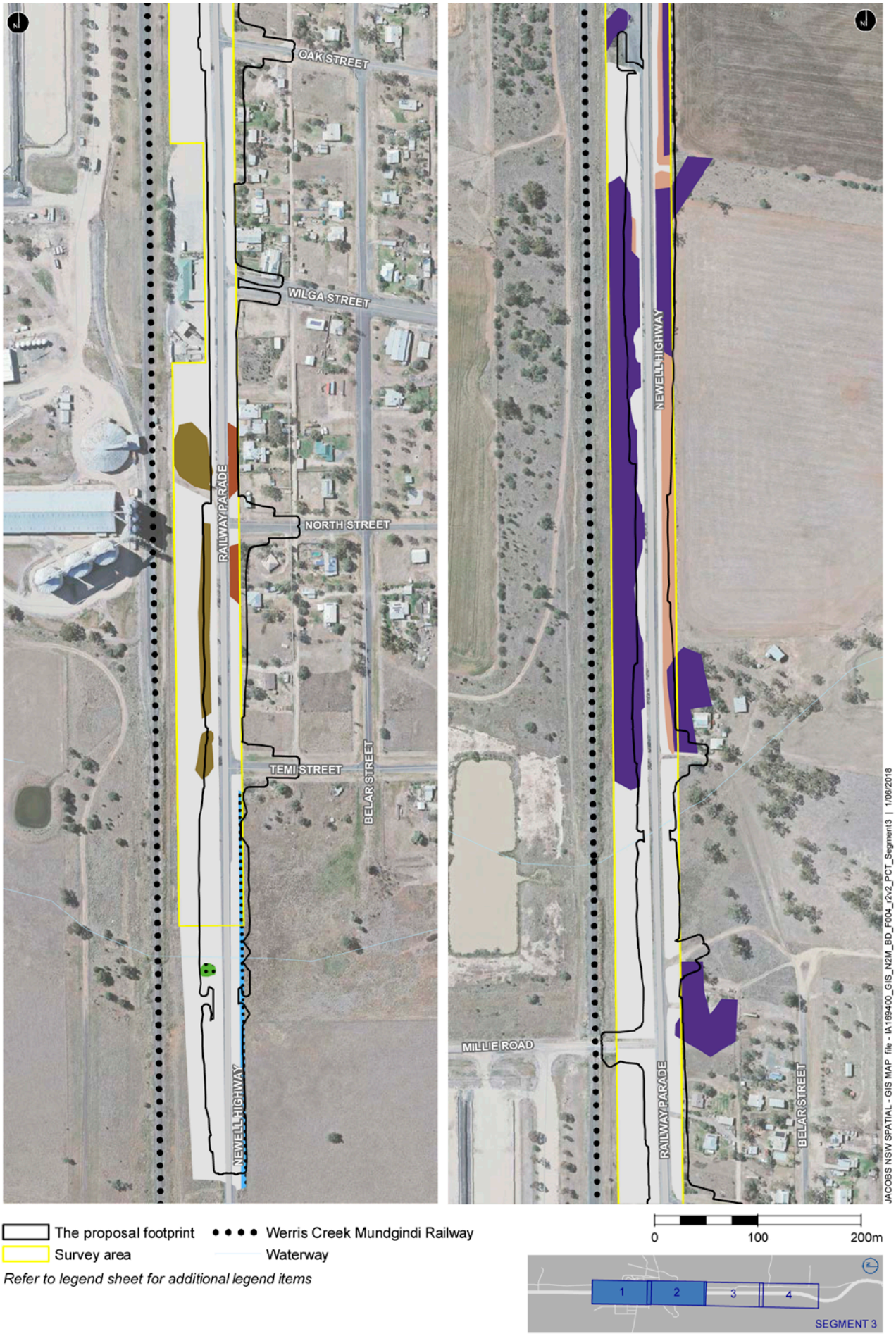


Figure 3.2 Plant Community types, Page 10

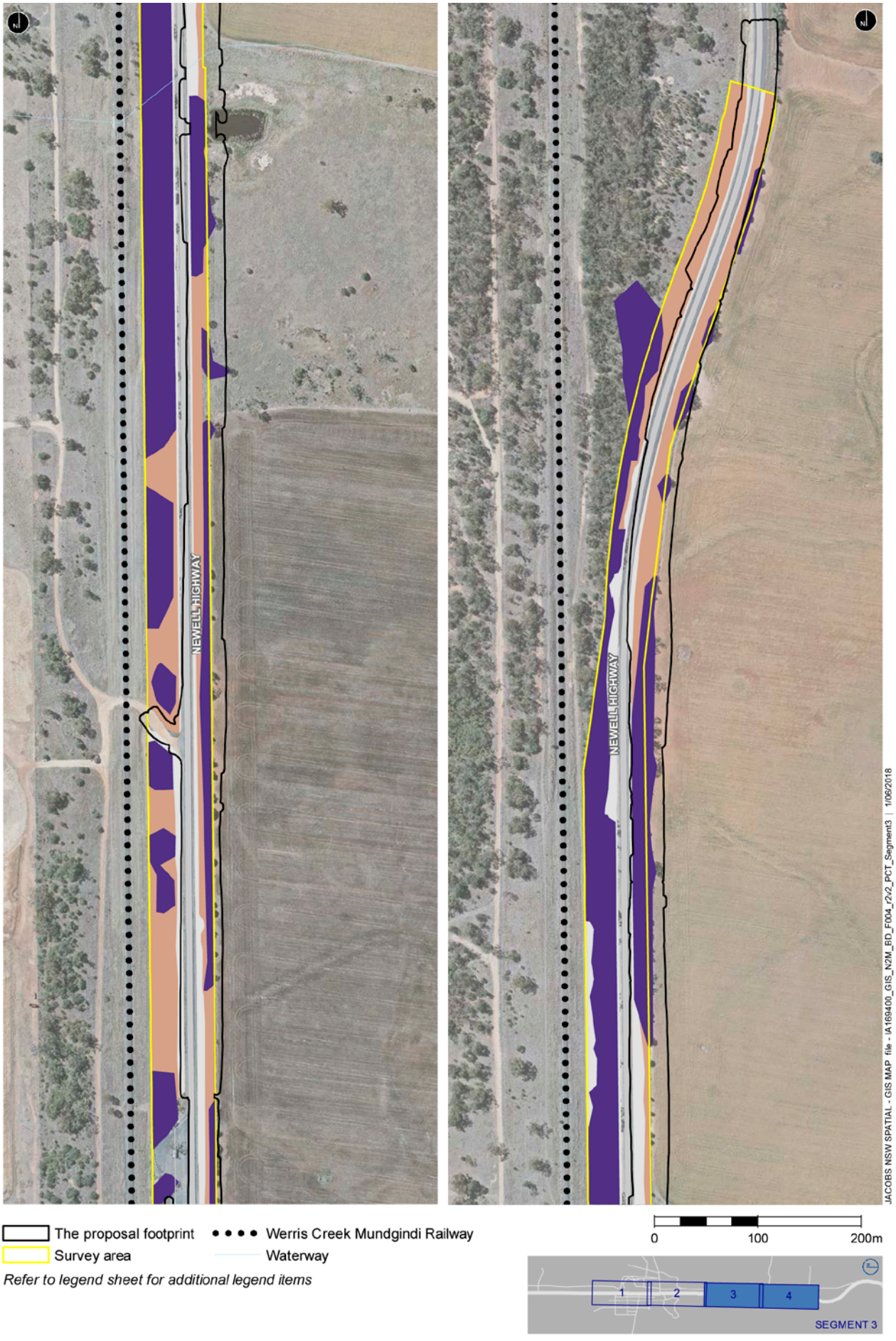


Figure 3.2 Plant Community types, Page 11

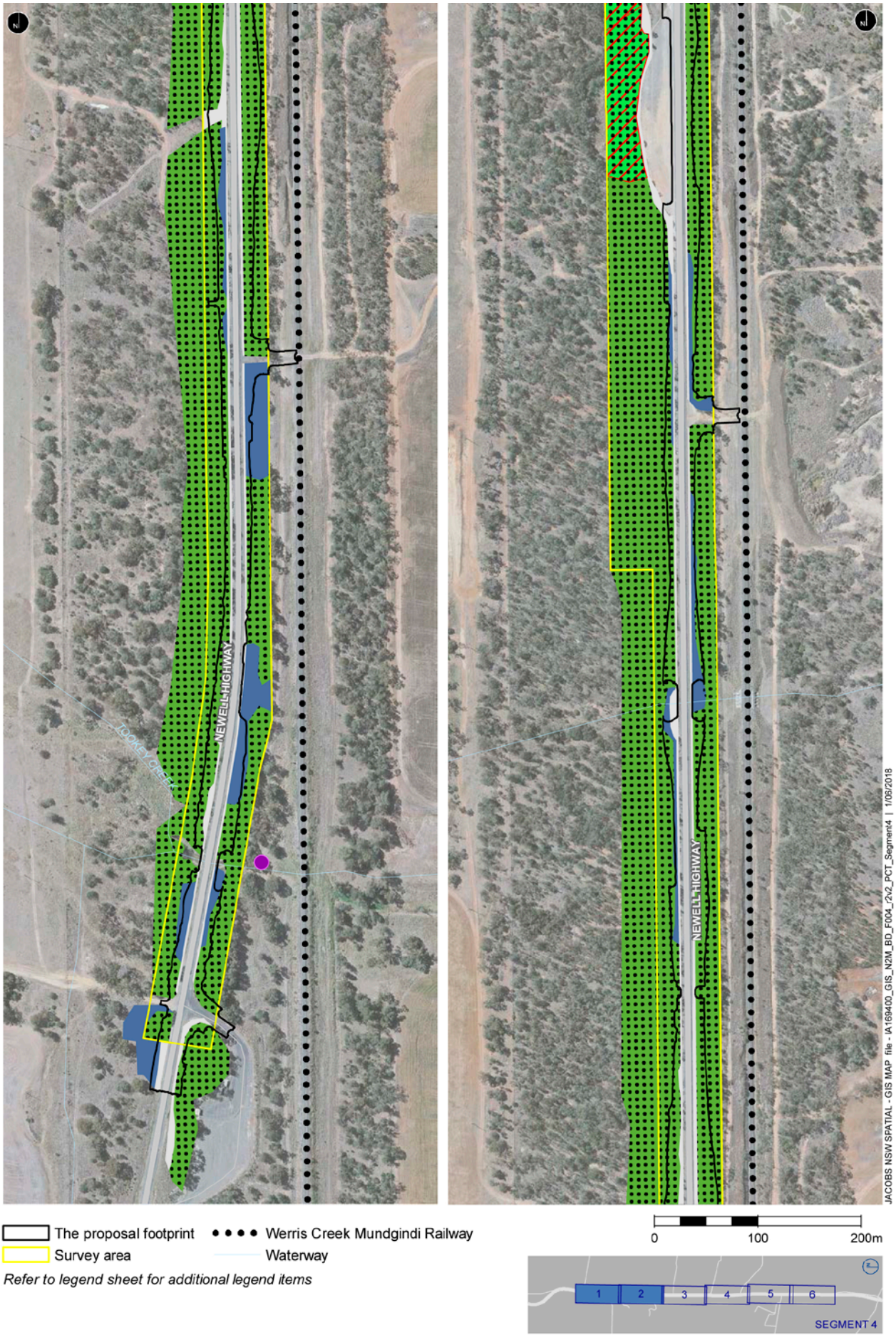


Figure 3.2 Plant Community types, Page 12

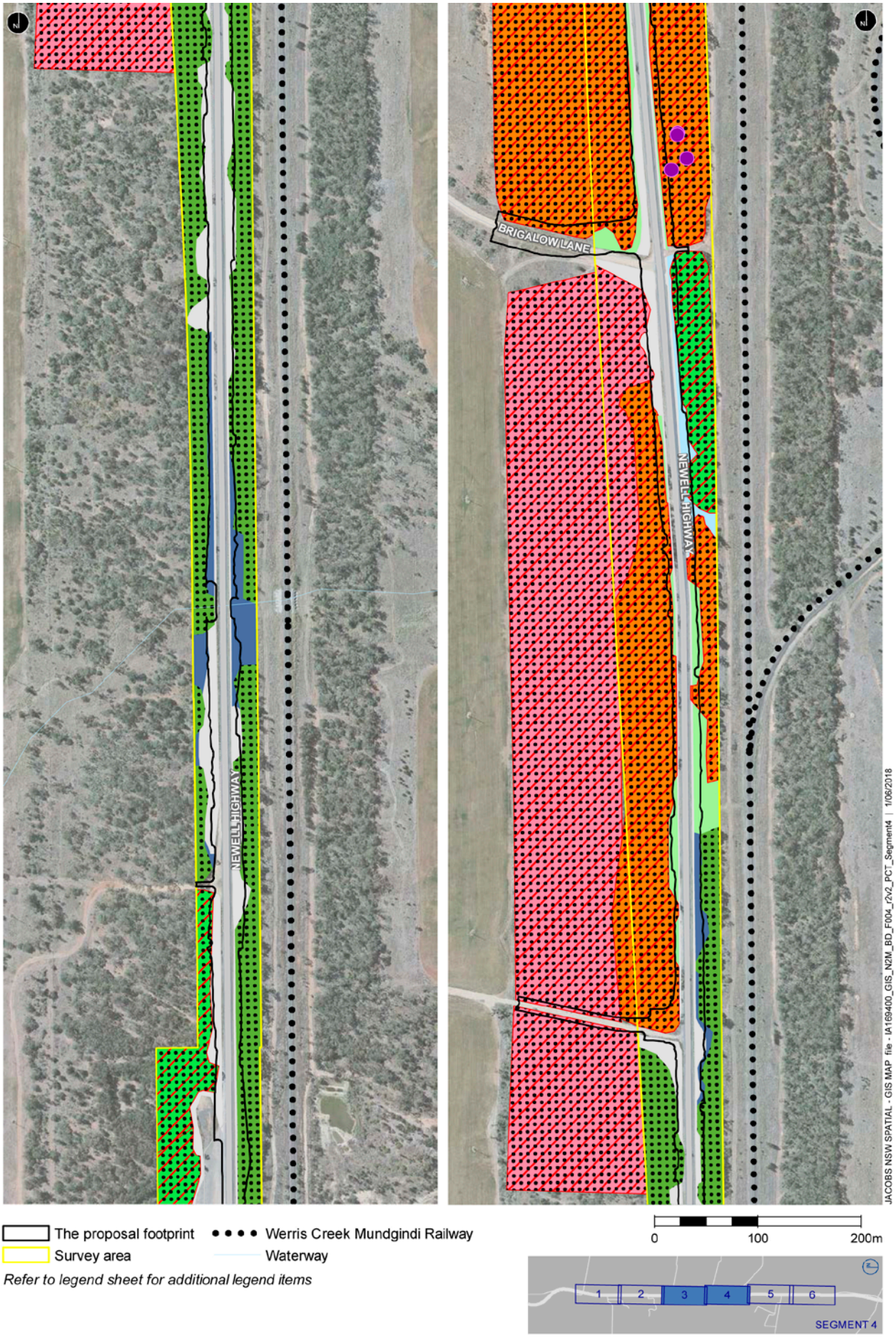


Figure 3.2 Plant Community types, Page 13

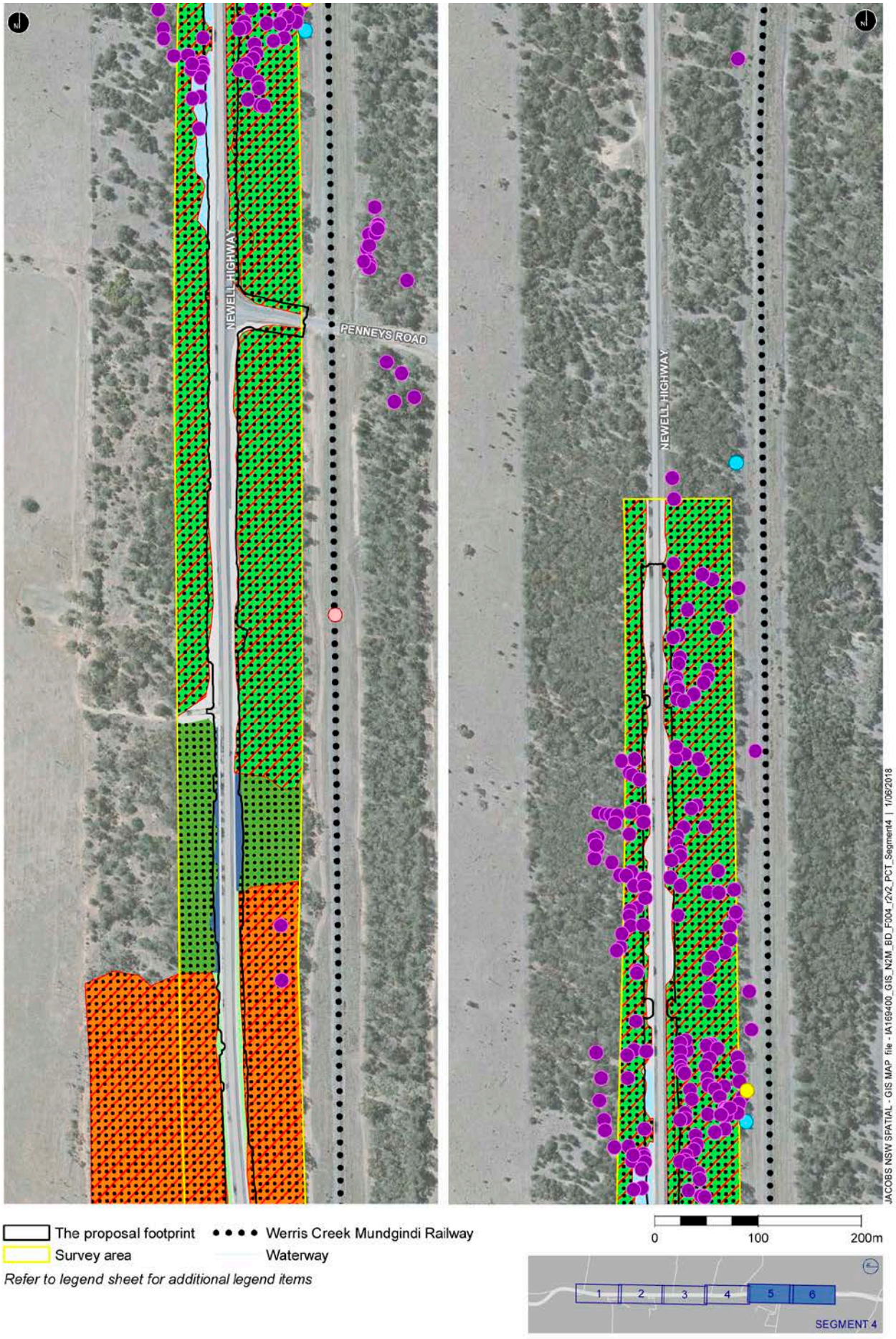


Figure 3.2 Plant Community types, Page 14

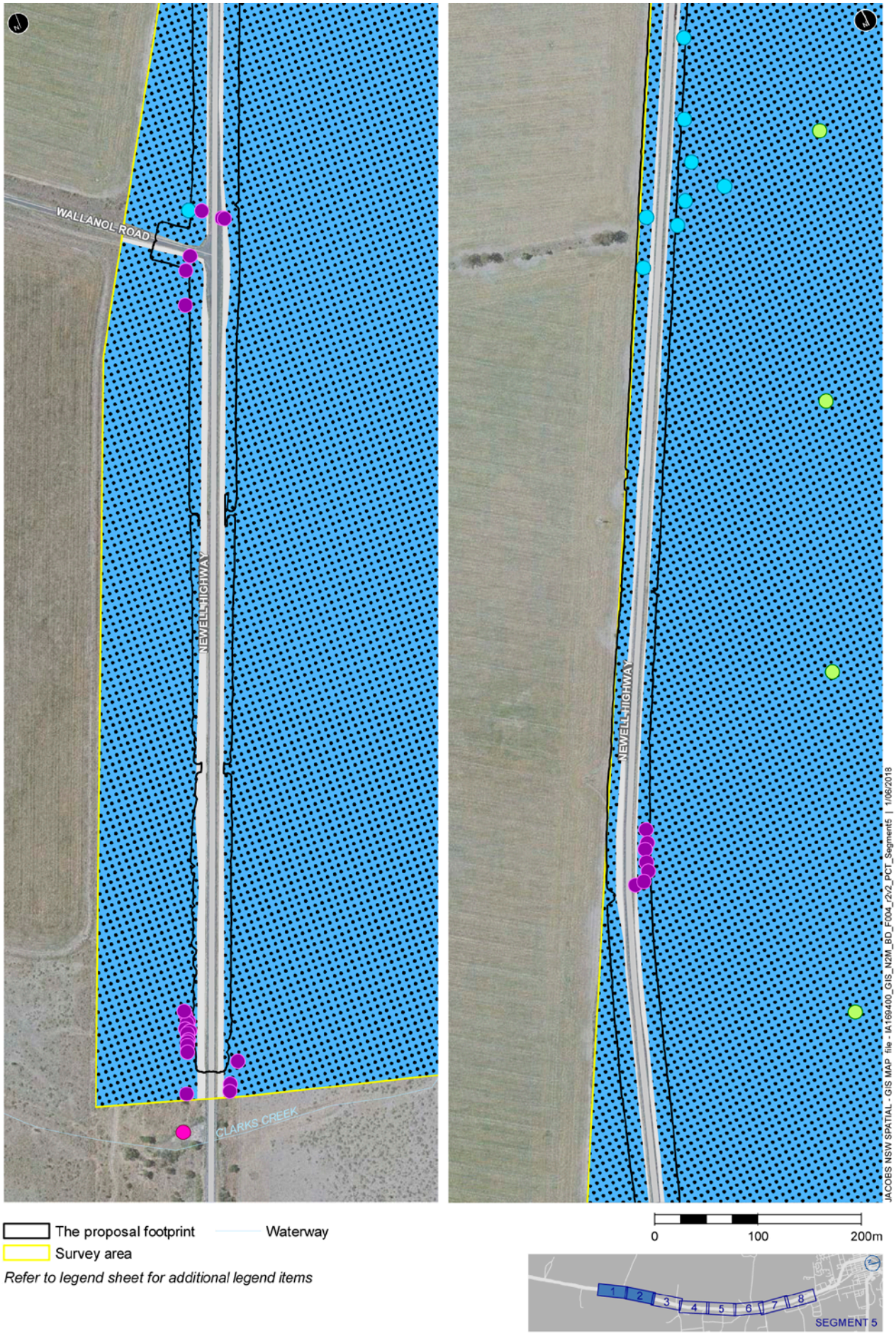


Figure 3.2 Plant Community types, Page 15

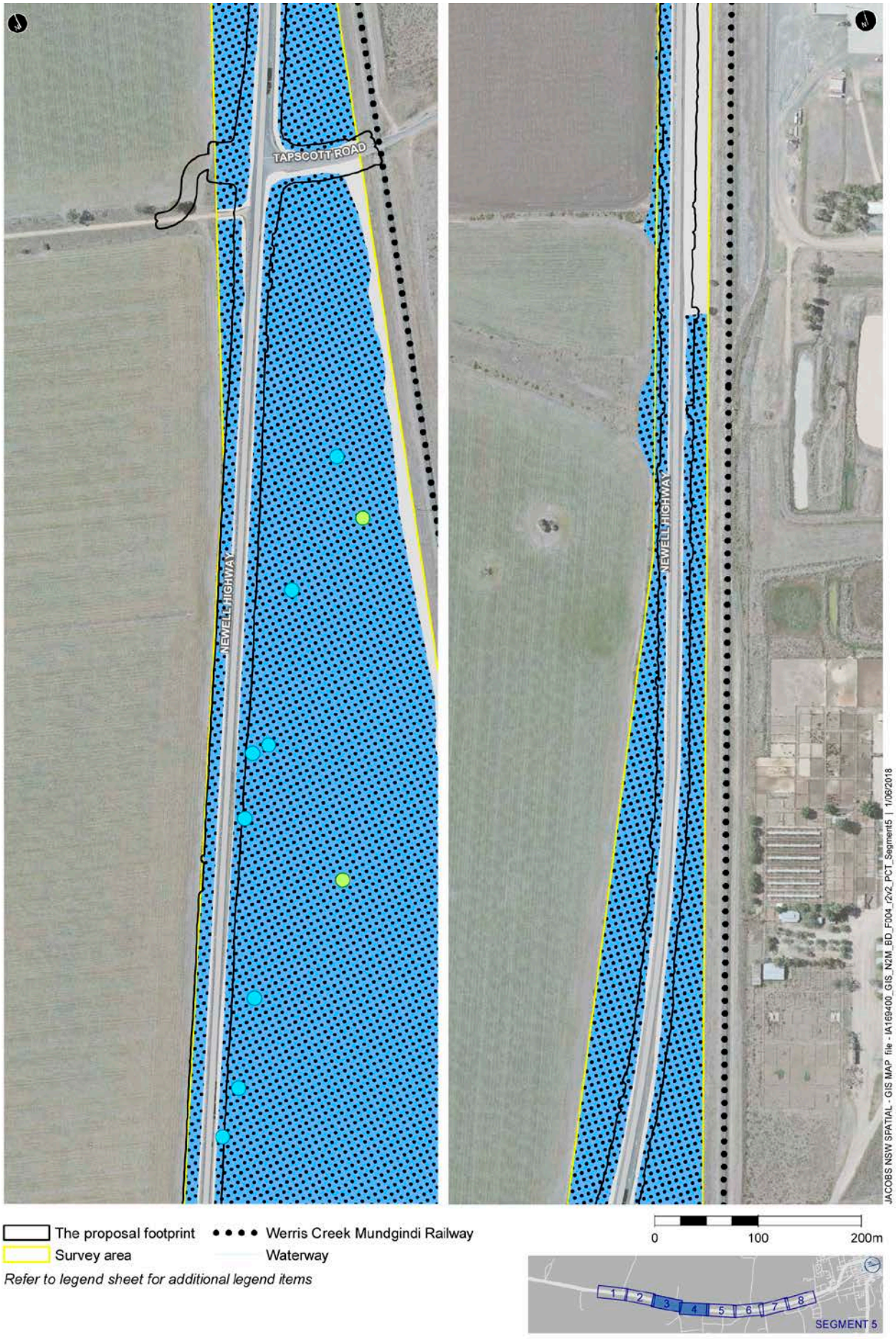


Figure 3.2 Plant Community types, Page 16

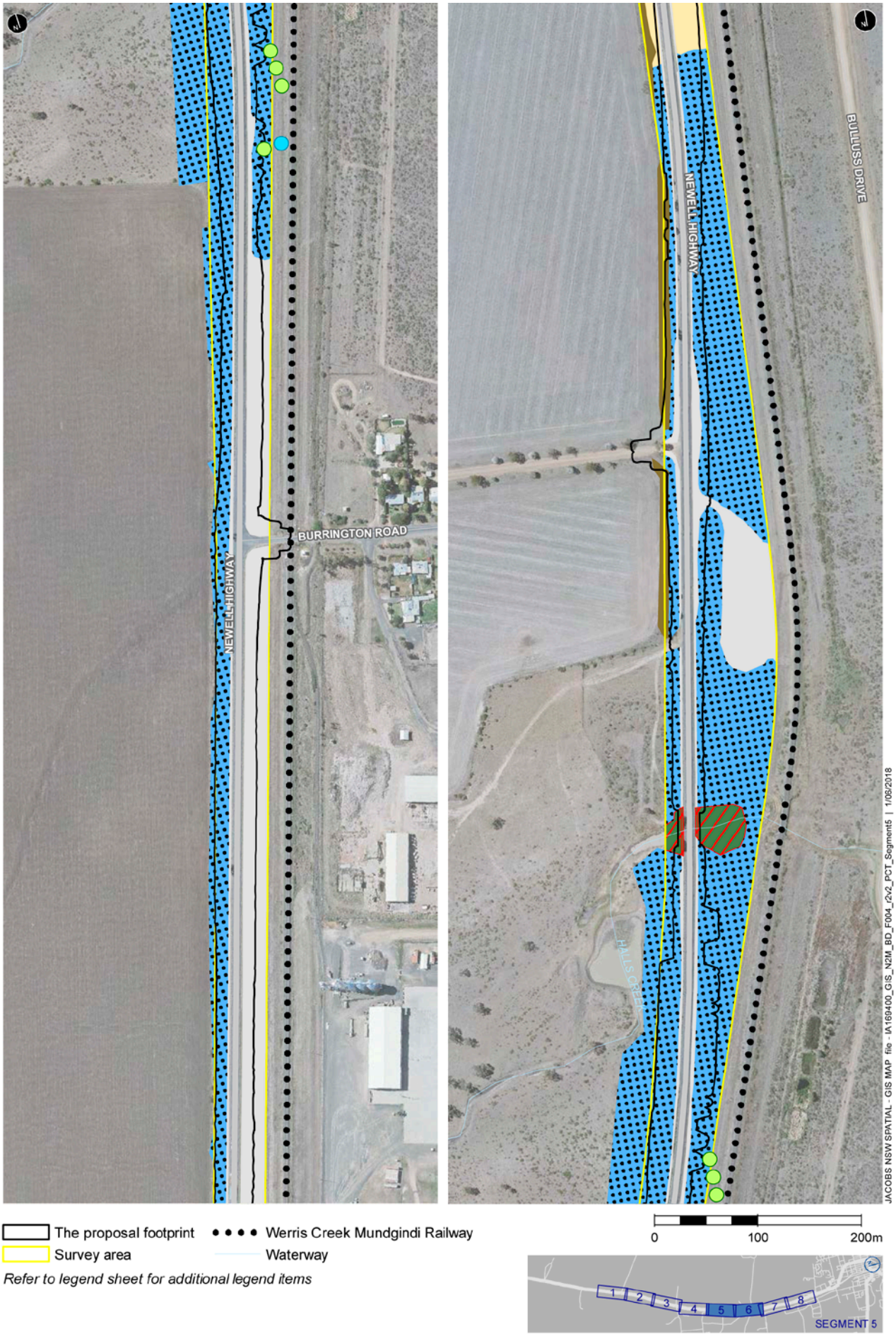


Figure 3.2 Plant Community types, Page 17

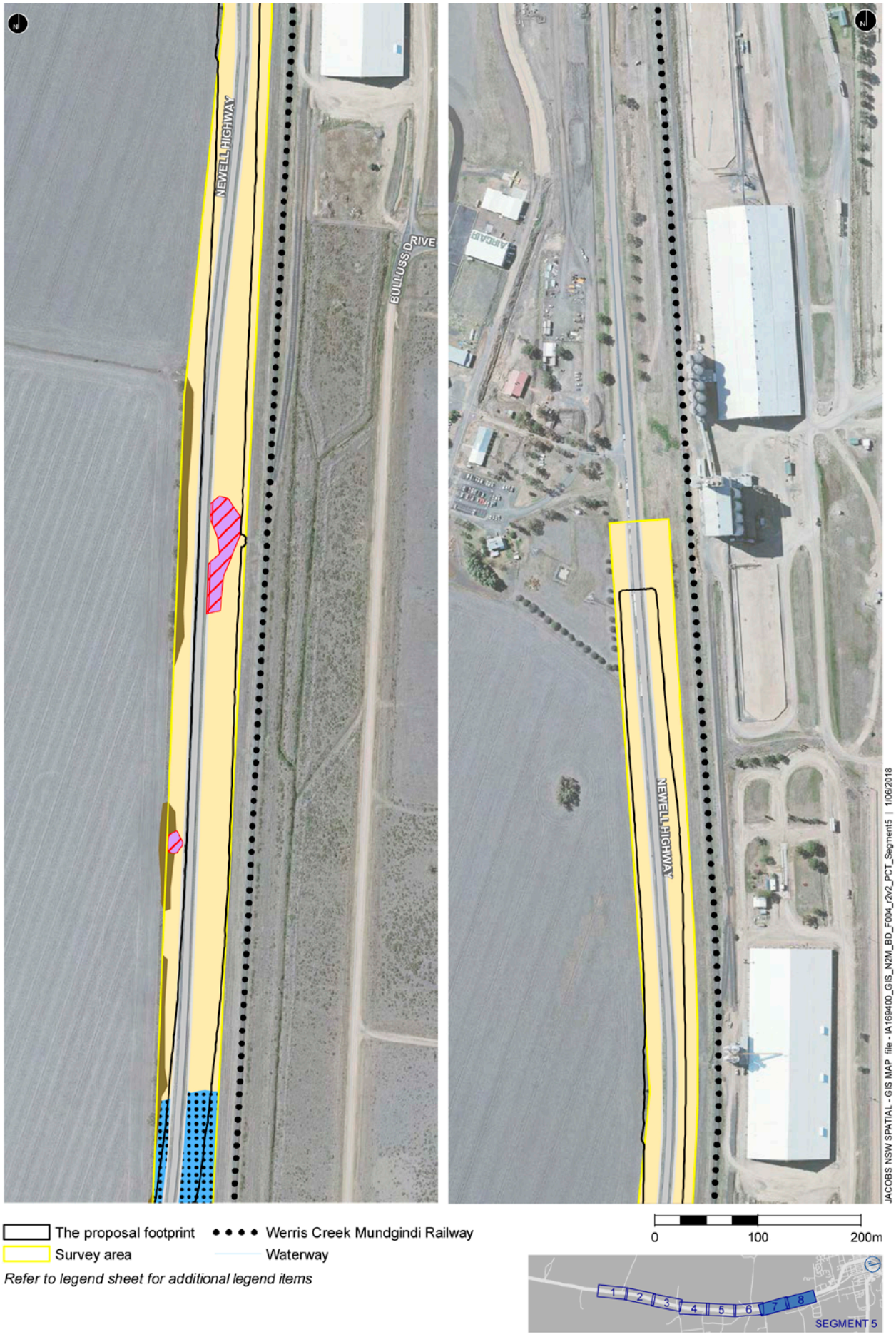


Figure 3.2 Plant Community types, Page 18

3.3 Aquatic surface water ecosystems and fish habitat

Within the study area, surface water was observed as small ponds within ephemerally flowing creeks, including Tookey Creek (Photograph 11), Halls Creek (Photographs 12 and 13), and an unnamed stream south of Edgeroi (very small shallow pools only in this stream). Two other named streams, Bobbiwa Creek (Photograph 14), Tarlee Creek and other unnamed streams were observed but none of these contained substantial surface water at the time of the survey. The aquatic surface water ecosystems are shown in Figure 3.3.

An assessment of the fish habitat value of these streams, based on the modelled habitat of threatened fish, field observation, aerial photograph interpretation and fish records is provided in Table 3.2. This assessment considered the current indicative distribution of the threatened Southern Purple Spotted Gudgeon in NSW, modelled from past catchment data and environmental conditions as provided by the Department of Primary Industries (2017).

The assessment has also considered the *Policy and Guidelines for fish habitat conservation and Management* (Department of Primary Industries 2013).

The assessment of stream habitats within the proposal area indicates that:

- Three of the streams would be classified as Class 2 (moderate key fish habitat); or Class 1 (major key fish habitat) if threatened species are present
- Six of the streams would be classified as Class 3 as (minimal key fish); or Class 1 (major key fish habitat) if threatened species are present
- The remaining streams would be classified as Class 4 (unlikely key fish habitat).

Photograph 11: Semi-permanent /Ephemeral pool at Tookey Creek

Photograph 12: Halls Creek – western side showing instream pools

Photograph 13: Halls Creek – eastern side showing instream pool and emergent aquatic vegetation

Photograph 14: Bobbiwaa Creek - dry stream channel

Table 3-6 Assessment of the fish habitat value of streams in the study area (reference: Department of Primary Industries 2013; 2017)

Water body and location	Surface water	Mapped as Key Fish Habitat by DPI	Modelled habitat for threatened species by DPI	Habitat assessment result	Key fish habitat sensitivity classification	Key Fish Habitat status based on habitat assessment
Halls Creek south of Moree (north of Burrington Road) Segment: N2MS5	Surface water in pools at the time of survey; the presence of fringing vegetation (*Typha* sp.) suggests that that the ponds may contain water even during low rainfall periods.	No	No	Halls Creek appears to be an intermittently flowing creeks that retains water for extended periods in a series of disconnected pools after flow ceases. Considered to be possible habitat for one or more of the following threatened species of fish: • Purple Spotted Gudgeon • Eel Tailed Catfish (recorded on the creek downstream).	Type 1 - Highly sensitive key fish habitat (contains native aquatic plants and is expected threatened species habitat).	Class 2: Moderate key fish habitat Or Class 1: Major key fish habitat if threatened species present)
Tookey Creek North of Bellata near Tookey Creek rest area Segment: N2MS4	Moderate sized ephemeral ponds; contained standing water at the time of the survey but aerial photography suggests that these pools are ephemeral. Aerial photography shows that substantial pools (natural pools and dams) exist upstream and downstream within and adjacent to the stream channel.	Yes	Yes Purple Spotted Gudgeon	Tookey Creek appears to be an intermittently flowing creek that retains water for extended periods in a series of disconnected pools after flow ceases. Considered to be possible habitat for the Purple Spotted Gudgeon. It appears that shallow ephemeral pools form within the waterway after rain events; possibly permanent pools (farm dams) are located close to the channel outside of the study area. It is mapped as habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the creek within the study area; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 1 - Highly sensitive key fish habitat (expected threatened species habitat).	Class 2: Moderate key fish habitat Or Class 1: Major key fish habitat if threatened species present)
Bobbiwaa Creek near Junefield Road North of Narrabri Segment: N2MS2	No standing water or obvious ephemeral pools recorded. Aerial photography shows that pools (natural pools and dams) exist upstream and downstream within and adjacent to the stream channel.	Yes	Yes Purple Spotted Gudgeon Eel Tailed Catfish	Bobbiwaa Creek is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that semi-permanent pools form within the waterway after rain events; possibly permanent pools (billabongs and dams) are located close to the channel outside of the study area. It is mapped as habitat for the Purple Spotted Gudgeon and Eel Tailed Catfish. These species are unlikely to permanently occupy the stretch of the creek within the study area; if present they may occur in deeper pool refugia upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 1 - Highly sensitive key fish habitat (expected threatened species habitat).	Class 2: Moderate key fish habitat Or Class 1: Major key fish habitat if threatened species present)

Water body and location	Surface water	Mapped as Key Fish Habitat by DPI	Modelled habitat for threatened species by DPI	Habitat assessment result	Key fish habitat sensitivity classification	Key Fish Habitat status based on habitat assessment
Tarlee Creek north of Edgeroi Segment: N2MS2	No standing water observed but evidence of shallow ephemeral pools recorded. Aerial photography shows that pools (natural pools and dams) exist upstream and downstream within and adjacent to the stream channel.	No	Yes Purple Spotted Gudgeon	Tarlee Creek is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that shallow ephemeral pools form within the waterway after rain events; possibly permanent pools (farm dams) are located close to the channel outside of the study area. It is mapped as habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the creek within the study area; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 1 - Highly sensitive key fish habitat (expected threatened species habitat).	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)
Unnamed stream south of Edgeroi -between Smithfield Rd and Couradda Rd Segment: N2MS2	A small pool with no emergent aquatic vegetation and an area of impeded drainage (ephemeral wetland) observed in the study area. Aerial photography shows that pools (dams) exist upstream and downstream within and adjacent to the stream channel.	No	Yes Purple Spotted Gudgeon	The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that shallow ephemeral pools form within the waterway in the study area after rain events; possibly permanent pools (dams) are located in the stream channel outside of the study area. It is mapped as habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the creek within the study area; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 1 - Highly sensitive key fish habitat (expected threatened species habitat).	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)
Gehan Creek north of Bellata 1 north of Millie Road Segment: N2MS3	No standing water observed in the study area but the surrounding area is likely to form an ephemeral wetland after heavy rain. Aerial photography shows that pools (dams) exist upstream and downstream within and adjacent to the stream channel.	No	Yes Purple Spotted Gudgeon	The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that shallow ephemeral pools form within the waterway in the study area after rain events; possibly permanent pools (dams) are located in the stream channel outside of the study area. It is mapped as habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the creek within the study area; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 1 - Highly sensitive key fish habitat (expected threatened species habitat).	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)

Water body and location	Surface water	Mapped as Key Fish Habitat by DPI	Modelled habitat for threatened species by DPI	Habitat assessment result	Key fish habitat sensitivity classification	Key Fish Habitat status based on habitat assessment
Unnamed stream north of Bellata Segment: N2MS3	No standing water observed in the natural stream channel in the study area; a dam lined with emergent aquatic vegetation (*Typha* sp. etc) is located at the edge of the study area. The surrounding area is likely to form an ephemeral wetland after heavy rain. Aerial photography shows one pool (dam) at the upstream edge of the study area and pools (natural pools and dams) downstream within and adjacent to the stream channel.	No	Yes Purple Spotted Gudgeon	The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that shallow ephemeral wetlands form within the waterway in the study area after rain events; possibly permanent pools (dams) are located in the stream channel at the upstream edge of and outside of the study area. It is mapped as habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the creek within the study area but may occupy the dam at the edge; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 1 - Highly sensitive key fish habitat (expected threatened species habitat).	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)
Unnamed tributary of Narrabri Creek Segment: N2MS1	No sign of any waterway in this location though there appear to be ephemeral wetland areas in adjacent paddocks.	Yes	No	The waterway has at most intermittent flow following rain events only, has no defined drainage channel, no evidence of free standing water or pools post rain events; i.e. it is a shallow depression with no aquatic flora present. Unlikely to provide habitat for threatened aquatic species.	Type 3 – Minimally sensitive key fish habitat.	Class 4 Unlikely key fish habitat
Halls Creek south of Moree (north of Burrington Road) Segment: N2MS5	No standing water observed but evidence of shallow ephemeral pools recorded. Aerial photography shows that pools (dams) exist upstream and downstream within and adjacent to the stream channel.	No	No	The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that shallow ephemeral pools form within the waterway after rain events; possibly permanent pools (farm dams) are located close to the channel outside of the study area. It is not mapped as habitat for any threatened species but is a tributary of Tookey Creek which is mapped as habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the creek within the study area; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 3 – Minimally sensitive key fish habitat, or Type 1 - Highly sensitive key fish habitat (possible threatened species habitat).	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)

Water body and location	Surface water	Mapped as Key Fish Habitat by DPI	Modelled habitat for threatened species by DPI	Habitat assessment result	Key fish habitat sensitivity classification	Key Fish Habitat status based on habitat assessment
Tookey Creek North of Bellata near Tookey Creek rest area Segment: N2MS4	No standing water observed but an area of impeded drainage (ephemeral wetland) observed in the study area. Aerial photography shows that water pools in this area and that pools (dams) exist upstream and downstream within and adjacent to the stream channel.	No	No	The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). It appears that shallow ephemeral pools form within the waterway after rain events; possibly permanent pools (farm dams) are located close to the channel outside of the study area. It is not mapped as habitat for any threatened species but is a tributary of Halls Creek which is considered to be potential habitat for the Purple Spotted Gudgeon. This species is unlikely to permanently occupy the stretch of the stream within the study area; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.	Type 3 – Minimally sensitive key fish habitat, or Type 1 - Highly sensitive key fish habitat (possible threatened species habitat).	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)
Bobbiwaa Creek near Junefield Road North of Narrabri Segment: N2MS2	No sign of any distinct waterway but there may be ephemeral wetland areas. Small areas of standing water in culverts only.	No	No	The waterway has at most intermittent flow following rain events only, has no defined drainage channel, no evidence of free standing water or pools post rain events; i.e. it is a shallow depression with no aquatic flora present. Unlikely to provide habitat for threatened aquatic species.	Type 3 – Minimally sensitive key fish habitat.	Class 4 Unlikely key fish habitat

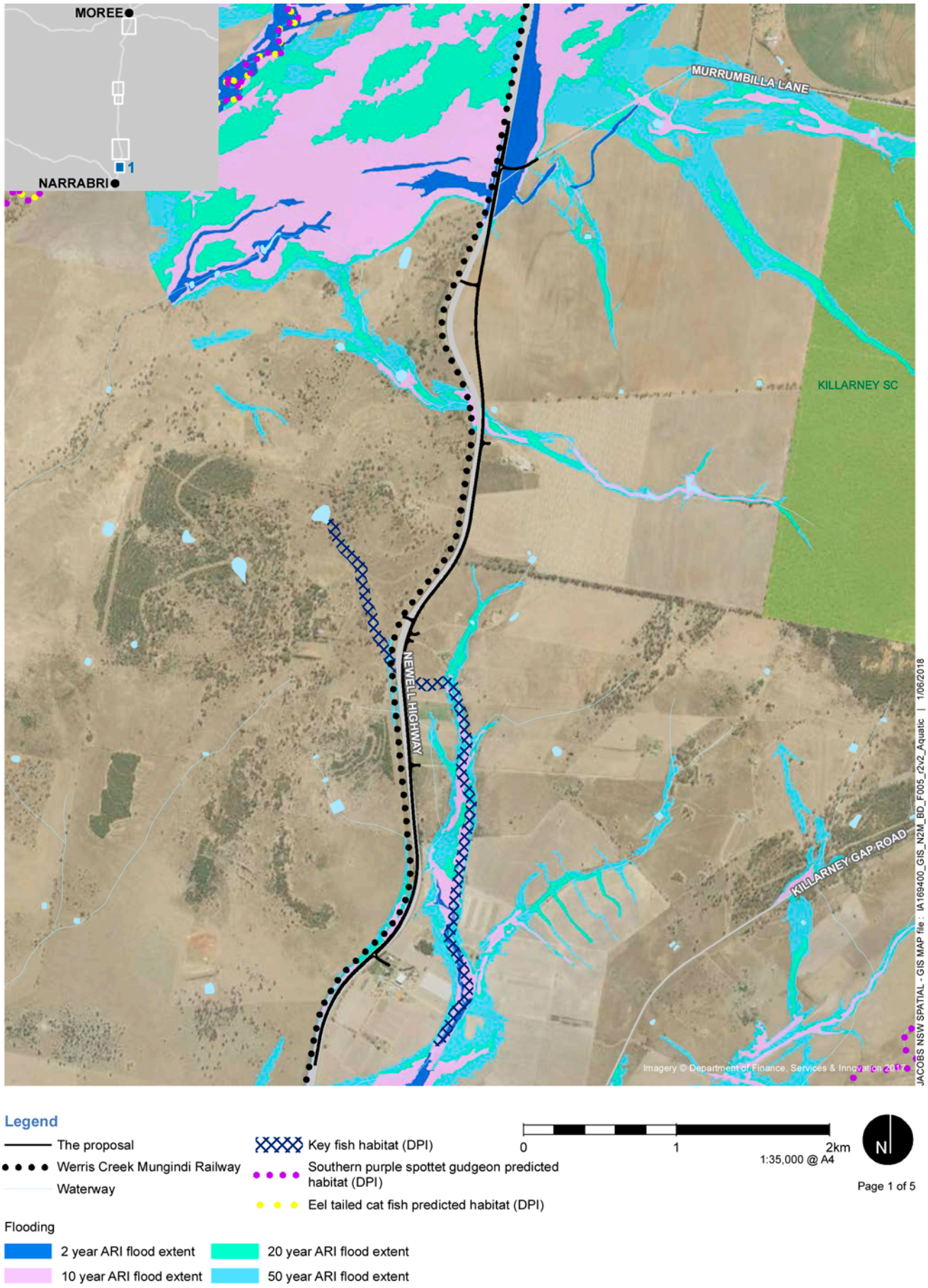


Figure 3.3 Aquatic surface water ecosystems, Page 1 of 5

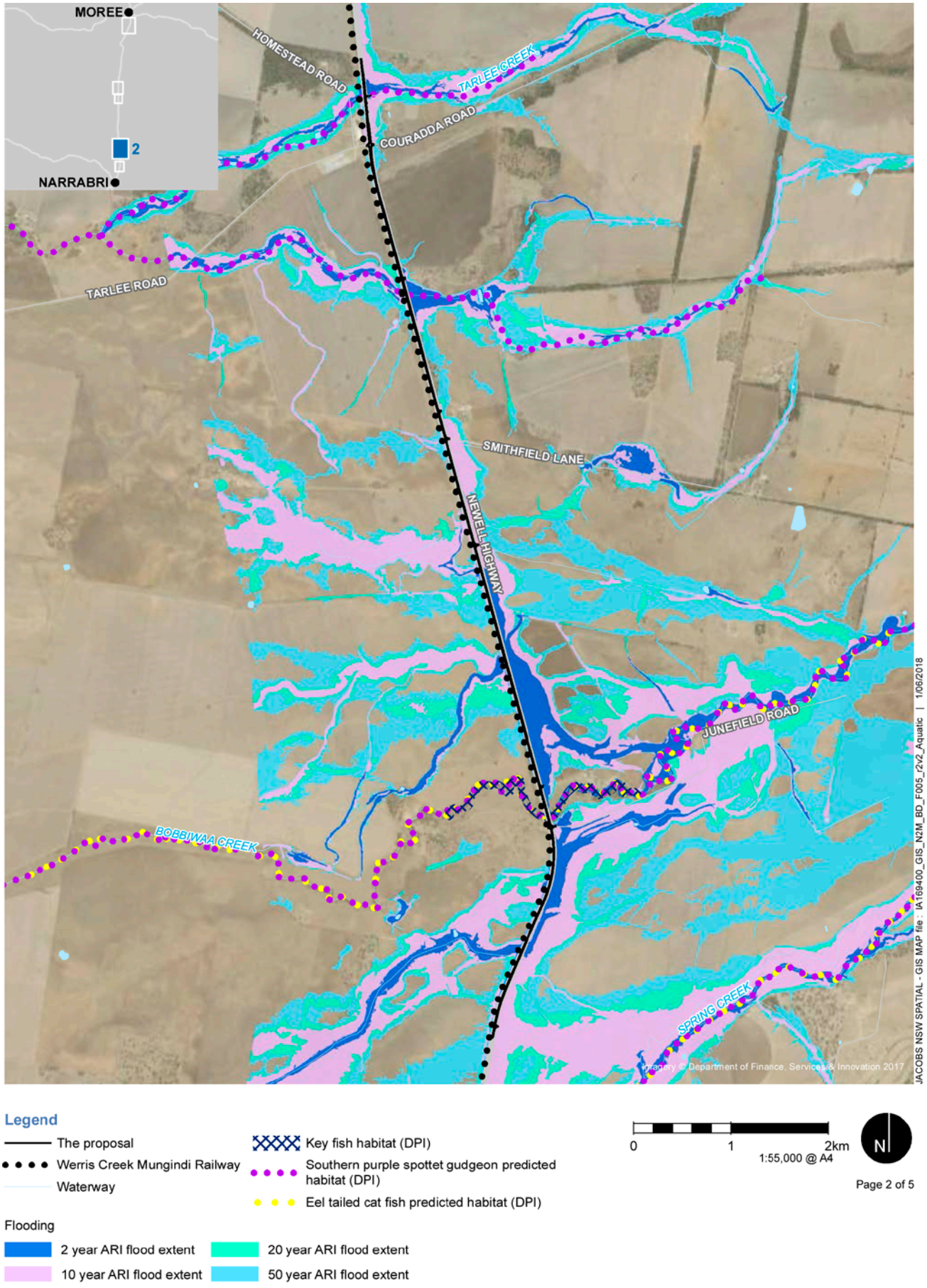


Figure 3.3 Aquatic surface water ecosystems, Page 2 of 5

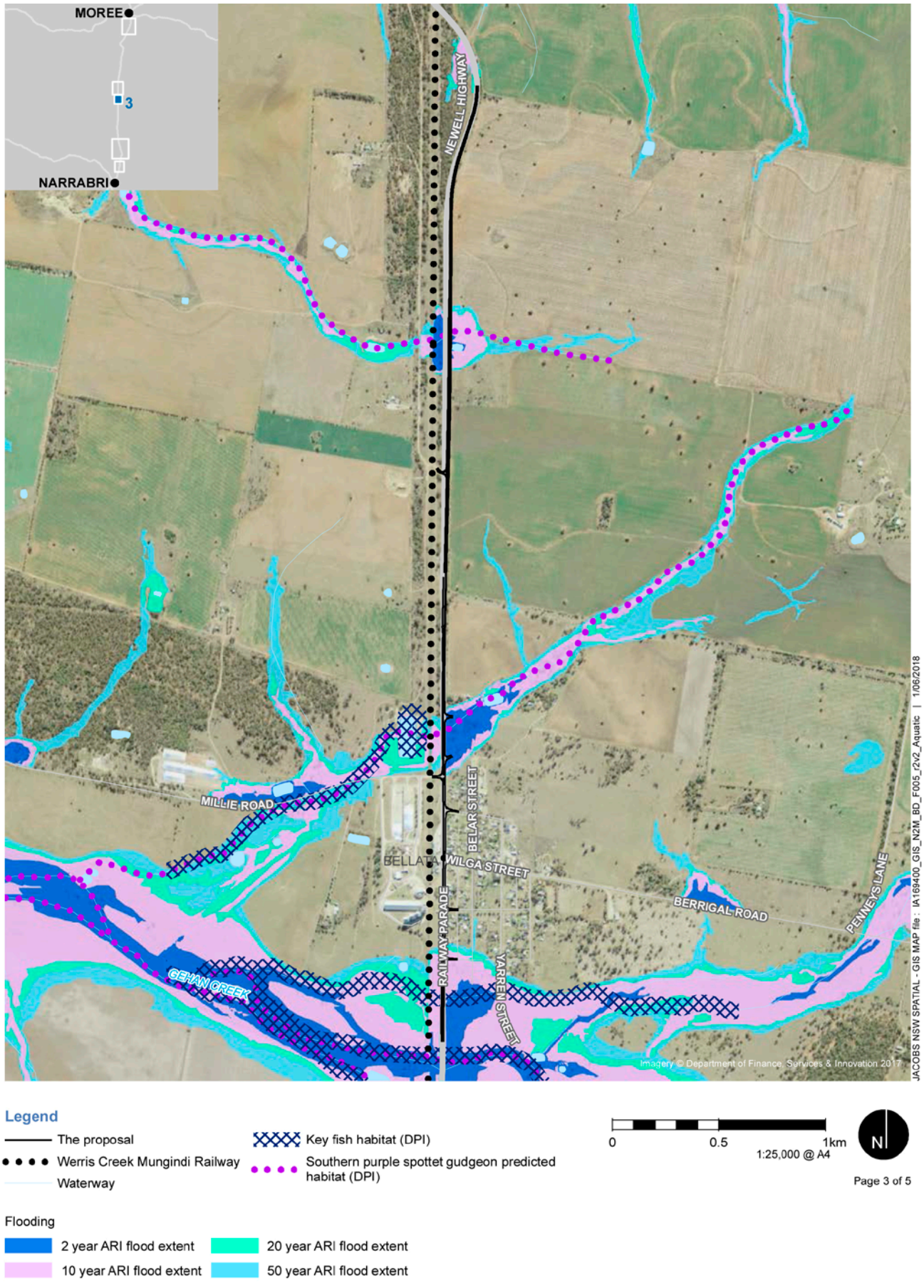


Figure 3.3 Aquatic surface water ecosystems, Page 3 of 5

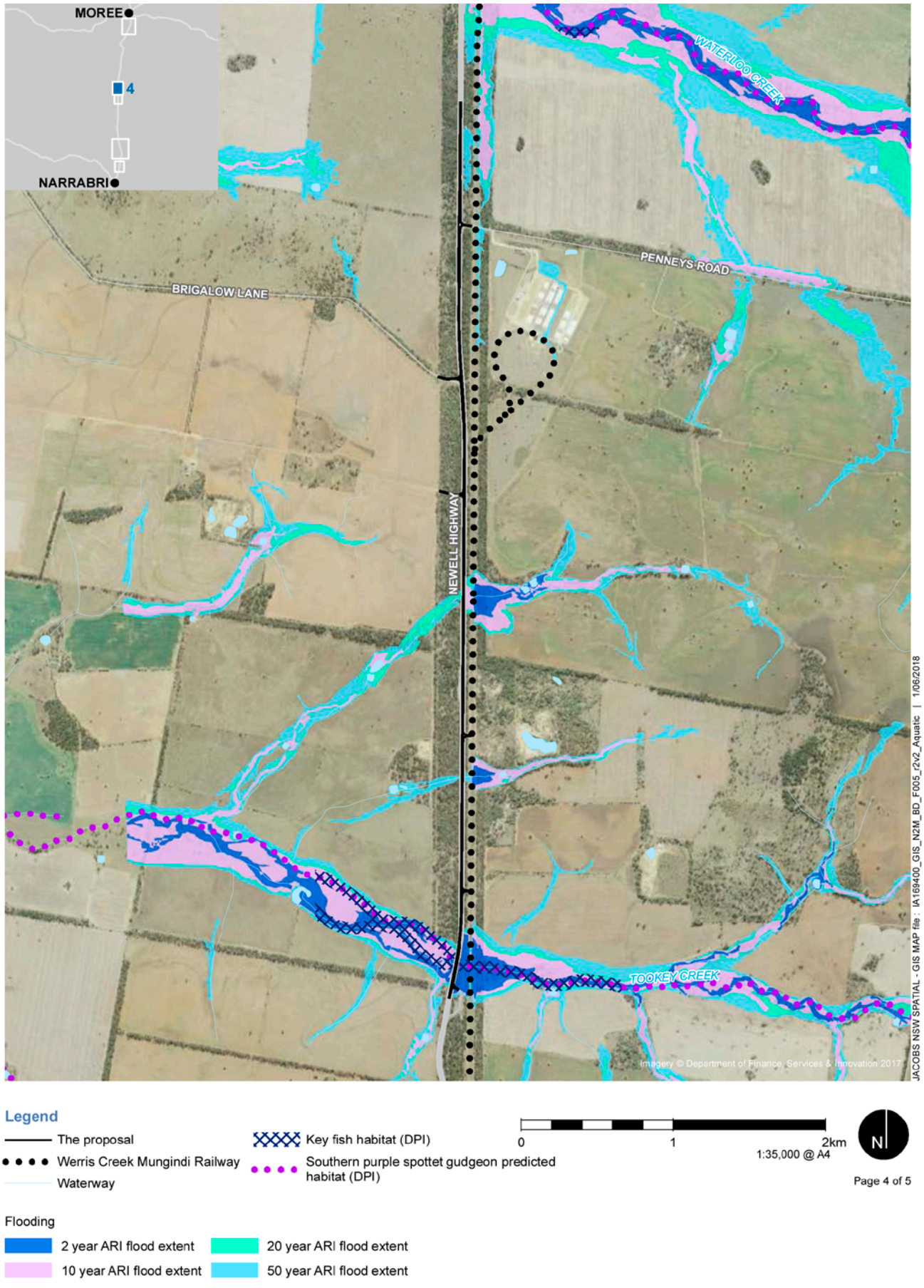


Figure 3.3 Aquatic surface water ecosystems, Page 4 of 5

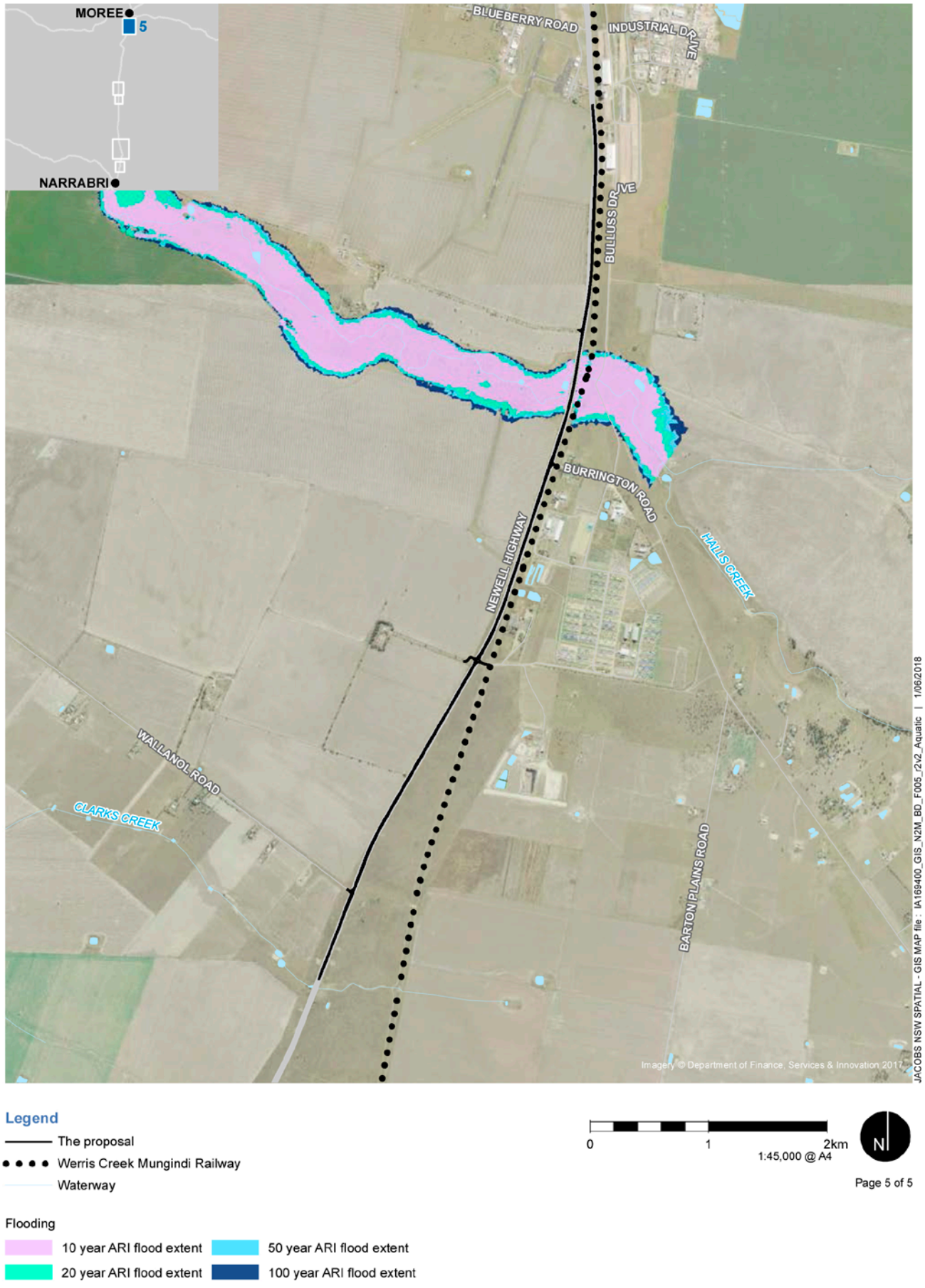


Figure 3.3 Aquatic surface water ecosystems, Page 5 of 5

3.4 Groundwater dependence of terrestrial and aquatic ecosystems

The level of groundwater dependence of vegetation communities in the study area has been identified using the Atlas of GDE (Bureau of Meteorology, 2017) and the *Risk Assessment Guidelines for Groundwater Dependant Ecosystems* released by the NSW DPI (Kuginis et al., 2012).

3.4.1 Classification of groundwater dependant 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).

3.4.2 Groundwater dependant ecosystems on the proposal site

The level of groundwater dependence and potential for interaction is identified for terrestrial ecosystems in the study area is identified in Table 3-7

Figure 3.4 shows the distribution of these vegetation communities in the study area.

Aquatic groundwater dependant ecosystems

Mapped aquatic GDEs in the locality between Narrabri and Moree are restricted to rivers and larger creeks including:

- Namoi River/Narrabri Creek (proposal >5km north)
- Mehi River (proposal >2km north)
- Gurley Creek (proposal >10km away)
- Tycannah Creek (proposal >5km north)
- Gehan Creek (proposal 50m north).

GDEs associated with these waterbodies would consist of:

- Baseflow streams (subsurface component and surface/free-water component), and
- Groundwater dependent wetlands.

These waterways are likely to be facultative GDEs which are chiefly reliant on surface water but require groundwater in some locations such as permanent wetlands and permanent pools but not in others such as the main channel and ephemeral wetland areas. The areas reliant on groundwater would be considered to be in the facultative-highly-dependent category with other parts of the systems falling in to facultative-proportional category.

All of these aquatic GDEs are quite distant from the proposal no lands within the banks of these waterbodies or in close proximity will be affected by the proposal. They area thus unlikely to be affected by the localised effects on groundwater likely to result from the increased width and elevation of the roadway.

The proposal is located only about 50 metres north of Gehan Creek, south of Bellata, which is mapped as a moderate potential GDE. There is therefore some potential for impacts on the GDE, associated with altered groundwater movement patterns associated with the proposal. The proposal will not directly affect lands within the banks of Gehan Creek or adjacent, regularly inundated areas and is unlikely to result in significant changes to surface water penetration or groundwater movement. It is therefore unlikely to significantly affect this GDE.

Other smaller streams in the study are which have only ephemeral flow and intermittent expression of surface water are unlikely to have baseflow characteristics and are unlikely to be significantly dependent on groundwater. These systems would be in the facultative-opportunistic category. They are therefore unlikely to be significantly affected by the likely minor influence of the proposal on groundwater.

Figure 3.4 Aquatic GDEs

Terrestrial groundwater dependant ecosystems

Most of the terrestrial ecosystems of the study area are mapped as having low potential to be GDEs. Two communities are however considered to have significant potential for groundwater dependence as shown in Table 3.7. The low potential GDEs would be classified either as non-dependent ecosystems or as facultative-opportunistic GDEs with only minor interaction with groundwater. Figure 3.5 shows the distribution of terrestrial GDEs in the study area

Table 3-7 Level of groundwater dependence of terrestrial ecosystems in study area

Ecosystem	Potential for GDE interaction (BoM, 2017)	Type of GDE (Kuginis *et al.* 2012)	Likely type and degree of groundwater dependence (Kuginis *et al.* 2012)
Carbeen +/- Coolibah grassy woodland on floodplain clay loam soil on north-western NSW floodplains,	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.
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW	Moderate 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.
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	Low potential GDE - from regional studies	Groundwater dependent terrestrial ecosystem (phreatophytic)	Non-dependent ecosystems or possibly facultative-opportunistic May use groundwater where available during times of water stress but to be dependent chiefly on rainfall.
Brigalow viney scrub open forest on alluvial often gilgaied clay from Pilliga Scrub to Goondi			
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion			
Poplar Box - White Cypress Pine - Wilga - Ironwood shrubby woodland on red sandy-loam soils in the Darling Riverine Plains Bioregion and Brigalow Belt			
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains			
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion			

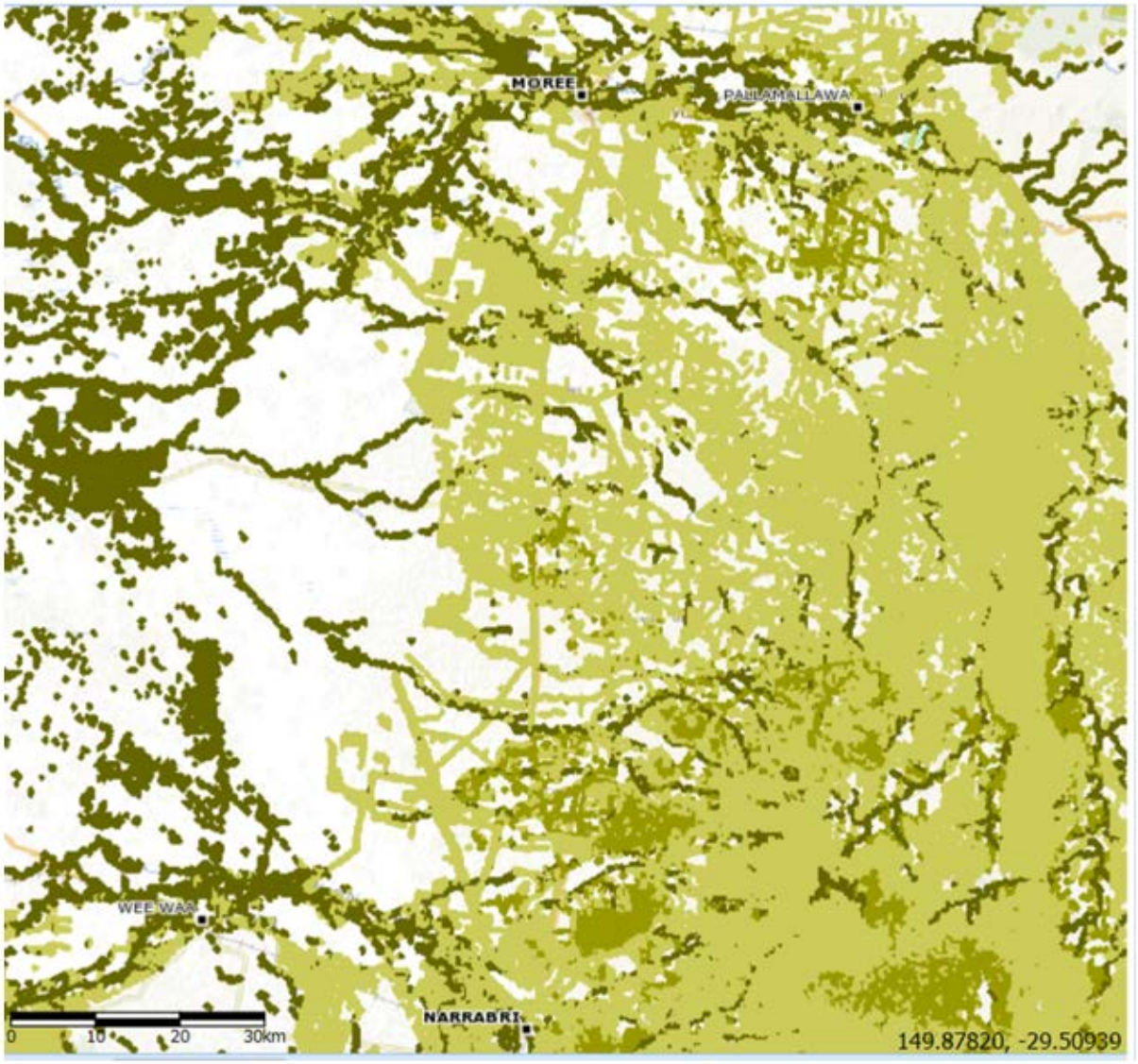


Figure 3.5 Terrestrial GDEs

Subterranean groundwater dependant ecosystems

There is no data on the GDE atlas for subterranean GDEs in the region. Apart from the subsurface component of the streams discussed under aquatic ecosystems, no other shallow subterranean GDEs are likely to occur in the study area as the locality lacks the limestone and porous sedimentary geology types most closely associated with these systems. The proposal is therefore unlikely to significantly impact subterranean GDEs.

3.5 Threatened ecological communities - terrestrial

A number of state and Commonwealth listed terrestrial threatened ecological communities were recorded across the study area. Table 3-8 lists the terrestrial threatened ecological communities and condition thresholds. Communities listed under the BC Act are discussed in detail in this section with communities listed under the EPBC Act discussed in Section 3.9.1 and aquatic threatened ecological communities listed under the FM Act discussed in Section 3.6. Communities listed under the BC Act are described in detail below. The distribution and extent of threatened ecological communities in the study area is mapped in Figure 3.2

BC Act (NSW):

- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered)
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)
- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered).

EPBC Act (Commonwealth):

- Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered)
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered)
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered)
- Weeping Myall Woodlands (Endangered).

Table 3-8 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	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)	Yes. Refer to Section 3.8.1 for discussion of EPBC Act listed TECs.	Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion and are dominated in parts and co-dominated in other by Brigalow (*Acacia harpophylla*). 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. The occurrence of the PCT in Moderate to Good (Relatively Intact) condition is dominated by native species in all vegetation layers. Part of the occurrence has recently been burnt and is regenerating and therefore does not currently meet structural benchmarks for the PCT. Other, unburnt areas meet all condition benchmarks for the PCT. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition. Both the burnt and unburnt areas are consistent with the determination for the community.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland 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.
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)	No	Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate/ Good (Moderately disturbed)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion and have upper strata dominated by *Eucalyptus camaldulensis, Eucalyptus populnea, Casuarina cristata, Geijera parviflora* and *Acacia salicina*, all of which are consistent with the TEC determination. In some locations, the patches also contain occasional specimens of *Eucalyptus coolabah* and the surrounding landscape contains scattered individuals of *Corymbia tessellaris* (Carbeen). The ground stratum in the Moderate/ Good (Moderately disturbed) patches of this community in the study area is moderately to highly disturbed but still retains some species characteristic of the TEC such as *Einadia nutans, Paspalidium jubiflorum* and *Eriochloa crebra*. The Moderate to Poor (Derived Grassland) patches of the associated PCT are generally at least co-dominated by exotic species. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition. Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland 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.

BC Act listed threatened ecological community	EPBC Act listed threatened ecological community?	Associated plant community type (PCT/s)	Relevant condition class	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland 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.
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered)	Yes. Refer to Section 3.8.1 for discussion.	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147) Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion. The areas of PCT 147 have an upper strata dominated by *Ehretia membranifolia, Ventilago viminalis* and *Geijera parviflora* with occasional *Eucalyptus populnea* and *Casuarina cristata*. *Notelaea microcarpa* and *Carissa ovata* were found in the middle stratum and a variety of characteristic ground stratum species were recorded, such as *Austrostipa verticillata, Brunoniella australis, Dichondra s. A,* and *Dichanthium sericeum*. The floristic composition of the vegetation observed and the associated PCT clearly match the description of the *Southern semi-evergreen vine thickets* unit of the TEC as described in the national recovery plan for the TEC and the associated PCT is listed as being part of the TEC in the BioNet Vegetation classification database. The areas of PCT 55 in the study area consist of small-scale mixture of areas dominated by *Casuarina cristata* and areas dominated by *Geijera parviflora* with *Notelaea microcarpa*, *Alectryon oleifolius* and *Capparis lasiantha*. The floristic composition of the vegetation observed and the associated PCTs match the BC Act determination for the TEC and the associated PCTs are listed as being part of the TEC in the BioNet Vegetation classification database. The occurrences of the PCTs are dominated by native species in all vegetation layers. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland 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.

BC Act listed threatened ecological community	EPBC Act listed threatened ecological community?	Associated plant community type (PCT/s)	Relevant condition class	Discussion regarding inclusion in the community as described in the BC Act scientific committee determination
-	Not currently listed but recommended for listing by the TSSC. Refer to Section 3.8.1 for discussion.	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	N/A	N/A
-	Yes. Refer to Section 3.8.1 for discussion.	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52).	N/A	N/A
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered)	Yes. Refer to Section 3.8.1 for discussion.	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South and/or Darling Riverine Plains bioregions, have upper strata dominated by Weeping Myall (*Acacia pendula*) or co-dominated by Weeping Myall and Belah (*Casuarina cristata*). *Myoporum montanum* was abundant in the middle stratum with other species such as *Pittosporum angustifolium* and *Geijera parviflora*. A variety of characteristic ground stratum species were recorded, such as *Panicum decompositum, Solanum esuriale, Eriochloa sp.,* and *Dichanthium sericeum*. The floristic composition of the vegetation observed and the associated PCT clearly match the BC Act determination for the TEC and the associated PCT is listed as being part of the TEC in the BioNet Vegetation classification database. The Moderate to Good (Relatively Intact) occurrences of the PCT are dominated by native species in all vegetation layers. There are no condition criteria in the determination for inclusion and exclusion of patches of characteristic vegetation on the basis of condition.
			Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some other determinations, the determination for the community does not explicitly include derived native grassland. Derived native grassland 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.

3.6 Threatened species and populations

Targeted surveys were undertaken throughout the study area for all threatened species considered as having a moderate to high likelihood of occurring. The initial list was based mostly on the findings of the PEI, though contained some additional species not previously considered. The results of the surveys are shown below, 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).

The distribution of threatened species discussed in the following section and known records of threatened flora and fauna from the broader locality is provided Figure 3.6.

3.6.1 Habitat assessment and surveys results for plants

Field surveys identified three threatened flora species within the study area and a further 12 flora species as having a moderate to high likelihood of occurring. These species are listed as discussed in Table 3-9.

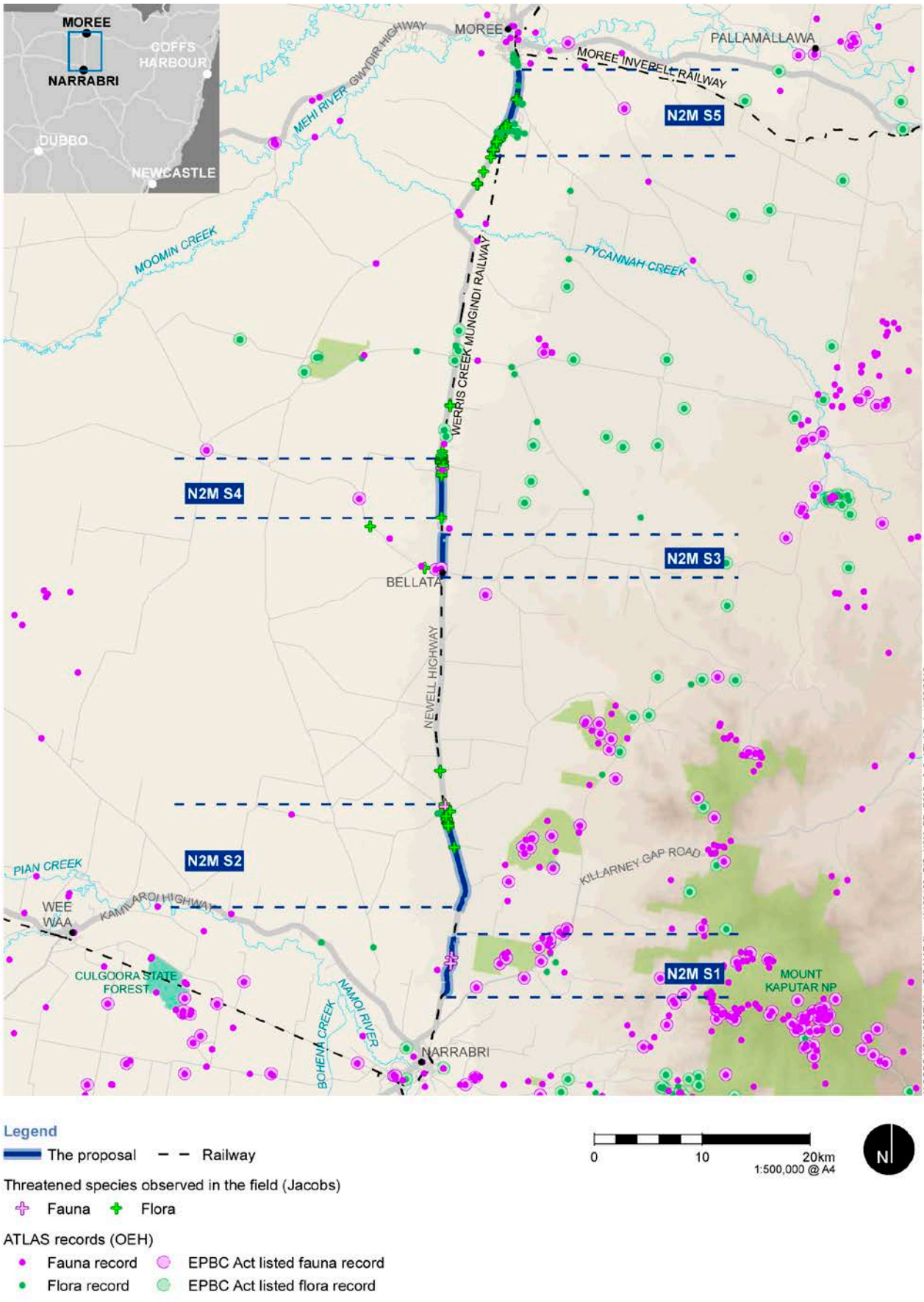


Figure 3.6 Threatened flora and fauna locations in the study area and locality

Table 3-9 Habitat assessment and surveys results for threatened plant species

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Digitaria porrecta	Finger Panic Grass	-	E	**Recorded** in the study areas of N2MS2, N2MS4 and N2MS5 during field surveys in a variety of PCTs (55, 27, 52). Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Homopholis belsonii	Belson's Panic	V	E	**Recorded;** found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs (27, 35, 52, 55, 56). Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Desmodium campylocaulon	Creeping Tick-trefoil	-	E	**Recorded**; in the study area of N2MS5 during field surveys. Probable elsewhere in associated habitat. Associated habitat on site includes: • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27) • Brigalow viney scrub open forest (PCT 445)
Dichanthium setosum	Bluegrass	V	V	High – suitable habitat widespread. Previously recorded immediately adjacent to the study area. Not recorded during the field surveys but is an inconspicuous species, especially when found amongst similar Dichanthium and Bothriochloa species. Associated habitat on site includes: • Weeping Myall open woodland (PCT 27) • Poplar Box - Belah woodland (PCT 56) • Belah woodland (PCT 55) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Bertya opponens	Coolabah Bertya	V	V	Low – all records of this species are from Jacks Creek to the south of Narrabri. • A small amount of potential habitat is present; • Poplar Box - White Cypress Pine woodland (PCT 397).
Diuris tricolor	Pine Donkey Orchid	-	V	Moderate – species not known from locality but is known from a relevant IBRA sugregion and study area contains potential habitat. Survey timing was not suitable for detection of this species. Associated habitat on site includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) • Poplar Box - Belah woodland (PCT 56).

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Swainsona sericea	Silky Swainson-pea	-	V	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Survey timing was not suitable for detection of this species. Associated habitat on site includes: • Weeping Myall open woodland (PCT 27) • Poplar Box - Belah woodland (PCT 56) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Tylophora linearis	-	E	V	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat on site includes: • Poplar Box - White Cypress Pine woodland (PCT 397).
Lepidium aschersonii	Spiny Peppercress	V	V	Moderate– recorded in the locality and suitable habitat are found in study area. Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Poplar Box - Belah woodland (PCT 56)
Polygala linariifolia	Native Milkwort	-	E	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat on site includes: • Poplar Box - White Cypress Pine woodland (PCT 397).
Pterostylis cobarensis	Greenhood Orchid	-	V	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat. Survey timing was not suitable for detection of this species. Associated habitat on site includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Swainsona murrayana	Slender Darling Pea	V	V	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat. Survey timing was marginal for detection of this species. Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Lepidium monoplocoides	Winged Peppercress	E	E	Moderate. Recently recorded near Narrabri and in the Pilliga area. Associated habitat on site includes: • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Sida rohlenae	Shrub Sida	-	E	Moderate. Known from the Brigalow Belt south but not the relevant subregions. Associated habitat on site includes: • Poplar Box - Belah woodland (PCT 56) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Cyperus conicus		-	E	Moderate. Recorded in the locality and associated habitat is present. Associated habitat on site includes: • Poplar Box - White Cypress Pine woodland (PCT 397) • Belah woodland (PCT 55) • Poplar Box - Belah woodland (PCT 56) • Carbeen +/- Coolabah grassy woodland (PCT 628)

3.7 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 the Act.

Lowland Darling River aquatic ecological community

All of the waterways within the study area are tributaries of the Darling River via the Namoi River and Gwydir Rivers. 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.

Excluded from the community are man-made/artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs.

Table 3-10 Character of the Lowland Darling River aquatic ecological community in the study area

Water body and location	Character of the EEC in the location
Halls Creek south of Moree (north of Burrington Road) Segment: N2MS5	Surface water observed in pools at the time of survey; the presence of fringing vegetation (*Typha* sp.) suggests that that the ponds may contain water even during low rainfall periods. Fish and other aquatic species may permanently the occupy the stretch of the creek within the study area and would utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.
Tookey Creek North of Bellata near Tookey Creek rest area Segment: N2MS4	Appears to be an intermittently flowing creek that retains water for extended periods in a series of disconnected pools after flow ceases. Considered to be habitat for a variety of fish and aquatic invertebrates possibly including threatened species of fish. There was surface water in pools at the time of survey but aerial photography suggests that these pools are ephemeral.
Bobbiwaa Creek near Junefield Road North of Narrabri Segment: N2MS2	A waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna. No standing water or obvious ephemeral pools were recorded. Aquatic species are unlikely to permanently occupy the stretch of the creek within the study area; if present they may occur in deeper pool refugia upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.
Tarlee Creek north of Edgeroi Segment: N2MS2	Tarlee Creek is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna. No standing water observed but it appears that shallow ephemeral pools form within the waterway after rain events; Aquatic species are unlikely to permanently occupy the stretch of the creek within the study area but are likely to utilise the habitat in the study area during high rainfall periods, particularly for movement between more permanent habitats.
Unnamed stream south of Edgeroi -between Smithfield Road and Couradda Road Segment: N2MS2	The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna. A small pool with no emergent aquatic vegetation and an area of impeded drainage (ephemeral wetland) observed in the study area. It appears that shallow ephemeral pools form within the waterway in the study area after rain events; aquatic species are likely to utilise the habitat in the study area when it is inundated and for movement between these more permanent habitats.
Gehan Creek north of Bellata 1 north of Millie Road	No standing water observed in the study area but the surrounding area is likely to form an ephemeral wetland after heavy rain. The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna. It appears that shallow ephemeral pools form

Water body and location	Character of the EEC in the location
Segment: N2MS3	within the waterway in the study area after rain events; possibly permanent pools (dams) are located in the stream channel outside of the study area. Aquatic species are unlikely to permanently occupy the stretch of the creek within the study area but may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.
Unnamed stream north of Bellata Segment: N2MS3	No standing water observed in the natural stream channel in the study area; a dam lined with emergent aquatic vegetation (*Typha* sp. etc) is located at the edge of the study area. The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna Aquatic species are unlikely to permanently occupy the stretch of the creek within the study area but may occupy the dam at the edge; if present it may occur in deeper pool refugia (farm dams) upstream and/or downstream and may utilise the habitat in the study area during high rainfall periods for movement between these more permanent habitats.
Unnamed tributary of Tookey Creek south of Brigalow Lane Segment: N2MS4	No standing water observed but evidence of shallow ephemeral pools recorded. The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna. It appears that shallow ephemeral pools form within the waterway after rain events; possibly permanent pools (farm dams) are located close to the channel outside of the study area. Aquatic fauna species are unlikely to permanently occupy the stretch of the creek within the study area but may utilise the habitat in the study area during high rainfall periods and for movement between these more permanent habitats.
Unnamed highly modified tributary of Halls Creek South of Burrington Road Moree Segment: N2MS5	No standing water observed but an area of impeded drainage (ephemeral wetland) observed in the study area. The stream is a waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna. Aquatic fauna species are unlikely to permanently occupy the stretch of the stream within the study area but are likely to do so during high rainfall periods and for movement between these more permanent habitats.

3.7.1 Habitat assessment and survey results for threatened fauna

Field surveys identified two threatened bird species within the study area and a further 36 flora species as having a moderate to high likelihood of occurring, including 22 birds, 11 mammals, two reptiles and one invertebrate. These species are listed as discussed in Table 3-11.

Table 3-11 Habitat assessment and surveys results for threatened fauna

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	-	V	**Recorded**; confirmed in the study areas of N2MS1 and N2MS2 during field surveys. Likely also in N2MS3 and N2MS4. Habitat widespread. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Calyptorhynchus lathami	Glossy-black Cockatoo	-	V	**Recorded**; likely presence confirmed by chewed cones in roadside Belah in N2MS4 during field surveys. Belah habitat widespread. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397)
Circus assimilis	Spotted Harrier	-	V	High – known from locality. Suitable habitat widespread; the most suitable habitat includes the edges of ephemeral wetlands and creeks. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Brigalow viney scrub open forest (PCT 445) • Weeping Myall open woodland (PCT 27) • Queensland Bluegrass +/- Mitchell Grass (PCT 52)
Macropus dorsalis	Black-striped Wallaby	-	E	High – many of records of this species from the Pilliga National Park. Some records also along the road alignment. Suitable habitat present in the study area includes: • Brigalow viney scrub open forest (PCT 445) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - White Cypress Pine woodland (PCT 397).

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	High – recorded in the locality at moderate frequency and suitable habitat widespread in study area. • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27) • Queensland Bluegrass +/- Mitchell Grass (PCT 52).
Chthonicola sagittata (Pyrrholaemus sagittatus)	Speckled Warbler	-	V	High – suitable habitat present and the species has been frequently recorded in the locality, chiefly in larger patches of woodland in the east. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - White Cypress Pine woodland (PCT 397)
Hieraaetus morphnoides	Little Eagle	-	V	High – suitable habitat widespread and recorded at moderate frequency; including a record immediately adjacent to the study area. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Weeping Myall open woodland (PCT 27) • Brigalow viney scrub open forest (PCT 445) • Queensland Bluegrass +/- Mitchell Grass (PCT 52)
Ninox connivens	Barking Owl	-	V	High – suitable habitat widespread through study area. Recorded in larger woodland areas NE of Narrabri and in close proximity to Moree. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
Grantiella picta	Painted Honeyeater	V	V	High – suitable habitat widespread, particularly in areas with mistletoes; has been recorded in the Little Bumble TSR (road reserve) between Narrabri and Moree. Associated habitats in the study area include: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Chalinolobus picatus	Little Pied Bat	-	V	High; likely to forage in the study area and may roost in hollow-bearing trees and bridges/culverts. Associated habitats in the study area include: • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	High – this species may forge in woodland/forest and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Phascolarctos cinereus	Koala	V	V	High – identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes:

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
				• Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397).
Daphoenositta chrysoptera	Varied Sittella	-	V	High. Frequently recorded in the locality and habitat is widespread in the study area. • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	Moderate – infrequently recorded in the locality but suitable habitat is present. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subsp.)	-	V	Moderate – infrequently recorded but suitable habitat is present in study area. Associated habitat in the study area includes: • Carbeen +/- Coolabah grassy woodland (PCT 628)
Hoplocephalus bitorquatus	Pale-headed Snake	-	V	Moderate – may occur in the study area, particularly around vegetated creek lines. Associated habitat in the study area includes: • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Burhinus grallarius	Bush Stone-curlew	-	E	Moderate – may utilise woodland habitats; recorded infrequently in the locality. Associated habitat in the study area includes: • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - White Cypress Pine woodland (PCT 397)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
				• Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Sminthopsis macroura	Stripe-faced Dunnart	-	V	Moderate – no records in locality, however this species occupies the same habitat as the common fat-tailed dunnart, of which there are records in Narrabri, Bellata and Moree. Unlikely there has been comprehensive surveys for this species in the study area. Associated habitat present in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Falco hypoleucos	Grey Falcon	-	E	Moderate – not common in the locality however this species may pass through the study area on occasion. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Hamirostra melanosternon	Black-breasted Buzzard	-	V	Moderate – occasionally recorded in the locality, this species may hunt around creeks, woodlands and grasslands in the study area. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397)
Tyto novaehollandiae	Masked Owl	-	V	Moderate – several records of this species in Pilliga NP, Bobbiwaa Conservation Area and Moema NP. This species is likely to use the study area for hunting, though may also nest in the larger hollows. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
Neophema pulchella	Turquoise Parrot	-	V	Moderate – some suitable habitat found in the study area. Associated habitat in the study area includes: • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - White Cypress Pine woodland (PCT 397) • Poplar Box - Belah woodland (PCT 56).
Aepyprymnus rufescens	Rufous Bettong	-	V	Moderate – species not recorded in locality (nearest records are in the Pilliga region) but the study area contains potential habitat. Associated habitats in the study area include: • Brigalow viney scrub open forest (PCT 445) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147)
Lophoictinia isura	Square-tailed Kite	-	V	Moderate – species seen 20km south-eat of Moree and in Moree. Likely to pass through the study area on occasion. May nest in large trees in the study area. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27).
Jalmenus eubulus	Pale Imperial Hairstreak	-	CE	Moderate – suitable habitat present in study area in N2MS 4. No records in the locality, however this does not discount the potential for this species to occur as it is only known from a single population. Associated habitat in the study area includes: • Brigalow viney scrub open forest (PCT 445).
Stagonopleura guttata	Diamond Firetail	-	V	Moderate – suitable habitat widespread but few local records. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Ardeotis australis	Australian Bustard	-	E	Moderate – suitable habitat widespread in study area but the species has been infrequently recorded. Associated habitat in the study area includes: • Belah woodland (PCT 55)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
				• Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Anomalopus mackayi	Five-clawed Worm-skink	V	E	Moderate – suitable habitat widespread. Five atlas records within the locality. All of the proposal is in the middle of the 'likely-to-occur' distribution (DSEWPaC 2011), with the floodplain area around Bellata (N2MS3) also being in the 'known' distribution of the species. • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Falco subniger	Black Falcon	-	V	Moderate – suitable habitat widespread. Recorded locations include Narrabri rubbish dump. This species may hunt and perch in the study area; nesting habitat in the study area is likely to be marginal due to its proximity to the highway. 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: • Carbeen +/- Coolabah grassy woodland (PCT 628) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Petaurus norfolcensis	Squirrel Glider	-	V	Moderate – this species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. Although vegetation in the study area is very fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands (e.g. Bobbiwaa Creek is connected to the conservation area). • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - White Cypress Pine woodland (PCT 397)
Glossopsitta pusilla	Little Lorikeet	-	V	Moderate – this species has been seen near Moree. Not common in the area though is likely to pass through. Associated habitat in the study area includes: • Poplar Box - White Cypress Pine woodland (PCT 397).

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act or FM Act	
Mormopterus eleryi	Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	-	E	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Brigalow viney scrub open forest (PCT 445)
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: • Belah woodland (PCT 55) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27) • Brigalow viney scrub open forest (PCT 445)
Vespadelus troughtoni	Eastern Cave Bat	-	V	Moderate – this species may forage in and around forest/woodland and roost in Fairy Martin mud nests in bridges and culverts in the study area. Associated habitat present in the study area includes: • Belah woodland (PCT 55) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397)
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	V	Moderate – this species may forage in and around woodland/forest and roost in bridges/culverts in the study area. Associated habitat present in the study area includes: • Belah woodland (PCT 55) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397)
Polytelis swainsonii	Superb Parrot	V	V	Moderate – this species previously recorded occasionally in and around Moree. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27) • Queensland Bluegrass +/- Mitchell Grass (PCT 52)

3.7.2 Aquatic species and populations

Table 3-12 Habitat assessment results for aquatic species

Species name	Common name	Status		Likelihood of occurrence
		EPBC Act	FM Act	
Mogurnda adspersa	Purple Spotted Gudgeon	-	E	Moderate No records in the locality. The DPI indicative distribution for the species (high probability of occurrence) includes: • Bobbiwaa Creek (2nd or 3rd order stream; braided) (no standing water) • Tarlee Creek north of Edgeroi (1st order) and some small areas of shallow standing water) • Unnamed stream south of Edgeroi (1st order) (ephemeral wetland and some small areas of standing water) • Unnamed stream north of Bellata 1 (1st order) (no standing water – dammed upstream and downstream) • Unnamed stream north of Bellata (1st order) (standing water in Typha-fringed dam approximately 20m from road; dammed upstream and downstream) • Tookey Creek (1st or 2nd order with moderate sized ephemeral ponds; no standing water) Unmapped but possible habitat in the study area includes: • Halls Creek south of Moree (north of Burrington Road) (standing water and riparian vegetation present).
Tandanus tandanus	Eel Tailed Catfish	-	EP	Moderate Apparently recorded via electrofishing in 2013 in Halls Creek south of Moree and in 2007 in Tycannah Creek. The DPI indicative distribution for the species (high probability of occurrence) includes: • Bobbiwaa Creek (2nd or 3rd order stream; braided) (no standing water). • Unmapped but possible habitat in the study area includes: • Halls Creek south of Moree (north of Burrington Road) (standing water and riparian vegetation present).

3.8 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 current alignment of the Newell Highway divides the remaining habitats in the study area. The barriers posed by the Newell Highway 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, roadside vegetation and small patches of vegetation which act as stepping-stones between larger area 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.

Some east – west wildlife connectivity is provided in the landscape within and around the study area by:

- Remnant riparian vegetation along larger streams including:
  - Bobbiwa Creek in N2MS2
  - Tookey Creek in N2MS4
  - Halls Creek in N2MS5
- Thin strips of vegetation of vegetation along minor road reserves (currently existent and gazetted); e.g.
  - Penneys Road and Brigalow Road in N2MS4
  - Couradda Road in Edhgeroi which is tenuously connected to Bobbiwaa Cca Zone 3 State Conservation Area and Moema National Park.
  - Smithfield Lane in Narrabri which is tenuously connected to Bobbiwaa Cca Zone 3 State Conservation Area.
- Small contiguous patches of vegetation and scattered trees within the surrounding agricultural land e.g.:
  - Patches near Homestead Road in Edgeroi
  - Patches near Millie-Bellata Road north of Bellata
- Narrow strips of vegetation on fencelines and gazetted (though not yet existent) roads; e.g:
  - A strip of vegetation connecting the highway to Killarney State Conservation Area
  - Grassland areas east of Hannah Street, Moree

North – south connectivity in the study area and surrounding landscape is primarily along the Newell Highway and the adjacent railway line including:

- Immediately south of Edgeroi, where the main north-south habitat connectivity feature is the vegetation within the Newell Highway road reserve.
- Immediately north of Bellata where vegetation along the road and rail corridors links a very large area of habitat (around 700 ha) in the west around Millie Road with a large area of habitat (>300 ha) associated with the Newell Highway and railway corridors and Waterloo Creek in the north.
- North and south of Halls Creek-Burrington Road, connecting the extensive area of natural grassland (~475 ha) with other extensive grassland and woodland areas to the north, and via Halls Creek to the riparian zone of the Mehi River.

3.9 Matters of National Environmental Significance

3.9.1 Threatened ecological communities

The plant community types which are associated with nationally listed threatened ecological communities are discussed in relation to diagnostic feature and condition thresholds in Table 3.13.

Table 3-13 Nationally listed threatened ecological communities and condition thresholds

Threatened ecological community	Associated plant community type (PCT/s)	Relevant condition class	Discussion
Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered).	Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are dominated in parts and co-dominated in others by Brigalow (*Acacia harpophylla*). The floristic composition of the vegetation observed and the associated PCT clearly matches the EPBC Act Listing Advice and Approved Conservation Advice for the TEC. The PCT is listed as being part of the TEC in the BioNet Vegetation classification database and Approved Conservation Advice for the TEC. The occurrence of the PCT in Moderate to Good (Relatively Intact) condition is dominated by native species in all vegetation layers. Part of the occurrence has recently been burnt and is regenerating and therefore does not currently meet structural benchmarks for the PCT. Other, unburnt areas meet all condition benchmarks for the PCT. Both the burnt and unburnt areas are consistent with the determination for the community. Due to the presence of mature Brigalow, it is clear that the patch has not been cleared in the last 15 years. Exotic perennial plant cover was very low (much less than 50%) and all patches of the community in the study area are larger than 0.5 hectares. All Moderate to Good (Relatively Intact) areas of the TEC mapped therefore meet the condition criteria for the EPBC Act TEC listing.
		Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some for some other TECs, the Listing Advice and Approved Conservation Advice for the community do not explicitly include derived native grassland. Derived native grassland 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.
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered)	Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147) Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South bioregion. The areas of PCT 147 have an upper strata dominated by *Ehretia membranifolia, Ventilago viminalis* and *Geijera parviflora* with occasional *Eucalyptus populnea* and *Casuarina cristata*. *Notelaea microcarpa* and *Carissa ovata* were found in the middle stratum and a variety of characteristic ground stratum species were recorded, such as *Austrostipa verticillata, Brunoniella australis, Dichondra s. A,* and *Dichanthium sericeum*. The floristic composition of the vegetation observed and the associated PCT clearly match the description of the *Southern semi-evergreen vine thickets* unit of the TEC as described in the national recovery plan for the TEC and the associated PCT is listed as being part of the TEC in the BioNet Vegetation classification database. The areas of PCT 55 in the study area consist of small-scale mixture of areas dominated by *Casuarina cristata* and areas dominated by *Geijera parviflora* with *Notelaea microcarpa*, *Alectryon oleifolius* and *Capparis lasiantha*. There are no condition thresholds listed for the EPBC Act community. The occurrences of the associated PCTs are dominated by native species in all vegetation layers. There are no condition criteria for inclusion and exclusion of patches of characteristic vegetation on the basis of condition. All of the Moderate to Good (Relatively Intact) condition class of the associated PCTs considered to be consistent with the EPBC Act listed community.

Threatened ecological community	Associated plant community type (PCT/s)	Relevant condition class	Discussion
		Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Unlike some for some other TECs, the Listing Advice and national recovery plan for the community do not explicitly include derived native grassland. Derived native grassland 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.
Poplar Box Grassy Woodland on Alluvial Plains (not currently listed but recommended by the TSSC for listing as Endangered)	Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	Larger patches of Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (PCT 56), are likely to corresponds with Poplar Box Grassy Woodland on Alluvial Plains as described in the draft conservation and listing advice. The thresholds for inclusion of patches of associated vegetation in the listed community are not clearly described in the draft advice, particularly as they relate to *Appendix F – Remnant roadside vegetation* which is unclear with regard to roadside patches in the <10m and 10-15m width ranges. Due to this lack of clarity, the actual amount of the vegetation which would meet the definition of the community cannot be accurately calculated. It would, however, only be a subset of the 13.73 ha of *Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW* (PCT 56), that would be impacted by the proposal.
		Moderate to Poor (Derived Grassland)	This condition class would generally be excluded from the community except where it clearly dominated by native species and is located within 30m of the outside edge of a patch of the community which has canopy cover.
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered)	Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	The relevant areas of vegetation are tussock grasslands dominated by grasses in the genera *Dichanthium, Astrebla, Austrostipa, Bothriochloa* and *Chloris*, and other tussock grasses and are located on fine-textured alluvial plains (Moree Plains) of northern New South Wales. They also contain a high diversity of other herbaceous plants including daises (Asteraceae) and legumes (Fabaceae). The emergent shrub layer consists of *Acacia farnesiana* which does not appear to affect the abundance of grass species. The tree canopy is absent throughout the vast majority of the community in the study area and, where present, comprises less than 10% of projective crown cover. Each of the patches surveyed meet the 'Good quality' and 'Best quality' condition as they are greater than 0.5 ha in area and have the following characteristics as measured in a 0.1 ha (e.g. 50 m x 20 m) area selected in an area with the most apparent native perennial grass species: • Contain more than 4 native perennial grass species from the indicator species list in a 0.1 ha area • At least 200 native perennial grass tussocks per 0.1 ha • Total projected canopy cover of shrubs (>0.5m) of less than 30%. • Perennial non-woody introduced weed species ranging from less than 5% to approximately 25% of the total projected crown cover. Despite detailed floristic analysis being undertaken over a smaller 0.04 ha area, each plots still contained at least four indicator species, including a combination of the following species; *Anthosachne (Elymus) plurinervis, Astrebla elymoides, Astrebla lappacea, Austrostipa aristiglumis, Bothriochloa biloba, Dichanthium sericeum, Digitaria divaricatissima, Panicum decompositum.*

Threatened ecological community	Associated plant community type (PCT/s)	Relevant condition class	Discussion
		Moderate to Poor (Derived Grassland)	Lower condition areas do not meet condition thresholds with regard to perennial non-woody introduced weed species cover and/or indicator native species diversity.
Weeping Myall Woodlands (Endangered)	Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	The relevant patches of vegetation are located in the Brigalow Belt South and/or Darling Riverine Plains bioregions, have upper strata dominated by Weeping Myall (*Acacia pendula*) or co-dominated by Weeping Myall and Belah (*Casuarina cristata*). *Myoporum montanum* was abundant in the middle stratum with other species such as *Pittosporum angustifolium* and *Geijera parviflora*. A variety of characteristic ground stratum species were recorded, such as *Panicum decompositum, Solanum esuriale, Eriochloa sp.,* and *Dichanthium sericeum*. The floristic composition of the vegetation observed and the associated PCT clearly matches the EPBC Act Listing Advice and Approved Conservation Advice for the TEC. The PCT is listed as being part of the TEC in the BioNet Vegetation classification database and Listing Advice for the TEC. The Moderate to Good (Relatively Intact) occurrences of the PCT are dominated by native species in all vegetation layers. Each patch of the mapped Moderate to Good (Relatively Intact) condition class has: • tree canopy dominated (at least 50% of trees present) by living and/or dead Weeping Myall; and • at least 5% tree canopy cover; and • an area of at least 0.5 ha; and • has more than two layers of regeneration of Weeping Myall present; or • the tallest layer of living or dead Weeping Myall is at least 4 m tall and of the vegetative cover present, at least 50% is comprised of native species. All Moderate to Good (Relatively Intact) areas of the TEC mapped therefore meet the condition criteria for the EPBC Act TEC listing.
		Moderate to Poor (Derived Grassland); only in close association with the relatively Intact condition class.	Derived native grassland is excluded from consideration as part of the TEC in this assessment except where it is clearly dominated by native species and located 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.

3.9.2 Threatened species and populations

Table 3.14 and Table 3.15 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 3-14 Habitat assessment and survey results for nationally listed threatened species of plants

Species name	Common name	EPBC Act Status	Potential occurrence
Tylophora linearis	-	E	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat on site includes: • Poplar Box - White Cypress Pine woodland (PCT 397)
Lepidium monoplocoides	Winged Peppercress	E	Moderate. Recently recorded near Narrabri and in the Pilliga area. Associated habitat on site includes: • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Homopholis belsonii	Belson's Panic	V	**Recorded;** found in study area during field surveys in a variety of PCTs (27, 35, 52, 55, 56). Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Dichanthium setosum	Bluegrass	V	High – suitable habitat widespread. Previously recorded immediately adjacent to the study area. Not recorded during the field surveys but is an inconspicuous species, especially when found amongst similar Dichanthium and Bothriochloa species. Associated habitat on site includes: • Weeping Myall open woodland (PCT 27) • Poplar Box - Belah woodland (PCT 56) • Belah woodland (PCT 55) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628)
Bertya opponens	Coolabah Bertya	V	Low – all records of this species are from Jacks Creek to the south of Narrabri. A small amount of potential habitat is present; • Poplar Box - White Cypress Pine woodland (PCT 397).
Lepidium aschersonii	Spiny Peppercress	V	Moderate– recorded in the locality and suitable habitat are found in study area. Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Poplar Box - Belah woodland (PCT 56)
Swainsona murrayana	Slender Darling Pea	V	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat. Survey timing was marginal for detection of this species. Associated habitat on site includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Poplar Box - Belah woodland (PCT 56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27) • Carbeen +/- Coolabah grassy woodland (PCT 628)

Table 3-15 Habitat assessment and survey results for nationally listed threatened fauna

Species name	Common name	EPBC Act Status	Likelihood of occurrence
Grantiella picta	Painted Honeyeater	V	High – suitable habitat widespread, particularly in areas with mistletoes; has been recorded in the Little Bumble TSR (road reserve) between Narrabri and Moree. Associated habitats in the study area include: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27)
Phascolarctos cinereus	Koala	V	High – identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes: • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397).
Anomalopus mackayi	Five-clawed Worm-skink	V	Moderate – suitable habitat widespread. • Belah woodland (PCT 55) • Brigalow viney scrub open forest (PCT 445) • Carbeen +/- Coolabah grassy woodland (PCT 628) • Poplar Box - Belah woodland (56) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Queensland Bluegrass +/- Mitchell Grass (PCT 52) • Weeping Myall open woodland (PCT 27)
Nyctophilus corbeni	Corben's Long-eared Bat	V	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: • Belah woodland (PCT 55) • Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27) • Brigalow viney scrub open forest (PCT 445)
Polytelis swainsonii	Superb Parrot	V	Moderate – this species previously recorded occasionally in and around Moree. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat in the study area includes: • Belah woodland (PCT 55) • Poplar Box - Belah woodland (PCT 56) • Poplar Box - White Cypress Pine woodland (PCT 397) • Weeping Myall open woodland (PCT 27) • Queensland Bluegrass +/- Mitchell Grass (PCT 52)

3.9.3 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.

3.9.4 Wetlands of international importance

The only wetlands of international importance in the locality are the group of wetlands that make up the *Gwydir wetlands: gingham and lower gwydir (big leather) watercourses* Ramsar site. The site is located west-north-west of Moree, approximately 30 - 40km upstream of the study area. Given its upstream location and distance from the study area, it is unlikely that the site would be affected by the proposal.

3.9.5 Migratory species

Table 3.16 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 3-16 Habitat assessment and survey results for nationally listed migratory fauna

Species name	Common name	EPBC Act	Likelihood of occurrence
Ardea alba	Great Egret	Migratory	High - confirmed north of Moree during field surveys.
Gallinago hardwickii	Latham's Snipe	Migratory	High; Confirmed during surveys near the study area in ephemeral wetland (impeded drainage associated with the highway) just south of Moree. Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
Rhipidura rufifrons	Rufous Fantail	Migratory	Moderate – few records occur in the locality. Species has been recorded in Narrabri. May pass through the study area on occasion.
Tringa nebularia	Common Greenshank	Migratory	Moderate – Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
Ardea ibis	Cattle Egret	Migratory	Moderate – may occur in study area when cattle are present.
Merops ornatus	Rainbow Bee-eater	Migratory	Moderate – species has been recorded in the locality. Suitable habitat in study area.
Apus pacificus	Fork-tailed Swift	Migratory	Moderate – would likely fly over the study area during migration.
Hirundapus caudacutus	White-throated Needletail	Migrator, Priority assessment list for Vulnerable status	Moderate – likely to fly over the study area during migration.

4 Impact assessment

4.1 Construction impacts

4.1.1 Removal of native vegetation

Under the current design (50 per cent concept design including a four metre construction buffer), the estimated clearing of native vegetation for the proposal as a whole is about 46.69 hectares. A summary of the vegetation loss for each segment is shown in Table 4-1.

Table 4-1 Native vegetation loss across each segments and the proposal

Segment	Native vegetation loss (ha)	Loss of state listed TECs (BC Act)	Loss of national listed TECs (EPBC Act)	Confirmed threatened plant species impacted
N2MS1	6.83	0.03	-	
N2MS2	13.38	5.88	2.54	Yes
N2MS3	4.83	-	0.13	
N2MS4	6.38	1.72	1.72	Yes
N2MS5	15.27	0.25	11.31	Yes
TOTAL	46.69 ha	7.88 ha	15.70ha	

A breakdown of native vegetation removal in each PCT and vegetation zone for the whole proposal is shown in Table 4.2. A summary of vegetation removal per proposal segment is provided in Table 4.3.

The proposal would also result in the removal of approximately:

- 0.47 ha of planted eucalypts, consisting of a mix of locally native species and species which are unlikely to occur naturally in the study area
- 31.85 ha of non-native vegetation which consists mainly of grassland/herbfield dominated (>50% of vegetation cover) by exotic species.

Table 4-2 Impacts on vegetation across whole proposal including TECs

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposal area[1] (hectares)	Percent[2] cleared
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	EEC	EEC	0.98	75
	Moderate to Poor (Derived Grassland)	No	No	0.22	
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	EEC	EEC	0.66	90
	Moderate to Poor (Derived Grassland)	No	No	0.53	
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	2.98	90
	Moderate to Poor (Derived Grassland)	No	No	0.04	
Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147)	Moderate to Good (Relatively Intact)	EEC	EEC	0.08 ha	83

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposal area[1] (hectares)	Percent[2] cleared
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	EEC recommended (refer note 3)	3.64	78
	Moderate to Poor (Derived Grassland)	No	No	1.05	
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	8.21	45
	Moderate to Poor (Derived Grassland)	No	No	5.35	
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	11.31	70
	Moderate to Poor (Derived Grassland - simplified)	No	No		
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC (In part – 4.32 ha)	3.17	86
	Moderate to Poor (Derived Grassland)	No	No	11.06	
Planted eucalypts	-	No	No	<1ha	-
Non-native vegetation	-	No	No	~30ha	-
Total clearing of BC Act listed threatened ecological communities					7.88
Total clearing of EPBC Act listed threatened ecological communities					15.70
Total clearing of native vegetation in moderate to good (relatively intact) condition					28.31
Total clearing of native vegetation in moderate to poor (derived grassland) condition					18.38
Total clearing of native vegetation					46.69

1- Area to be cleared based on ground-truthed vegetation mapping within the study area.
2- Based on the VIS classification database for the entire PCT
3- There is a preliminary determination to list this community as Endangered under the EPBC Act.

Table 4-3 Impacts on vegetation per proposal segment

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposal area[1] (hectares)	Percent cleared[2]
N2MS1					
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	2.68	45
	Moderate to Poor (Derived Grassland)	No	No	3.32	
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	No	0.03	86
Planted eucalypts	-	No	No	0.17	-
Non-native vegetation	-	No	No	5.09	-
Total clearing of BC Act listed TECs for N2MS1				0.03 ha	
Total clearing of EPBC Act listed TECs for N2MS1				0 ha	
Total clearing of native vegetation for N2MS1				6.03 ha	

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposal area[1] (hectares)	Percent cleared[2]
N2MS2					
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	2.95	90
	Moderate to Poor (Derived Grassland)	No	No	0.04	
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	No	0.77	78
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	EEC (In part – 2.54 ha)	2.94	86
	Moderate to Poor (Derived Grassland)	No	No	6.55	
Planted eucalypts	-	No	No	0.01	-
Non-native vegetation	-	No	No	4.77	-
Total clearing of BC Act listed TECs for N2MS2				5.88 ha	
Total clearing of EPBC Act listed TECs for N2MS2				2.54 ha	
Total clearing native vegetation for N2MS2				13.38 ha	
N2MS3					
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	No	0.02	78
	Moderate to Poor (Derived Grassland				
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	0.13	70
	Moderate to Poor (Derived Grassland - simplified)				
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (397)	Moderate to Good (Relatively Intact)	No	No	2.67	50
	Moderate to Poor (Derived Grassland)	No	No	2.02	
Non-indigenous Trees	-	No	No	0.11	-
Planted eucalypts	-	No	No	0.15	-
Non-native vegetation	-	No	No	4.77	-
Total clearing of BC Act listed TECs for N2MS3				0.00 ha	
Total clearing of EPBC Act listed TECs for N2MS3				0.13 ha	
Total clearing native vegetation for N2MS3				4.83 ha	
N2MS4					
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55)	Moderate to Good (Relatively Intact)	No	No	0.98	83
	Moderate to Poor (Derived Grassland)	No	No	0.22	
Brigalow viney scrub open forest on loamy soils in low hill landscapes in the northern Brigalow Belt South Bioregion (445)	Moderate to Good (Relatively Intact)	EEC	EEC	0.66	90
	Moderate to Poor (Derived Grassland)	No	No	0.53	

Plant community type (PCT)	Condition class	BC Act	EPBC Act	Proposal area[1] (hectares)	Percent cleared[2]
Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW (56)	Moderate to Good (Relatively Intact)	No	EEC recommended (refer note 3)	2.86	78
	Moderate to Poor (Derived Grassland)	No	No	1.05	
Non-native vegetation	-	No	No	3.77	-
Total clearing of BC Act listed TECs for N2MS4				1.72 ha	
Total clearing of EPBC Act listed TECs for N2MS4				1.72 ha	
Total clearing native vegetation for N2MS4				6.38 ha	
N2MS5					
Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil on north-western NSW floodplains, mainly Darling Riverine Plain Bioregion (628)	Moderate to Good (Relatively Intact)	EEC	No	0.04	90
Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains mainly the northern-eastern Darling Riverine Plains Bioregion (52)	Moderate to Good (Relatively Intact)	No	CEEC	11.31	70
	Moderate to Poor (Derived Grassland - simplified)				
Weeping Myall open woodland of the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (27)	Moderate to Good (Relatively Intact)	EEC	No	0.21	86
	Moderate to Poor (Derived Grassland)	No	No	3.72	
Planted eucalypts	-	No	No	0.12	-
Non-native vegetation	-	No	No	5.57	-
Total clearing of BC Act listed TECs for N2MS5				0.25 ha	
Total clearing of EPBC Act listed TECs for N2MS5				11.31 ha	
Total clearing native vegetation for N2MS5				15.27 ha	

1- Area to be cleared based on ground-truthed vegetation mapping within the study area.
2- Based on the VIS classification database
There is a preliminary determination to list this community as Endangered under the EPBC Act.

4.1.2 Threatened Ecological Communities

Under the current design (50 per cent concept design) (including a four metre construction buffer), the estimated clearing of Threatened Ecological Communities for the proposal is shown in Table 4-4 and Table 4-5.

Table 4-4 Description of TECs impacted by the proposal (BC Act)

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Approx. Impact on local occurrence
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered)	-	-	-	1.07	-	1.07	2 %
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)	-	-	-	0.66	-	0.66	3 %

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Approx. Impact on local occurrence
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)	-	2.95	-	-	0.04	2.98	6 %
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered)	0.03	2.94	-	-	0.21	3.17	2 %
TOTAL	0.03 ha	5.89 ha	0.0 ha	1.73 ha	0.25 ha	7.88 ha	

Table 4-5 Description of TECs impacted by the proposal (EPBC Act)

Threatened Ecological Community (EPBC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)	Approx. Impact on local occurrence
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregion (Endangered)	-	-	-	1.73	-	1.73	3 %
Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered)	-	-	-	0.66	-	0.66	5 %
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered)	-	-	0.13	-	11.31	11.44	2 %
Weeping Myall Woodlands (Endangered)	-	2.54	-	-	-	2.54	1 %
TOTAL	-	2.54 ha	0.13 ha	1.73 ha	11.31 ha	16.37 ha	

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.

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 is provided in Table 4-6 and for threatened fauna species is provided in Table 4.7.

Table 4-6 Impacts on threatened plant species

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Digitaria porrecta	Finger Panic Grass	-	E	**Recorded** in the study areas of N2MS2, N2MS4 and N2MS5 during field surveys in a variety of PCTs (55, 27, 52). **A number of individuals** were recorded within the proposal area though only a proportion of the proposal area was subject to targeted searches and more individuals are likely to occur. Habitat, associated with the recorded locations, to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 ha - derived). Habitat for the species includes intact woodland/forest, natural grassland and derived grasslands. The intact woodland/forest and natural grassland are considered to be the more valuable habitats for the species. Considering this species was found distributed relatively evenly across the whole proposal, it is likely that it occurs in suitable in all segments habitat. The impact has been calculated across the whole proposal. **Total known and potential habitat affected 35.64 ha**.
Homopholis belsonii	Belson's Panic	V	E	**Recorded;** found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs (27, 35, 52, 55, 56). Habitat, associated with the recorded locations, to be impacted includes: • Belah woodland (0.98 ha – intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact). Habitat for the species generally excludes derived grasslands however scattered individuals are present under Mimosa (*Vachellia farnesiana*) bushes. **Total known and potential habitat affected 19.04 ha.**
Desmodium campylocaulon	Creeping Tick-trefoil	-	E	**Recorded**; in the study area of N2MS5 during field surveys. Habitat, associated with the recorded locations, to be impacted includes: • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (0.21 ha - intact, 3.72 ha - derived). Habitat for this species includes derived grasslands. **Total known and potential habitat affected in N2MS5 = 15.23 ha).**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Diuris tricolor	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: • Poplar Box - White Cypress Pine shrub grass tall woodland (8.21 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact). **Total potential habitat affected = 8.21 hectares**
Swainsona sericea	Silky Swainson-pea	-	V	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Survey timing was not suitable for detection of this species. Associated habitat to be impacted includes: • Weeping Myall open woodland (3.17 ha - intact, 11.06 ha - derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived). Habitat for the species includes derived grasslands. **Total potential habitat affected = 21.94 hectares**
Tylophora linearis	-	E	V	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (8.21 ha - intact). **Total potential habitat affected = 8.21 hectares**
Lepidium aschersonii	Spiny Peppercress	V	V	Moderate– recorded in the locality and suitable habitat are found in study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived). Habitat for the species includes derived grasslands. **Total potential habitat affected = 7.08 hectares**
Polygala linariifolia	Native Milkwort	-	E	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (8.21 ha - intact). **Total potential habitat affected = 8.21 hectares**
Pterostylis cobarensis	Greenhood Orchid	-	V	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat. Survey timing was not suitable for detection of this species. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (8.21 ha - intact). **Total potential habitat affected = 8.21 hectares.**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act	
Swainsona murrayana	Slender Darling Pea	V	V	Moderate– Recorded in the locality and the study area contains a large amount of likely suitable habitat. Survey timing was marginal for detection of this species. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived). Habitat for the species includes derived grasslands. **Total potential habitat affected = 25.64 hectares**
Lepidium monoplocoides	Winged Peppercress	E	E	Moderate. Recently recorded near Narrabri and in the Pilliga area. Associated habitat to be impacted includes: • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived) Habitat for the species includes derived grasslands. **Total potential habitat affected = 19.02 hectares**
Sida rohlenae	Shrub Sida		E	Moderate. Known from the Brigalow Belt south but not the relevant subregions. Associated habitat to be impacted includes: • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived) Habitat for the species includes derived grasslands. **Total potential habitat affected = 7.71 hectares**
Cyperus conicus	-	-	E	Moderate. Recorded in the locality and associated habitat is present. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine shrub grass tall woodland (8.21 ha - intact) • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived) **Total potential habitat affected = 17.12 hectares**

Table 4-7 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)	
Pomatostomus temporalis temporalis	Grey-crowned Babbler	-	V	**Recorded**; confirmed in the study areas of Sections 1 and 2 during field surveys. Also highly likely to be present in N2MS3 and N2MS4. Habitat widespread. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) **Total known and potential habitat affected = 18.98 hectares**
Calyptorhynchus lathami	Glossy-black Cockatoo	-	V	**Recorded**; likely presence confirmed by chewed cones in roadside Belah in N2MS4 during field surveys. Belah habitat widespread. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) **Total known and potential habitat affected = 15.81 hectares**
Circus assimilis	Spotted Harrier	-	V	High – known from locality. Suitable habitat widespread; the most suitable habitat includes the edges of ephemeral wetlands and creeks. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) **Total potential habitat affected = 35.64 hectares**
Macropus dorsalis	Black-striped Wallaby	-	E	High – many of records of this species from the Pilliga National Park. Some records also along the road alignment. Suitable habitat present in the study area includes: • Brigalow viney scrub open forest (0.66 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) patches are considered marginal as they exist as narrow and fragmented patches with little connectivity. **Total potential habitat affected (excluding marginal habitat) = 8.95 hectares.**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	V	High – recorded in the locality at moderate frequency and suitable habitat widespread in study area. • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact). **Total potential habitat affected = 35.64 hectares**
Chthonicola sagittata (Pyrrholaemus sagittatus)	Speckled Warbler	-	V	Moderate – marginal habitat present (relatively small patch size, linear shape and fragmentation). Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) **Total potential habitat affected = 16.55 hectares**
Hieraaetus morphnoides	Little Eagle	-	V	High – suitable habitat widespread and recorded at moderate frequency; including a record immediately adjacent to the study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) **Total potential habitat affected = 35.72 hectares**
Ninox connivens	Barking Owl	-	V	High – suitable habitat widespread through study area. Recorded in larger woodland areas NE of Narrabri and in close proximity to Moree. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - Belah woodland (3.64 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) **Total potential habitat affected = 19.64 hectares**
Grantiella picta	Painted Honeyeater	V	V	High – suitable habitat widespread, particularly in areas with mistletoes; has been recorded in the Little Bumble TSR (road reserve) between Narrabri and Moree. Associated habitats in the study area include: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) **Total potential habitat affected = 16.08 hectares**
Chalinolobus picatus	Little Pied Bat	-	V	High; likely to forage in the study area and may roost in hollow-bearing trees and bridges/culverts. Associated habitats in the study area include: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 49.28 hectares**
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V	High – this species may forage in woodland/forest and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 49.28 hectares**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Phascolarctos cinereus	Koala	V	V	High – identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) **Total potential habitat affected = 13.71 hectares**
Daphoenositta chrysoptera	Varied Sittella	-	V	High. Frequently recorded in the locality and habitat is widespread in the study area. • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact). **Total potential habitat affected = 16.08 hectares**
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	V	Moderate – infrequently recorded in the locality but suitable habitat is present. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) **Total potential habitat affected = 16.08 hectares**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Hoplocephalus bitorquatus	Pale-headed Snake	-	V	Moderate – may occur in the study area, particularly around vegetated creek lines. Associated habitat to be impacted includes: • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 42.74 hectares**
Burhinus grallarius	Bush Stone-curlew	-	E	Moderate – may utilise woodland habitats; recorded infrequently in the locality. Associated habitat to be impacted includes: • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha - derived) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 43.31 hectares**
Sminthopsis macroura	Stripe-faced Dunnart	-	V	Moderate – no records in locality, however this species occupies the same habitat as the common fat-tailed dunnart, of which there are records in Narrabri, Bellata and Moree. Unlikely there has been comprehensive surveys for this species in the study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 35.64 hectares**
Falco hypoleucos	Grey Falcon	-	E	Moderate – not common in the locality however this species may pass through the study area on occasion. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 35.64 hectares**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Hamirostra melanosternon	Black-breasted Buzzard	-	V	Moderate – occasionally recorded in the locality, this species may hunt around creeks, woodlands and grasslands in the study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) **Total potential habitat affected = 12.83 hectares**
Tyto novaehollandiae	Masked Owl	-	V	Moderate – several records of this species in Pilliga NP, Bobbiwaa Conservation Area and Moema NP. This species is likely to use the study area for hunting, though may also nest in the larger hollows. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived) **Total potential habitat affected = 46.26 hectares**
Neophema pulchella	Turquoise Parrot	-	V	Moderate – some suitable habitat found in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) **Total potential habitat affected = 14.83 hectares**
Aepyprymnus rufescens	Rufous Bettong	-	V	Moderate – species not recorded in locality (nearest records are in the Pilliga region) but the study area contains potential habitat. Associated habitats in the study area include: • Brigalow viney scrub open forest (0.66 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) **Total potential habitat affected = 0.74 hectares**
Lophoictinia isura	Square-tailed Kite	-	V	Moderate – species seen 20km south-eat of Moree and in Moree. Likely to pass through the study area on occasion. May nest in large trees in the study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - Belah woodland (3.64 ha - intact)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) **Total potential habitat affected = 16.08 hectares**
Jalmenus eubulus	Pale Imperial Hairstreak	-	CE	Moderate – suitable habitat present in study area. No records in the locality, however this does not discount the potential for this species to occur as it is only known from a single population. Associated habitat to be impacted includes: • Brigalow viney scrub open forest (0.66 ha - intact). **Total potential habitat affected = 0.66 hectares**
Stagonopleura guttata	Diamond Firetail	-	V	Moderate – suitable habitat widespread but few local records. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) **Total potential habitat affected = 16.08 hectares**
Ardeotis australis	Australian Bustard	-	E	Moderate – suitable habitat widespread in study area but the species has been infrequently recorded. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived). **Total potential habitat affected = 35.64 hectares**
Anomalopus mackayi	Five-clawed Worm-skink	V	E	High – suitable habitat widespread in the study area and species has been recorded locally; survey conditions were not conducive to detection of the species. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived)

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
				• Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived). **Total potential habitat affected = 34.50 hectares**
Falco subniger	Black Falcon	-	V	Moderate – suitable habitat widespread. Recorded locations include Narrabri rubbish dump. This species may hunt and perch in the study area; nesting habitat in the study area is likely to be marginal due to its proximity to the highway. 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: • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived). **Total potential habitat affected = 28.56 hectares**
Petaurus norfolcensis	Squirrel Glider	-	V	Moderate – this species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. 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 (e.g. Bobbiwaa Creek is connected to the conservation area). The species is moderately likely to be found in segments 1 and 2. • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - White Cypress Pine woodland (2.68 ha - intact) **Total potential habitat affected = 5.63 hectares**
Glossopsitta pusilla	Little Lorikeet	-	V	Moderate – this species has been seen near Moree. Not common in the area though is likely to pass through. Associated habitat to be impacted includes: • Poplar Box - White Cypress Pine woodland (8.21 ha - intact). **Total potential habitat affected = 8.21 hectares**
Mormopterus eleryi	Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	-	E	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact). **Total potential habitat affected = 7.28 hectares**

Species name	Common name	Status		Likelihood of occurrence and habitat on site
		EPBC Act	BC Act (or FM Act)	
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat to be impacted includes: • Belah woodland (0.98 ha - intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) • Weeping Myall open woodland (3.17 ha - intact) • Brigalow viney scrub open forest (0.66 ha - intact). **Total potential habitat affected = 16.74 hectares**
Vespadelus troughtoni	Eastern Cave Bat	-	V	Moderate – this species may forage in and around forest/woodland and roost in Fairy Martin mud nests in bridges and culverts in the study area. Associated habitat to be impacted includes: • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) **Total potential habitat affected = 14.91 hectares**
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	-	V	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: • Belah woodland (0.98 ha - intact) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact) • Poplar Box - Belah woodland (3.64 ha - intact) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact) **Total potential habitat affected = 15.89 hectares**
Polytelis swainsonii	Superb Parrot	V	V	Moderate – this species previously recorded occasionally in and around Moree. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat to be impacted includes: • Belah woodland (0.98 ha – intact, 0.22 ha - derived) • Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived) • Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived) • Poplar Box - White Cypress Pine woodland (8.21 ha - intact, 5.35 ha derived) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact) • Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived). **Total potential habitat affected = 48.01 hectares**

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 4.8 and a summary of potential impacts on aquatic biodiversity is presented in Table 4-9.

Table 4-8 Potential impacts on aquatic biodiversity at each waterway crossing

Water body	Key Fish Habitat status based on habitat assessment	Potential impacts on the waterway and associated threatened species and the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* Endangered Ecological Community (Lowland Darling River EEC).
Halls Creek, south of Moree (north of Burrington Road) Segment: N2MS5	Class 2: Moderate key fish habitat Or Class 1: Major key fish habitat if threatened species present)	No in-stream works are proposed here. Tie-in to existing bridge only. Earthworks would however be undertaken in very close proximity to the waterway. 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.
Tookey Creek, North of Bellata near Tookey Creek rest area Segment: N2MS4	Class 2: Moderate key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts on Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works. 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. A small area of habitat of the Lowland Darling River EEC would be removed in this location due to filling of the stream channel associated with culvert extension and road widening.
Bobbiwaa Creek , near Junefield Road North of Narrabri Segment: N2MS2	Class 2: Moderate key fish habitat Or Class 1: Major key fish habitat if threatened species present)	No in-stream works are proposed here. Tie-in to existing bridge only. Potential impact on downstream water quality is possible due to turbidity and sedimentation from the works.
Tarlee Creek, north of Edgeroi Segment: N2MS2	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts on Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works. 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. A small area of habitat of the Lowland Darling River EEC would be removed in this location due to filling of the stream channel associated with culvert extension and road widening.

Water body	Key Fish Habitat status based on habitat assessment	Potential impacts on the waterway and associated threatened species and the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* Endangered Ecological Community (Lowland Darling River EEC).
Unnamed stream south of Edgeroi - between Smithfield Rd and Couradda Rd Segment: N2MS2	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts on Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works. 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. A small area of habitat of the Lowland Darling River EEC would be removed in this location due to filling of the stream channel associated with culvert extension and road widening.
Gehan Creek north of Bellata 1 north of Millie Road Segment: N2MS3	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts on Purple Spotted Gudgeon are unlikely as there are no distinct areas of pooling present. Potential impact on downstream water quality is possible due to turbidity and sedimentation from the works and tannins from mulch but would likely be minor due to the existing disturbed nature of the stream. Minimal impact on the Lowland Darling River EEC.
Unnamed stream north of Bellata Segment: N2MS3	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts (habitat removal) on Purple Spotted Gudgeon individuals and their habitat may be possible if the adjacent vegetated in-stream farm dam is affected by the works. Potential impact on downstream water quality is possible due to turbidity and sedimentation from the works and tannins from mulch. Slight increase in the obstruction to fish passage and changes to hydrology due to culvert extension. A small area of habitat of the Lowland Darling River EEC would be removed in this location due to disturbance to the in-stream dam associated with culvert extension and road widening.
Unnamed tributary of Narrabri Creek Segment: N2MS1	Class 4 Unlikely key fish habitat	Unlikely to be impacted by the proposal due to the lack of aquatic habitat.
Unnamed tributary of Tookey Creek south of Brigalow Lane Segment: N2MS4	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts on Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works. 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. A small area of habitat of the Lowland Darling River EEC would be removed in this location due to disturbance to the in-stream dam associated with culvert extension and road widening.

Water body	Key Fish Habitat status based on habitat assessment	Potential impacts on the waterway and associated threatened species and the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River* Endangered Ecological Community (Lowland Darling River EEC).
Unnamed highly modified tributary of Halls Creek South of Burrington Road Moree Segment: N2MS5	Class 3 Minimal key fish habitat Or Class 1: Major key fish habitat if threatened species present)	Culvert extension works in this location would disturb the bed of this ephemeral stream. Direct impacts on Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works. 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. A small area of habitat of the Lowland Darling River EEC would be removed in this location due to disturbance to the in-stream dam associated with culvert extension and road widening.
Other unnamed first order streams in study area Segment: All	Class 4 Unlikely key fish habitat	Unlikely to be impacted by the proposal due to the lack of aquatic habitat.

Table 4-9 Summary of aquatic impacts

Type of impact	Affected streams	Extent and/or intensity of impact
Increased obstruction to fish passage	• Tookey Creek • Tarlee Creek • Unnamed stream south of Edgeroi • Gehan Creek • Unnamed stream north of Bellata • Unnamed tributary of Narrabri Creek • Unnamed tributary of Tookey Creek • Unnamed highly modified tributary of Halls Creek	Slight increase in the obstruction to fish passage and changes to hydrology due to culvert extension.
Permanent loss of habitat for: • Lowland Darling River EEC, • Purple Spotted Gudgeon	• Tookey Creek • Tarlee Creek • Unnamed stream south of Edgeroi • Gehan Creek • Unnamed stream north of Bellata • Unnamed tributary of Narrabri Creek • Unnamed tributary of Tookey Creek • Unnamed highly modified tributary of Halls Creek	A small area of habitat would be filled in this location due to culvert extension and road widening. The habitat lost consists of part of some ephemeral pools within stream channels and possibly part of a well-vegetated in-stream dam.
Direct physical disturbance of habitat for: • Lowland Darling River EEC, • Purple Spotted Gudgeon	• Tookey Creek • Tarlee Creek • Unnamed stream south of Edgeroi • Gehan Creek • Unnamed stream north of Bellata • Unnamed tributary of Narrabri Creek • Unnamed tributary of Tookey Creek • Unnamed highly modified tributary of Halls Creek	A small area of habitat would be physically disturbed in this location due to earthworks required for the culvert extension and road widening. The habitat that would be disturbed consists of part of some ephemeral pools within stream channels and possibly part of a well-vegetated in-stream dam. Disturbance may result in changes to vegetation and water holding capacity of pools thereby altering their habitat value.
Water quality impacts on downstream habitats	• Halls Creek • Tookey Creek • Bobbiwaa Creek • Tarlee Creek • Unnamed stream south of Edgeroi • Gehan Creek • Unnamed stream north of Bellata • Unnamed tributary of Narrabri Creek • Unnamed tributary of Tookey Creek • Unnamed highly modified tributary of Halls Creek • Other unnamed first order streams in study area	A reduction in habitat quality is possible due to turbidity and sedimentation from the works and tannins from mulch. The intensity of water quality impacts can be mitigated through adequate stormwater and sediment management.
Mortality of individuals of Purple Spotted Gudgeon	• Halls Creek • Tookey Creek • Bobbiwaa Creek • Tarlee Creek • Unnamed stream south of Edgeroi • Gehan Creek • Unnamed stream north of Bellata • Unnamed tributary of Narrabri Creek • Unnamed tributary of Tookey Creek • Unnamed highly modified tributary of Halls Creek • Other unnamed	Mortality of Purple Spotted Gudgeon individuals may be possible if standing water is present at the time of the works and is drained to facilitate construction.

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 (including the Koala) and 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. Special consideration will be given to removal of Koala habitat.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity corridors and habitat fragmentation

In several locations, the proposal would break apart continuous habitats into separate smaller ‘fragments’. 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. 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.

In only one instance, would the proposal divide or break apart a substantial area of continuous habitat; a patch of native grassland at the north end of N2MS2 which would be divided by the new location of a side-road.

The widening of the Newell 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 the eastern and western sides of the Newell Highway. 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 (ie seed or other vegetative reproductive material) between habitat patches would continue with little impact for those species with sees 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 moderate 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 moderate level of edge effects from agricultural activity, the existing roadways and other development. The vegetation patches within the study area affected by moderate to 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). 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 an existing road, the risk of vehicle strike is expected to increase some degree but the significance of such an impact cannot be easily predicted.

The increased impact on most threatened species is expected to be low but the existing risk to populations of some threatened species such as the Black-striped Wallaby may currently be substantial and remain so after the proposal. For this reason, opportunities to reduce road-kill mortality of fauna should be investigated during detailed design.

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, mainly in close proximity to the existing Newell Highway and along minor roads and tracks. As such, the spread and proliferation of weeds must be managed during construction. Weeds of particular concern include exotic perennial grasses such as Coolatai grass (*Hyparrhenia hirta*) and Guinea grass (*Megathyrsus maximus*) which were recorded in the study area.

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 feral pigs (*Sus scrofa*), foxes (*Vulpes vulpes*), rabbits (*Oryctolagus cuniculus*), cats (*Felis catus*), goats (*Capra hircus*), deer (Cervidae family) and wild dogs (*Canis lupus* spp.).

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 extension of culverts and increase in the 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 Noise, light and vibration

Considering the existing levels of noise and vibration from the existing Newell Highway 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 permeant lighting would be installed in areas that are not currently lit.

4.2.9 Groundwater dependent ecosystems

Aquatic GDEs

Most of the aquatic GDEs in the locality are quite distant from the proposal and no lands within the banks of these waterbodies or in close proximity will be affected by the proposal. They area thus unlikely to be affected by the localised effects on groundwater likely to result from the increased width and elevation of the roadway.

The proposal is located only about 50 metres north of Gehan Creek, south of Bellata, which is mapped as a moderate potential GDE. There is therefore some potential for impacts on the GDE, associated with altered groundwater movement patterns associated with the proposal. The proposal will not directly affect lands within the banks of Gehan Creek or adjacent, regularly inundated areas and is unlikely to result in significant changes to surface water penetration or groundwater movement. It is therefore unlikely to significantly affect this GDE.

Other smaller streams in the study are which have only ephemeral flow and intermittent expression of surface water are unlikely to have baseflow characteristics and are unlikely to be significantly dependent on groundwater. These systems would be in the facultative-opportunistic category. They are therefore unlikely to be significantly affected by the likely minor influence of the proposal on groundwater.

Terrestrial GDEs

Most of the terrestrial vegetation types of the study area would be classified as non-dependent ecosystems or possibly facultative-opportunistic ecosystems. Such ecosystems may use groundwater where available during times of water stress but would be dependent chiefly on rainfall and unlikely to be affected by the proposal.

Poplar Box - Belah woodland on clay-loam soils on alluvial plains of north-central NSW is likely to be a facultative-opportunistic ecosystem, moderately reliant on groundwater particularly during times of water stress. This ecosystem is likely to use groundwater where available during times of water stress but to be dependent chiefly on rainfall and is unlikely to be significantly affected by the proposal.

The Carbeen +/- Coolibah grassy woodland on floodplain clay loam soil on north-western NSW floodplains along waterways is likely to be classified as a facultative-proportional ecosystem that is likely to be dependent in part on groundwater. Such ecosystems may be modified (e.g. in species composition) by changes in groundwater attributes but are unlikely to be destroyed by groundwater changes. The small-scale, low intensity changes in groundwater likely to result from the proposal are unlikely to substantially affect such ecosystems.

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.

While data from all recent projects in the locality is not freely available, some information on the likely biodiversity impacts from recent projects is available as follows:

- North Moree heavy duty pavement upgrade
- Newell Highway Mungle Back Creek to Boggabilla heavy duty pavement upgrade
- Previous Newell Highway upgrade projects.

Table 4-10 Summary of potential cumulative impacts for endangered ecological communities and species recorded in the proposal area

Value impacted (area of community or species habitat)	Newell Highway Heavy Duty Pavement proposals/projects – clearing in hectares			Other recent and future proposals in the region	Cumulative impact
	Narrabri to Moree (this (proposal)	North Moree (planned proposal)	Mungle Back Creek to Boggabilla (proposal approved)		
Brigalow-Belah Woodland (Brigalow TEC; BC Act and EPBC Act)	0.66 ha	0 ha	17.5 ha	Not known	18.02 ha
Weeping Myall open woodland (Weeping Myall TEC; BC Act and EPBC Act) (PCT 27)	3.17 ha (BC Act) 2.54 (EPBC Act)	4.40 ha (BC Act) 3.92 (EPBC Act)	0	Not known	Not known ~7 ha or more
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (EPBC Act CEEC) (PCT 52)	11.31 ha	11.98 ha	-.	unknown	Not known ~23 ha or more
Homopholis belsonii (Belson's Panic)	19.04 ha	12.05	34 ha	Unknown	~50-100 ha
Desmodium campylocaulon (Creeping Tick-trefoil)	15.23 ha	14.37	41 ha	Unknown	~50-90 ha
Grey-crowned Babbler (*Pomatostomus temporalis*)	18.98 ha	6.44	34 ha	Unknown	~50-60 ha

4.4 EPBC Act Strategic Assessment

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 Part 5 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).

The *Roads and Maritime Services Environment Protection and Biodiversity Conservation Act 1999 – Strategic Assessment policy* states biodiversity offsets are required when a significant impact is likely for threatened biodiversity listed under the EPBC Act (Roads and Maritime Services 2005).

The proposal may result in a significant impact upon two threatened species and one threatened ecological community listed under the EPBC Act; therefore, biodiversity offsets are required. The strategic assessment recommends that biodiversity offsets are calculated using the FBA methodology. A Biodiversity Offset Strategy (BOS) will be prepared for the proposal which will identify:

- The credits required under the FBA to compensate for nationally listed threatened species, ecological communities and migratory species where a significant impact is likely; and
- Options available to meet the offset requirements for nationally listed matters on a 'like-for-like' basis.

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 would be assessed under Part 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 Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change, 2007) which outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the former 'seven-part test'. The guidance provided by the Department of Environment and Climate Change (2007) has been used here in preparing these tests of significance and in determining whether there is likely to be a significant effect to a threatened species, population or ecological community listed under the BC Act.

Full details of assessment of significance under the BC Act are presented in Appendix B. The conclusions of the BC Act assessment are provided in Table 4.11.

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 4-12.

Table 4-11 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**	
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions	X	N	Y	N	Y	No
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions	X	N	?	N	Y	No
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	X	N	Y	N	Y	No
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	X	N	Y	N	Y	No
Desmodium campylocaulon (Creeping Tick-trefoil)	N	X	N	N	Y	No
Digitaria porrecta (Finger Panic Grass)	N	X	N	N	Y	No
Homopholis belsonii (Belson's Panic)	Y	X	Y	N	Y	No
Plants chiefly associated with PCTs on sandy soils containing White Cypress Pine: • *Polygala linariifolia* (Native Milkwort) • *Pterostylis cobarensis* (Greenhood Orchid) • *Tylophora linearis.*	N	X	Y	N	Y	No
Plants not recorded during surveys and chiefly associated with PCTs on sandy and sandy-loam soils containing White Cypress Pine and Belah: • *Cyperus conicus* • *Diuris tricolor* (Pine Donkey Orchid) • *Lepidium aschersonii* (Spiny Peppercress) • *Sida rohlenae* (Shrub Sida)	N	X	Y	N	Y	No
Plants not recorded during surveys and chiefly associated with a wide range of PCTs on cracking-clay and clay-loam soils: • *Lepidium monoplocoides (*Winged Peppercress*)* • *Swainsona murrayana* (Slender Darling Pea) • *Swainsona sericea* (Silky Swainson-pea)	N	X	Y	N	Y	No
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)	N	X	Y	N	Y	No
Painted Honeyeater (*Grantiella picta*)	N	X	Y	N	Y	No
Little Lorikeet (*Glossopsitta pusilla*)	N	X	Y	N	Y	No
Superb Parrot (*Polytelis swainsonii*)	N	X	Y	N	Y	No
Black-cockatoos: • Glossy-black Cockatoo (*Calyptorhynchus lathami*)	N	X	Y	N	Y	No
Woodland/forest birds • Diamond Firetail (*Stagonopleura guttata*) • Dusky Woodswallow (*Artamus cyanopterus cyanopterus*) • Hooded Robin (south-eastern form) (*Melithreptus gularis gularis*) • Speckled Warbler (*Chthonicola sagittata*) • Varied Sittella (*Daphoenositta chrysoptera*) • Turquoise Parrot (*Neophema pulchella*).	N	X	Y	N	Y	No
Forest/Woodland Owls: • Barking Owl (Ninox connivens) • Masked Owl (Tyto novaehollandiae)	N	X	Y	N	Y	No
Birds of open woodland and grassland habitats: • Australian Bustard (*Ardeotis australis*) • Bush Stone-curlew (*Burhinus grallarius*)	N	X	Y	N	Y	No

Biodiversity Conservation Act 2016 test of significance						
Birds of prey: • Square-tailed Kite (*Lophoictinia isura*) • Spotted Harrier (*Circus assimilis*) • Little Eagle (*Hieraaetus morphnoides*) • Grey Falcon (*Falco hypoleucos*) • Black Falcon (*Falco subniger*) • Black-breasted Buzzard (*Hamirostra melanosternon*)	N	X	Y	N	Y	No
Insectivorous Bats: • Little Pied Bat (*Chalinolobus picatus*) • Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) • Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat (*Mormopterus eleryi*) • Eastern Cave Bat (*Vespadelus troughtoni*) • Corben's Long-eared Bat (*Nyctophilus corbeni*) • Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	N	X	Y	N	Y	No
Koala (*Phascolarctos cinereus*)	N	X	Y	N	Y	No
Squirrel Glider (*Petaurus norfolcensis*)	N	X	Y	N	Y	No
Black-striped Wallaby (*Macropus dorsalis*)	N	X	Y	N	Y	No
Rufous Bettong (*Aepyprymnus rufescens*)	N	X	Y	N	Y	No
Stripe-faced Dunnart (*Sminthopsis macroura*)	N	X	Y	N	Y	No
Pale-headed Snake (*Hoplocephalus bitorquatus*)	N	X	Y	N	Y	No
Five-clawed Worm Skink (*Anomalopus mackayi*)	N	X	Y	N	Y	No
Pale Imperial Hairstreak (*Jalmenus eubulus*)	N	X	Y	N	Y	No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ? = unknown impact.

1. Significance Assessment Questions as set out in the *Biodiversity Conservation Act 2016:*
   - 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.
   - 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, 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 development or activity, 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.
   - 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.

Fisheries Management Act 1994 test of significance								
Threatened species, or communities	**Significance assessment question[1]**							**Likely significant effect?**
	a	**b**	**c**	**d**	**e**	**f**	**g**	
Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River	X	X	N	N	N	N	Y	No
Purple-spotted Gudgeon (*Morgurnda adspersa)*	N	X	N	X	N	N	Y	No
Eel-tailed Catfish in the Murray / Darling Basin Endangered Population (*Tandanus tandanus*)	X	N	N	X	N	N	Y	No

1. Significance Assessment Questions as set out in the *Fisheries Management Act 1994:*
   - 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.
   - 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

proposed development or activity:

(iii) 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

(iv) 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 or ecological community:

(iv) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(v) 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

(vi) 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 proposed development 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 action of a recovery plan or threat abatement plan

g 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.

Table 4-12 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											
Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Qld	Y	N	Y	N	N	Y	Y	NA	NA	NA	Yes
Weeping Myall Woodlands	Y	N	N	N	N	N	Y	NA	NA	NA	No
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Y	N	Y	N	Y	Y	Y	NA	NA	NA	No
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions	Y	N	N	N	N	N	Y	NA	NA	NA	No
Species											
Homopholis belsonii	Y	Y	N	Y	Y	N	N	N	Y	Yes	Yes
Lepidium aschersonii	N	N	N	N	N	N	N	N	N	No	No
Lepidium monoplocoides	N	N	N	N	N	N	N	N	N	NA	No
Swainsona murrayana	N	N	N	N	N	N	N	N	N	No	No
Tylophora linearis	N	N	N	N	N	N	N	N	N	NA	No
Five-clawed Worm-skink (*Anomalopus mackayi*)	Y	Y	Y	Y	Y	Y	N	N	Y	Yes	Yes
Painted Honeyeater (*Grantiella picta*)	N	N	N	N	N	N	N	N	N	No	No
Superb Parrot (Polytelis swainsonii)	N	N	N	N	N	N	N	N	N	No	No
Koala (Phascolarctos cinereus)	N	N	N	N	N	N	N	N	N	No	No
Corben's Long-eared Bat (*Nyctophilus corbeni*)	N	N	N	N	N	N	N	N	N	No	No

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

1) reduce the extent of an ecological community
2) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
3) adversely affect habitat critical to the survival of an ecological community
4) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
5) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
6) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
   -- assisting invasive species, that are harmful to the listed ecological community, to become established, or
   -- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
7) interfere with the recovery of an ecological community.

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

1) Lead to a long-term decrease in the size of a population
2) Reduce the area of occupancy of the species
3) Fragment an existing population into two or more populations
4) Adversely affect habitat critical to the survival of a species
5) Disrupt the breeding cycle of a population
6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
7) Result in invasive species that are harmful to a species becoming established in the species' habitat
8) Introduce disease that may cause the species to decline
9) Interfere with the recovery of the species.

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

1) lead to a long-term decrease in the size of an important population of a species
2) reduce the area of occupancy of an important population
3) fragment an existing important population into two or more populations
4) adversely affect habitat critical to the survival of a species
5) disrupt the breeding cycle of an important population
6) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
7) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
8) introduce disease that may cause the species to decline, or
9) interfere substantially with the recovery of the species.

An important population as determined by the EPBC Act is a population of a vulnerable species that is likely to be key source 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.

4.6 Impact summary

It is evident from the discussion and assessment in chapter 4, that the proposal will impact biodiversity, which includes listed ecological communities, populations of threatened species and known habitat.

Separate impacts significance assessments were undertaken under the differing impact significance criteria of the NSW BC Act and FM Act and Commonwealth EPBC Act.

The assessments under the BC Act and FM Act concluded that, according to the relevant criteria, the proposal would not have a significant impact on the affected species and communities.

Assessment of relevant species and communities under the EPBC Act significance criteria identified a likely significant impact for one ecological community and two species. This impact is summarised below:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* (Critically Endangered Act– EPBC): Almost entirely restricted to N2MS5. The proposal would remove 11.31 hectares of this community
- *Homopholis belsonii* (Belson's Panic) (BC Act): The proposal would reduce the extent of local populations by about 19.04 ha
- Five-clawed Worm Skink (*Anomalopus mackayi*) (Endangered BC Act and EPBC Act). Much of the vegetation in the study area can be considered important habitat for the

species, it is known to occur in 5 of the PCTs identified. The proposal will see the removal of 34.50 hectares of potential habitat across the proposal. It is difficult to define the impact area and proposal segment, however mostly associated with N2MS2, N2MS4 and N2MS5.

Opportunities to avoid and minimise impacts should be considered in in finalising the detailed design.

A summary of the overall predicted ecological impacts from the proposal is provided in Table 4.13.

Table 4-13 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 threated ecological communities (BC Act)	Reduction in extent of communities	Segments: • N2MS1 = 0.03 ha • N2MS2 = 5.88 ha • N2MS3 = 0 ha • N2MS4 = 1.72 ha • N2MS5 = 0.25 ha	Permanent	Clearing of native vegetation
	All terrestrial threated ecological communities (EPBC Act)	Reduction in extent of communities	Segments: • N2MS1 = 0 ha • N2MS2 = 2.54ha • N2MS3 = 0.13 ha • N2MS4 = 1.72 ha • N2MS5 = 11.31 ha	Permanent	
	All threatened plants	A reduction in population size and extent	Species identified during surveys: • *Desmodium campylocaulon* = 15.23 ha, with the core habitat consisting of the 11.31 ha of natural grassland habitat in Segment 5 • *Digitaria porrecta* = 35.64 ha across whole proposal • *Homopholis belsonii* known and potential habitat: o N2MS2 = ~2.00 ha o N2MS3 = 0 ha o N2MS4 = 4.59ha o N2MS5 = 11.31 (habitat considered less valuable to the species due to the lack of trees). Species moderately to highly likely to occur but not detected during surveys. Impacts to associated habitat across whole proposal include: • *Polygala linariifolia*, *Pterostylis cobarensis*, *Tylophora linearis* = 8.21 ha • *Cyperus conicus* = 17.12 ha • *Diuris tricolor* = 8.21 ha • *Lepidium aschersonii* = 7.08 ha • *Sida rohlenae* = 7.71 ha • *Lepidium monoplocoides* = 19.02 ha • *Swainsona murrayana* = 25.64 ha • *Swainsona sericea* = 21.94 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 ground-foraging fauna	Loss of habitat and a reduction in population size	Macropods highly likely to occur across whole proposal. Impacts to associated habitat include: • Black-striped Wallaby = 8.95 ha Macropods moderately likely to occur across whole proposal. Impacts to associated habitat include: • Rufous Bettong = 0.66 ha Small terrestrial mammals moderately likely to occur across whole proposal. Impacts to associated habitat include: • Stripe-faced Dunnart = 35.64 ha Arboreal reptiles moderately likely to occur across whole proposal. Impacts to associated habitat include: • Pale-headed Snake = 42.74 ha	Permanent	Clearing of native vegetation
	Threatened hollow-dependant fauna	Loss of habitat and a reduction in population size	Hollow dependent species identified during surveys: • Glossy Black-cockatoo (chewed cones recorded in N2MS4). Total impact to habitat = 15.81 ha. Owls moderately likely to occur across whole proposal. Impacts to associated habitat include moderately likely to occur across whole proposal: • Barking Owl = 19.64 ha • Masked Owl = 46.26 ha. Other hollow dependent birds moderately likely to occur across whole proposal. Impacts to associated habitat include: • Little Lorikeet = 8.21ha • Superb Parrot = 48.01 ha • Turquoise Parrot = 14.83 ha. Hollow-roosting insectivorous bats moderately likely to occur across whole proposal. Impacts to associated habitat include moderately likely to occur across whole proposal: • Yellow-bellied Sheathtail-bat = 49.28 ha • Bristle-faced free-tailed bat = 7.28 ha • Corben's Long-eared Bat = 16.74 ha. Arboreal mammals moderately likely to occur. Impacts to associated habitat across whole proposal include: • Squirrel Glider = 5.63 ha	Permanent	• Clearing of native vegetation • Removal of dead wood and dead trees

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
	All other threatened fauna	Loss of habitat and a reduction in population size	Species identified during surveys: • Grey-crowned Babbler (recorded in Segments 1 and 2. Likely also in N2MS3 and N2MS4). Total impact to habitat = 16.86 ha Species highly likely to occur; impacts to associated habitat across whole proposal include: • Koala = 13.71 ha • Pale Imperial Hairstreak = 0.66 ha • Five-clawed Worm-skink = 34.50 ha Birds highly likely to occur across whole proposal. Impacts to associated habitat include: • Painted Honeyeater = 16.08 ha • Dusky Woodswallow = 35.64 ha • Varied Sittella = 16.08 ha • Spotted Harrier = 35.64 ha • Little Eagle = 35.72 ha Birds moderately likely to occur across whole proposal. Impacts to associated habitat include: • Diamond Firetail = 16.08 ha • Hooded Robin (south-eastern form) = 16.08 ha • Speckled Warbler = 16.55 ha • Australian Bustard = 35.64 ha • Bush Stone-curlew = 43.31 ha • Square-tailed Kite = 16.08 ha • Grey Falcon = 35.64 ha • Black Falcon = 28.56 ha • Black-breasted Buzzard = 12.83 ha Cave-roosting insectivorous bats moderately likely to occur across whole proposal. Impacts to associated habitat include moderately likely to occur across whole proposal: • Little Pied Bat = 49.28 ha • Eastern Cave Bat = 14.91 ha • Eastern Bentwing-bat = 15.89 ha	Permanent	• 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?
Removal of threatened flora	All threatened flora	A reduction in population size and extent	Species identified during surveys: • *Desmodium campylocaulon* = 37.76 ha, with the core habitat consisting of the 15.81 ha of natural grassland habitat in Segment 5 • *Digitaria porrecta* = 35.64 ha across whole proposal • *Homopholis belsonii* known and potential habitat: o N2MS2 = 7.38 ha o N2MS3 = 3.52 o N2MS4 = 4.47 ha o N2MS5 = 16.13 (habitat considered less valuable to the species due to the lack of trees). Species moderately to highly likely to occur but not detected during surveys. Impacts to associated habitat across whole proposal include: • *Polygala linariifolia*, *Pterostylis cobarensis*, *Tylophora linearis* = 8.21 ha • *Cyperus conicus* = 17.12 • *Diuris tricolor* = 8.21 ha • *Lepidium aschersonii* = 7.08 ha • *Sida rohlenae* = 7.71 • *Lepidium monoplocoides* = 19.02 • *Swainsona murrayana* = 25.64 • *Swainsona sericea* = 21.94 ha	Permanent	• Clearing of native vegetation Species identified during surveys: • *Digitaria porrecta* = 35.64 ha across whole proposal • *Homopholis belsonii* known and potential habitat: o N2MS2 = 7.38 ha o N2MS3 = 3.52 o N2MS4 = 4.47 ha o N2MS5 = 16.13 (habitat considered less valuable to the species due to the lack of trees). Species moderately to highly likely to occur but not detected during surveys. Impacts to associated habitat across whole proposal include: • *Polygala linariifolia*, *Pterostylis cobarensis*, *Tylophora linearis* = 8.21 ha • *Cyperus conicus* = 17.12 • *Diuris tricolor* = 8.21 ha • *Lepidium aschersonii* = 7.08 ha • *Sida rohlenae* = 7.71 • *Lepidium monoplocoides* = 19.02 • *Swainsona murrayana* = 25.64 *Swainsona sericea* = 21.94 ha

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
Aquatic impacts	Purple Spotted Gudgeon	A reduction in population size and extent Decreased movement ability	Difficult to quantify	Long term	• Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands
Injury and mortality of fauna	Threatened microbats Threatened reptiles Threatened small terrestrial mammals Threatened woodland birds (nestlings) Threatened arboreal mammals Purple Spotted Gudgeon (if draining of water required)	A reduction in population size	Difficult to quantify	Long term	-
Fragmentation of identified biodiversity links and habitat corridors	Threatened reptiles 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	-
	Threatened ecological communities	Reduced ecosystem functionality due to reduced ability for component species to re-establish after local extinction.	Difficult to quantify		

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?
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	-
Invasion and spread of weeds	Threatened terrestrial animals	A reduction in habitat condition changes to floristics and vegetation structure	Difficult to quantify	Long term	• Invasion and establishment of exotic vines and scramblers • Invasion of native plant communities by African Olive (*Olea europaea* L. subsp. *cuspidata)* • 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	• Infection of native plants by *Phytophthora cinnamomi* • 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
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 is 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. 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 are planned to be located in highly disturbed areas to avoid impacts to biodiversity. Design refinements would be undertaken in the detailed design phase to reduce the scope of the overall impact to biodiversity. The primary method to avoid impacts is to ensure that they are considered in options analysis and selection of a preferred option such that activities are located away from areas of known or potential high biodiversity value wherever practicable.

The *Newell Highway Heavy Duty Pavements, Narrabri to Moree Preliminary environmental investigation* (WSP 2017) and the accompanying *Newell Highway Upgrade: Narrabri to Moree Preliminary Ecological Investigation* (WSP 2017) aimed to identify potential environmental issues for the proposal, including biodiversity, to inform options considerations and the design process.

A constructability workshop was undertaken in January 2018, during which minimisation of biodiversity impacts was considered based on the more detailed biodiversity survey and mapping of the study area prepared for this report.

Subsequently, a decision was made to progress with an option which consists of a combination of widening the existing road (on-line) to minimise impacts on areas of higher biodiversity value and construction of parts of the new pavement away from the existing highway alignment where this outcome would result in similar or lesser impact on biodiversity. The minimum practicable disturbance footprint (extending 4 metres beyond the outer edge of proposed fill batters) has been chosen in order to minimise the impacts associated with the chosen option. In Segment 4, the proposal has been redesigned to exclude any clearing beyond the outer edge of the proposed fill batter in order to minimise impacts on TECs with highly restricted areas of local occurrence and associated habitat for threatened species.

In identifying suitable ancillary work sites, the first preference is to locate on 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 are planned to be located 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 proposal, 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 46.69 hectares.
	Pre-clearing surveys would be undertaken in accordance with *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Prior to construction	Effective	
	Vegetation removal would be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	
	Native vegetation would be re-established in accordance with *Guide 3: Re-establishment of native vegetation* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Post construction	Effective	
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (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 *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	Before construction	Effective	
	The final design impact area will be ground-truthed and offsets will be calculated and implemented as per Guideline for Biodiversity Offsets (November 2016) (refer Section 6).	Post construction	Effective	While the offsets developed for the proposal will address residual impacts, there is likely to be some time lag between impacts and the benefits accrued to biodiversity from offsetting.
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 46.69 hectares.
	Habitat removal would be undertaken in accordance with *Guide 4: Clearing of vegetation and removal of bushrock* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	If culvert extension necessitates the damage of any Fairy Martin mud nests within culverts, the removal of the nests should be undertaken by a suitably trained spotter-catcher outside of the breeding season for the Eastern Cave Bat; any roosting bats should be captured for release during night time hours to minimise predation risk. If bats are found to be using any of the mud nests removed, suitable bat roost boxes should be installed on the nearest suitable existing bridge to act as compensatory habitat.	During construction	Proven	
	Habitat would be replaced or re-instated in accordance with *Guide 5: Re-use of woody debris and bushrock* and *Guide 8: Nest boxes* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven	
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (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 *Guide 1: Pre-clearing process* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Proven	Removal of *Homopholis belsonii, Digitaria porrecta, Desmodium campylocaulon*
	The unexpected species find procedure is to be followed under *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (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 *Guide 10: Aquatic habitats and riparian zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011) and Section 3.3.2 *Standard precautions and mitigation measures* of the *Policy and guidelines for fish habitat conservation and management Update 2013* (DPI (Fisheries NSW) 2013).	During construction	Effective	Minor increased obstruction to fish passage Permanent loss of habitat for Lowland Darling River EEC and Purple Spotted Gudgeon
Injury and mortality of aquatic vertebrates	If any water is present in culvert extension areas at the time of construction, a clearance survey for native aquatic vertebrates should be conducted and captured individuals should be relocated into the nearest non-impacted area of suitable aquatic habitat along the same watercourse.	During construction	Effective	The mitigation measures should be effective but some injury or death of juvenile fish and tadpoles may still occur.
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	Vegetation restoration associated with the proposal should include targeted tree planting aimed at increasing canopy cover in key areas (particularly near waterways) to compensate for the loss of tree cover in these areas.	Detailed design, during construction and post construction	Effective	Minimal 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 *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	Residual impacts are expected to all new edges of remaining roadside vegetation.
Injury and mortality of terrestrial fauna	Fauna would be managed in accordance with *Guide 9: Fauna handling* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (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 in N2MS4 and at larger watercourse crossings to encourage fauna to use bridges and larger culverts to pass under the road. Consider retrofitting fauna furniture under the Bobbiwa Creek Bridge to aid Koalas to cross under the bridge, relatively safe from wild dog attack.	During construction	Effective	The mitigation measures should be effective but roadkill may still continue to occur at similar rates to those at present.
Invasion and spread of weeds	Weed species would be managed in accordance with *Guide 6: Weed management* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA 2011).	During construction	Effective	Minimal, as the proposed control measures are known to be effective.
	A proposal-specific vegetation management and restoration plan should be developed to guide the implementation of weed management and vegetation restoration. Vegetation restoration and management should be focussed on areas containing TECs and areas that have high connectivity value.	During construction	Effective	Minimal, as the proposed control measures are known to be effective.
Invasion and spread of pests	Pest species would be managed within the proposal site.	During construction	Effective	None expected
Invasion and spread of pathogens and disease	Pathogens would be managed in accordance with *Guide 2: Exclusion zones* of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (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 Biodiversity offsets

6.1 Offset requirements

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 clearing of threatened communities and/or habitat for threatened species exceeds set thresholds.

In addition, this biodiversity assessment identifies that the proposal is likely to have a significant impact on threatened biodiversity listed under EPBC Act (see Section 4.5 and Appendix B and C). 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.

All of the structurally intact woodland and forest vegetation in the study area is likely to be habitat for threatened species. As a large majority of the woodland and forest in the surrounding landscape has been either entirely cleared for crop production or reduced to derived grassland, all remaining areas are likely to be at least moderately important for threatened species. Areas of derived native grasslands are habitat for some threatened species that utilise more open habitats but are more abundant in the landscape and would generally be less important for threatened species. For this reason, offsets are proposed to be provided for all woodland and forest areas and natural grasslands but would only be provided for the areas of derived native grasslands that were found to be occupied by threatened species of plants. Under this approach, offsets would be provided for all areas of threatened ecological communities and known habitat for threatened species. The amounts of each vegetation type proposed for offsetting are shown in Table 6.1.

Table 6-1 Roads and Maritime offset thresholds

Description of activity or impact	Offsets required	Vegetation proposed to be offset
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	None 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	None Applies to the planted eucalypts vegetation only
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition	Applies to the 11.31 hectares of *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* community (PCT 52) listed as Critically endangered under the EPBC Act.
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition	Applies to the following TECs: • Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered – EPBC Act) (PCT 52 - 11.31 ha).

Description of activity or impact	Offsets required	Vegetation proposed to be offset
		• Weeping Myall Woodlands (Endangered – EPBC Act) (PCT 27 - 3.64 ha, overlapping with part of the 4.32 ha listed under the BC Act. • Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – BC Act) (1.07 ha including PCT 147 – 0.08 ha and PCT 55 – 0.98 ha) Also applies to the following PCTs that are not TECs but are threatened species habitat: • Poplar Box - Belah woodland (PCT 56- 3.64 ha) • Poplar Box - White Cypress Pine woodland (8.21 ha).
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS	Does not apply.
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 >1 ha or where the species is the subject of an SIS	Applies to the habitat of multiple species and includes the TECs and some better condition areas of non-threatened vegetation types. • Belah woodland; PCT 55 (0.98 ha – intact, 0.08 ha - derived) • Brigalow viney scrub open forest; PCT 445 (0.66 ha - intact, 0.02 -derived) • Queensland Bluegrass +/- Mitchell Grass; PCT 52 (11.31 ha) • Weeping Myall open woodland (3.17 ha - intact, 0.26 ha - derived).
Works involving clearing of NSW listed threatened species habitat where the species is an ecosystem credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing >5 ha or where the species is the subject of an SIS	Applies to the habitat of multiple species and includes the TECs and some better condition areas of non-threatened vegetation types: • Belah woodland (0.98 ha – intact) • Brigalow viney scrub open forest (0.66 ha) • Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha) • Poplar Box - Belah woodland (3.64 ha) • Poplar Box - White Cypress Pine woodland (8.21 ha) • Queensland Bluegrass +/- Mitchell Grass (11.31 ha) • Weeping Myall open woodland (3.17 ha - intact).
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat	Applies to predicted habitat of the Purple Spotted Gudgeon and Eel-tailed Catfish. To be calculated based on the detailed design. Estimated at around 0.03 ha in total based on around 50 square metres of net loss of habitat at each of six culvert extension locations affecting predicted habitat for the Purple Spotted Gudgeon.

For aquatic biodiversity listed under the Fisheries Management Act 1995 (FM Act), offsets are to be provided in accordance with DPI's Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013).

The precise extent and nature of offsets required will be determined as the detailed design progresses and based on the final design and impacts of the proposal.

6.2 Biodiversity offsets

The final offset requirement for the proposal would be determined during detailed design and development of the offset package. During the detailed design phase the proposal area may change from that assessed here which would result in a different offset requirement for the proposal than what is presented in this report.

6.2.1 Availability of offsets

The availability of biodiversity offsets for the proposal will be dependent on whether or not there are areas containing the relevant species and communities available in the relevant bioregions for dedication as offsets. Such land may include:

- Lands under the control of Roads and Maritime Services
- Travelling Stock Reserves
- Pastoral leasehold lands

6.2.2 Opportunities for undertaking supplementary actions

There may be opportunities to undertake supplementary actions to benefit some of the affected species. Such activities may include:

- Strategic restoration of native vegetation to enhance local and regional scale habitat connectivity; e.g. on crown lands (e.g. travelling stock reserves and roadsides) and on private land (e.g. along waterways).
- Undertaking research on the distribution and ecology of poorly-known species.

7 Conclusion

This biodiversity assessment has investigated the potential impacts to terrestrial and aquatic flora and fauna associated with the proposed major pavement upgrades to five segments of the Newell Highway between Narrabri and Moree in northern NSW. 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.

Eight PTCs 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, moderate and good 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 and these are present within the road verge, table drains, road embankments, and cropping and grazing land (this includes the currently proposed compound sites).

A number of the PCTs identified are consistent with threatened ecological communities listed under the NSW BC Act, 2016 and the Commonwealth EPBC Act (MNES), as follows:

- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland (Critically Endangered – EPBC Act)
- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered – BC Act) also includes Brigalow (Acacia harpophylla dominant and co-dominant) (Endangered EPBC Act).
- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions (Endangered – BC Act) also includes Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (Endangered – EPBC Act)
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered – BC Act) also includes Weeping Myall Woodlands (Endangered – EPBC Act)
- Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered – BC Act).

Based on the current design (50 per cent concept design), the estimated clearing of native vegetation for the proposal as a whole is about 46.69 hectares. This includes about 7.57 hectares of state listed TECs (11 per cent of the vegetation loss) and 22.8 hectares of nationally listed TECs (34 per cent of the vegetation loss). Around 16.60 hectares of the critically endangered Natural Grasslands ecological community would be directly impacted in N2MS5. The assessment identifies the loss of vegetation and TECs relevant to each proposal segment proposed, in order to provide data that may be used to further avoid and minimise impacts to vegetation.

Three threatened species of plant were recorded in the proposal area and broader study area:

- *Homopholis belsonii* (Belson's Panic) (Vulnerable EPBC Act, Endangered BC Act)
- *Desmodium campylocaulon* (Creeping Tick-trefoil) (Endangered BC Act)
- *Digitaria porrecta* (Finger Panic Grass) (Endangered BC Act).

A further nine threatened flora species are considered at least moderately likely to occur based on the presence of suitable habitat.

Three threatened fauna species were recorded in the study area:

- Little Eagle (Vulnerable BC Act)
- Grey-crowned Babbler (Vulnerable BC Act)
- Glossy Black-cockatoo (Vulnerable BC Act).

A further 33 threatened fauna species are considered at least moderately likely to occur based on the presence of suitable habitat.

The biodiversity assessment identifies the loss of individuals and habitat for these listed species relevant to each proposal segment proposed, in order to provide data that may be used to further avoid and minimise impacts to threatened species.

An assessment of significance was prepared in accordance with the BC Act (Section 7.3) and EPBC Act (Significant Impact Guidelines 1.1) for each of the identified threatened species and ecological communities.

Assessments of significance prepared in accordance with the BC Act (Section 7.3) concluded that, according to the relevant criteria, the proposal would not have a significant impact on the affected species and communities. With regard to recorded threatened plants, the assessments concluded that:

- *Homopholis belsonii* (Endangered BC Act) occurs as three populations within the study area. The population within N2MS2 may be substantially impacted but planned design refinement of the proposal and other mitigation measures are likely to reduce impacts to such an extent that they would not be significant. Impacts on the other two populations in the study area are considered unlikely to be significantly impacted, as surveys have demonstrated that these populations are large and extend well beyond the proposal area
- Impacts on the other two recorded threatened plant species, *Digitaria porrecta* (Endangered BC Act) and *Desmodium campylocaulon* (Endangered BC Act), are considered unlikely to be significant, as surveys have demonstrated that the local occurrence of these species is large and extends well beyond the proposal area
- Potential impacts on the threatened bird species recorded are not likely to be significant as the edge habitat which would be removed is unlikely to be important for breeding and is only likely to be moderately important for foraging, movement and shelter.

All of the waterways within the study area are tributaries of the Darling River via the Namoi River and Gwydir Rivers. 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. The aquatic habitats in the study area were identified as providing potential habitat for two species;

- Purple Spotted Gudgeon (*Mogurnda adspersa*) (Endangered species FM act)
- Eel Tailed Catfish (*Tandanus tandanus*) (Endangered population FM Act).

An assessment of significance was prepared in accordance with the FM Act for each of the identified threatened species and the aquatic ecological community. The assessment was based on the current proposal, and has concluded that the proposal is unlikely to have a significant impact on these two aquatic species and the aquatic ecological community.

Assessment of relevant species and communities under the EPBC Act significance criteria identified a likely significant impact for one ecological community and two species:

- *Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* (Critically Endangered Act– EPBC): Almost entirely restricted to N2MS5. The proposal would remove 11.31 hectares of this community.

- *Homopholis belsonii* (Belson's Panic) (BC Act): The proposal would reduce the extent of local populations by about 19.04 ha across N2MS2, N2MS4 and N2MS5.
  Five-clawed Worm Skink (*Anomalopus mackayi*) (Endangered EPBC Act). Much of the vegetation in the study area may be important habitat for the species as defined under the EPBC Act. The proposal will involve the removal of 34.50 hectares of potential habitat mostly within N2MS2, N2MS4 and N2MS5.
  The Roads and Maritime Strategic Assessment: Environment Protection and Biodiversity Conservation Act 1999 negate the requirement to refer significant impacts to nationally listed species, ecological communities and migratory species to the Federal Department of the Environment and Energy. In accordance with the strategic assessment, this proposal has applied the "avoid, minimise, mitigate and offset" hierarchy.

Opportunities to avoid and minimise impacts to biodiversity will be identified and realised as the detailed design is developed. 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. The works would involve clearing of habitat for threatened species and areas of threatened ecological communities in moderate to good condition. As such, offsets (or supplementary measures) are warranted. In addition, this biodiversity assessment identifies that the proposal is likely to have a significant impact on threatened biodiversity listed under the EPBC Act. Offsets for these matters will be provided on a 'like-for-like' basis in accordance with the strategic assessment.

During the detailed design phase, the proposal area may be reduced from that assessed in the current report, which would result in decreased impacts. Offset requirements will be determined at this time and a biodiversity offset package prepared for the proposal.

8 References

BAREA, L. P. 2008. Nest-site selection by the Painted Honeyeater (Grantiella picta), a mistletoe specialist. Emu, 108(3), 213-220.

BAREA, L. P. AND WATSON, D. M. 2007. Temporal variation in food resources determines onset of breeding in an Australian mistletoe specialist. Emu 107: 203–209.

BRIGALOW BELT REPTILES WORKSHOP 2010. Proceedings from the workshop for the nine listed reptiles of the Brigalow Belt bioregions. 18-19 August. Brisbane: Queensland Herbarium.

COGGER, H.G., E.E. CAMERON, R.A. SADLIER & P. EGGLER 1993. The Action Plan for Australian Reptiles. Canberra, ACT: Australian Nature Conservation Agency. Available from: http://www.environment.gov.au/biodiversity/threatened/action/reptiles/index.html.

COMMONWEALTH OF AUSTRALIA 2011. Draft Referral guidelines for the nationally listed Brigalow Belt reptiles. Available from: http://www.environment.gov.au/resource/epbc-act-draft-referral-guidelines-nationally-listed-brigalow-belt-reptiles

COMMONWEALTH OF AUSTRALIA 2014. EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory).

COURTNEY, J. & DEBUS, S. 2006. Breeding habits and conservation status of the Musk Lorikeet *Glossopsitta concinna* and Little Lorikeet *G. pusilla* in Northern New South Wales. *Australian Field Ornithology,* 23**,** 109-124.

DEPARTMENT OF ENVIRONMENT 2013. Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Canberra, ACT: Commonwealth of Australia.

DEPARTMENT OF THE ENVIRONMENT AND ENERGY (2018) Species Profile and Threats Database. Anomalopus mackayi — Five-clawed Worm-skink, Long-legged Worm-skink. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?showprofile=Y&taxon_id=25934

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2007. Threatened species assessment guidelines. The assessment of significance. Hurstville: Department of Environment and Climate Change.

DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE 2008. Recovery Plan for the Koala (Phascolarctos cinereus) (Approved). Sydney: Department of Environment and Climate Change.

DEPARTMENT OF ENVIRONMENT CLIMATE CHANGE AND WATER 2009. Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Sydney: Department of Environment, Climate Change and Water.

DEPARTMENT OF ENVIRONMENT CLIMATE CHANGE AND WATER 2010. Cumberland Plain Recovery Plan. *In:* DEPARTMENT OF ENVIRONMENT, C. C. A. W. (ed.). Sydney: Department of Environment, Climate Change and Water.

DEPARTMENT OF THE ENVIRONMENT AND ENERGY. 2017. *Finalised priority assessment lists* [Online]. Canberra: Australian Government. Available: http://www.environment.gov.au/biodiversity/threatened/assessments/fpal [Accessed 14/11/2017.

FAHRIG, L. 2002. Effects of habitat fragmentation on the extinction threshold: a review. *Ecological Applications,* 12**,** 346-352.

FAIRFULL, S. & WITHERIDGE, G. 2003. Why do fish need to cross the road? Fish passage requirements for waterway crossings. Cronulla: NSW Fisheries.

GALL, B.C. 1980. Aspects of the ecology of the koala Phascolarctos cinereus (Goldfuss) in Tucki Tucki Nature Reserve, New South Wales. Australian Wildlife Research. 7:167-176.

GARNETT, S. T., SZABO, J. K. AND DUTSON, G. 2011. The Action Plan for Australian Birds 2010. Birds Australia, CSIRO Publishing, Melbourne.HIGGINS, P. J. (ed.) 1999. *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds,* Melbourne: Oxford University Press.

JURSKIS, V. & M. POTTER 1997. Koala surveys, ecology and conservation at Eden. Sydney, NSW: Forest Research and Development Division, State Forests of New South Wales.

KUGINIS, L., BYRNE, G., SEROV, P. & WILLIAMS, J. P. 2012. Risk assessment guidelines for groundwater dependent ecosystems Volume 3 – Identification of high probability groundwater dependent ecosystems on the coastal plains of NSW and their ecological value. Sydney: Department of Primary Industries, Office of Water.

NSW DEPARTMENT OF PRIMARY INDUSTRIES 2013. Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (2013 upate).

NSW DEPARTMENT OF PRIMARY INDUSTRIES 2017. Southern Purple Spotted Gudgeon - Mogurnda adspersa July 2017, Primefact 1275, Second edition. Threatened Species Unit.

NSW ROADS AND TRAFFIC AUTHORITY 2011a. Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. Sydney: NSW Roads and Traffic Authority.

NSW ROADS AND TRAFFIC AUTHORITY 2011b. Protecting and managing biodiversity on RTA projects. Sydney: RTA Environment Branch.

OFFICE OF ENVIRONMENT AND HERITAGE 2015. BRG-Namoi Regional Native Vegetation Mapping. Sydney: NSW Office of Environment and Heritage.

OFFICE OF ENVIRONMENT AND HERITAGE 2016. NSW Guide to Surveying Threatened Plants Sydney: NSW Office of Environment and Heritage.

OFFICE OF ENVIRONMENT AND HERITAGE 2017a. Biodiversity Assessment Method. Sydney: State of New South Wales.

OFFICE OF ENVIRONMENT AND HERITAGE. 2017b. *BioNet Vegetation Classification* [Online]. NSW Office of Environment and Heritage. Available: http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx [Accessed 08/08/2015.

OFFICE OF ENVIRONMENT AND HERITAGE. 2017c. *Preliminary determinations by date* [Online]. NSW Government. Available: http://www.environment.nsw.gov.au/committee/preliminarydeterminationsbydate.htm [Accessed Page last updated: 28 August 2017.

ROYAL AUSTRALIAN ORNITHOLOGISTS UNION 2003. *The New Atlas of Australian Birds*, Royal Australian Ornithologists Union, Hawthorn East, Victoria.

SAUNDERS, D. L. & TZAROS, C. L. 2011. National Recovery Plan for the Swift Parrot Lathamus discolor. Melbourne: Birds Australia.

SPARK, P. (2010). Survey of the Habitat Requirements and Review of the Conservation Status of the Five-clawed Worm-skink (Anomalopus mackayi) within the Namoi River Catchment. Report to the Namoi Catchment Management Authority: Threatened Grassland Reptile Species Project, Tamworth. Tamworth, NSW: North West Ecological Services.

STRAHAN, R. (ed.) 1995. The Mammals of Australia. Australian Museum and Reed Books, Sydney.

TAYLOR, R., 2014. A Survey of the Pale Imperial Hairstreak Butterfly Jalmenus eubulus in New South Wales. Australian zoologist, 37(2), pp.248-255.

THACKWAY, R. & CRESSWELL, I. D. 1995. *An Interim Biogeographic Regionalisation of Australia,* Canberra, Australian Nature Conservation Agency.

THREATENED SPECIES SCIENTIFIC COMMITTEE 2008. Commonwealth Conservation Advice on *Eucalyptus nicholii*. Canberra: Department of the Environment, Water, Heritage and the Arts.

THREATENED SPECIES SCIENTIFIC COMMITTEE 2017. Guidelines for assessing the conservation status of native species according to the *Environment Protection and Biodiversity Conservation Act 1999* and *Environment Protection and Biodiversity Conservation Regulations 2000*. https://www.environment.gov.au/system/files/pages/d72dfd1a-f0d8-4699-8d43-5d95bbb02428/files/tssc-guidelines-assessing-species-2017.pdf

WSP 2017. Newell Highway Upgrade: Narrabri to Moree Preliminary Ecological Investigation. Sydney.

Appendix A – Habitat assessment table

Likelihood of occurrence 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 (i.e. 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 (i.e. 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.
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 (i.e. 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 a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Habitat assessment table – Threatened Flora

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Acacia jucunda	Yetman Wattle	-	E	Yetman Wattle is found in the Yetman district near the Queensland border on the North West Slopes of NSW. It also occurs in Queensland where it is reasonably common. Acacia jucunda abundance in populations has been recorded as locally occasional, locally common and frequent, with one population noted as being about one acre in extent. Mainly restricted to dry eucalypt woodland communities on sandy to sandy-loam soils. In Queensland, the species is found in dry ranges on loams or clay-loams in eucalypt communities. Associated species at the NSW sites include Acacia polybotrya and Callitris endlicheri.	-	Northern Basalts	Low – species not known from locality but is predicted for IBRA subregion. There is only a small amount of suitable habitat in the study area and the species has a very restricted known distribution in NSW. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Acacia pycnostachya	Bolivia Wattle	V	V	Two extensive populations exist in the vicinity of Bolivia Hills and Bluff River Nature Reserves south of Tenterfield, and on nearby private land. Smaller populations have been found west of Tenterfield on private land and the species may be more widespread than is currently documented. The plant tends to occur in patches although sparsely distributed individuals are common at Bolivia Hills. Acacia pycnostachya grows in dry sclerophyll forest amongst granite outcrops, on hillsides at altitudes of 700 to 900 m. Soil types range from acid volcanic to sandy and skeletal on exposed outcrops, to shallow sandy loams in less exposed sites. It often grows in stands in areas sheltered from fire.	-	Northern Basalts	None – species is known from a relevant IBRA sugregion but is not known from the locality and associated habitat is absent from the study area unsuitable.
Androcalva procumbens (*Commersonia procumbens*)	-	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 *Eucalyptus dealbata* and *Eucalyptus sideroxylon* communities, *Melaleuca uncinata* scrub, under mallee eucalypts with a *Calytrix tetragona* understorey, and in a recently burnt Ironbark and Callitris area. Also in *Eucalyptus fibrosa* subsp. *nubila*, *Eucalyptus dealbata*, *Eucalyptus albens* and *Callitris glaucophylla* woodlands north of Dubbo. Other associated species include *Acacia triptera*, *Callitris endlicheri*, *Eucalyptus melliodora*, *Allocasuarina diminuta*, *Philotheca salsolifolia*, *Xanthorrhoea species*, *Exocarpos cupressiformis*, *Leptospermum parvifolium* and *Kunzea parvifolia*.	PMST	-	Low – species recorded from Mount Kaputar National Park approximately 30km to the east and further south in the Pilliga. A small amount of potential though likely marginal habitat is present; Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Austrostipa metatoris	A spear-grass	V	V	Recorded in the Murray Valley with sites including Cunninyeuk Station, Stony Crossing, Kyalite State Forest (now part of Murrumbidgee Valley Regional Park) and Lake Benanee; scattered records also in central NSW including Lake Cargelligo, east of Goolgowi, Condobolin and south west of Nymagee. Otherwise only known from near Bordertown in south east South Australia. Grows in sandy areas of the Murray Valley; habitats include sandhills, sandridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils. Associated species include Eucalyptus populnea, E. intertexta, Callitris glaucophylla, Casuarina cristata, Santalum acuminatum and Dodonaea viscosa.	Associated PCT/s only	-	Low– associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)
Austrostipa wakoolica	A spear-grass	E	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 Callitris glaucophylla, Eucalyptus microcarpa, E. populnea, Austrostipa eremophila, A. drummondii, Austrodanthonia eriantha and Einadia nutans.	Associated PCT/s only	-	Low – associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Weeping Myall open woodland (PCT 27)
Bertya opponens	Coolabah Bertya	V	V	This plant is currently known from only four scattered sites in NSW: one from private property near Coolabah in western NSW and two to the south of Narrabri on the North West Slopes, including the largest population in Jacks Creek State Forest. Coolabah Bertya occurs in a range of habitats including stony mallee ridges and cypress pine forest on red soils. The wide variation in habitat type between the populations makes the identification of critical habitat very difficult. Consideration of disturbance regimes and grazing management are probably more important to the survival of populations in the long term. Associated species at Jacks Creek State Forest include Eucalyptus chloroclada, Callitris glaucophylla and Eucalyptus fibrosa.	135 – OEH PMST	-	Low – all records of this species are from Jacks Creek to the south of Narrabri. The study area contains only a small amount of possibly suitable habitat and the species was not recorded during surveys despite being quite conspicuous. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Capparis canescens	Wild Orange	-	E	Occurs in eastern Queensland and has recently been confirmed as occurring in north-western NSW. The species was known in NSW from a single population about 20 km NNW of Bonshaw and 50 km north of Ashford, however this population is reported to have recently been cleared by roadworks. Seven plants are said to still survive at the site. Grows in open eucalypt forest. Associated species include Eucalyptus sideroxylon and E. microcarpa woodland on siliceous sediments. Associated species at Queensland sites include E. dealbata, E. microtheca, E. crebra, E. fibrosa subsp. nubila, E. melanophloia, Callitris glaucophylla, Allocasuarina luehmannii, Lysiphyllum cunninghamii and Acacia and Alphitonia species.	-	Northern Basalts	None – species not known from locality. Habitat in study area unsuitable.
Cyperus conicus		-	E	Occurs rarely in the Pilliga area of NSW and is also found in Victoria, Qld, the NT and WA. Grows in open woodland on sandy soil. In central Australia, the species grows near waterholes and on the banks of streams in sandy soils. In Qld the species usually found on heavy soils. Recorded from Callitris forest in the Pilliga area, growing in sandy soil with Cyperus gracilis, C. squarrosus and C. fulvus. Interstate habitats include floodplains, creek beds and banks, swamps, run-on areas and various watercourses, near or in dams and bores, and in vegetation communities such as Melaleuca swamps, open Box woodland and sedgelands. Soils are usually sandy or silty and damp to wet.	2 – OEH	Northern Outwash Northern Basalts	Moderate. Recorded in the locality and associated habitat is present. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Desmodium campylocaulon	Creeping Tick-trefoil	-	E	Occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. Also occurs in the NT and Darling Downs district of south-eastern Queensland. Creeping Tick-Trefoil is confined to clay soils, usually with Astrebla and Iseilema species. In NSW Desmodium campylocaulon grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. Associated species include Acacia harpophylla, Astrebla pectinata and Sorghum, Dichanthium and Panicum species.	53 – OEH	Northern Outwash Northern Basalts	Recorded; in the study area of N2MS5 during field surveys. Probable elsewhere in associated habitat. Associated habitat on site includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Dichanthium setosum	Bluegrass	V	V	Dichanthium setosum has been reported from mid-coastal to inland NSW and Queensland. Dichanthium setosum occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending west to Narrabri. Dichanthium setosum is associated with heavy basaltic black soils and red-brown loams with clay subsoil.	4 – OEH PMST	Northern Outwash Northern Basalts	Low – suitable habitat widespread. Previously recorded immediately adjacent to the study area but repeated surveys in that locations and across the proposal area failed to record the species. Associated potential habitat in the study area includes: Weeping Myall open woodland (PCT 27) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Belah woodland on alluvial plains and low rises (PCT 55) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Digitaria porrecta	Finger Panic Grass	-	E	Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land. In NSW, the most frequently recorded associated tree species are Eucalyptus albens and Acacia pendula. Common associated grasses and forbs in NSW sites include Austrostipa aristiglumis, Enteropogon acicularis, Cyperus bifax, Hibiscus trionum and Neptunia gracilis. Flowering season is summer or late summer from mid-January to late February, with seeds maturing and falling from the plant soon after. Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.	31 – OEH	Northern Outwash Northern Basalts	Recorded in the study areas of N2MS2, N2MS4 and N2MS5 during field surveys. Associated habitat on site includes: Weeping Myall open woodland (PCT 27) Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Diuris tricolor	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 Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta, Ironbark and Acacia shrubland. The understorey is often grassy with herbaceous plants such as Bulbine 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 (Callitris 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.	-	Northern Basalts	Moderate – species not known from locality but is known from a relevant IBRA sugregion and study area contains potential habitat. Survey timing was not suitable for detection of this species. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56).
Eleocharis obicis	A Spike-Rush	V	V	Found relatively recently near Condobolin and Hay, with an old collection from the Barrier Range near Broken Hill. The more recent collection was made on the Lachlan River floodplain at Micabil, near Condobolin. Grows in ephemerally wet situations such as roadside mitre drains and depressions, usually in low-lying grasslands. Sites include depressions with heavy clay soils on the Lachlan River floodplain, with Eragrostis australasica, Atriplex vesicaria and A. nummularia shrublands, low-lying claypans near an irrigation channel, and a shallow open ditch on a low ridge with Eucalyptus populnea in red sandy soil over clay. Recorded as flowering in November. Found to be locally frequent to abundant in western NSW populations.	Associated PCT/s only	-	None– associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Hakea pulvinifera	Lake Keepit Hakea	E	E	Lake Keepit Hakea is confined to the North West Slopes of NSW, where it is known from a single population near Lake Keepit, north-east of Gunnedah. Associated species at the site include Alstonia constricta and Acacia decora also prevalent as shrubs. A sparse cover of grasses and forbs forms a ground layer but at least fifty percent of the site is bare earth or rock. The most common ground cover species is the introduced plant Petrorhagia nanteuilii. Other common species are the grasses Themeda australis, Cymbopogon obtectus and Aristida species.	-	Northern Basalts	None – species only known to occur in Lake Keepit locality. The study area does not contain suitable habitat.
Homopholis belsonii	Belson's Panic	V	E	It occurs on the northwest slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion. Grows in dry woodland (e.g. Belah) often on poor soils, although sometimes found in basalt-enriched sites north of Warialda and in alluvial clay soils. Habitat and ecology appear to be poorly known.	14 – OEH PMST	Northern Outwash Northern Basalts	Recorded; found in the study areas of N2MS2 and N2MS4 during field surveys in a variety of PCTs. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27)
Lepidium aschersonii	Spiny Peppercress	V	V	Not widespread, occurring in the marginal central-western slopes and north-western plains regions of NSW (and potentially the south western plains). Found on ridges of gilgai clays dominated by Brigalow (Acacia harpophylla), Belah (Casuarina cristata), Buloke (Allocasuarina luehmanii) and Grey Box (Eucalyptus microcarpa). In the south has been recorded growing in Bull Mallee (Eucalyptus behriana). Often the understorey is dominated by introduced plants. The species grows as a component of the ground flora, in grey loamy clays. Vegetation structure varies from open to dense, with sparse grassy understorey and occasional heavy litter.	84 – OEH PMST	Northern Outwash Northern Basalts	Moderate– recorded in the locality and suitable habitat are found in study area. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Lepidium monoplocoides	Winged Pepper cress	E	E	Widespread in the semi-arid western plains regions of NSW. Collected from widely scattered localities. Occurs on seasonally moist to waterlogged sites, on heavy fertile soils. Predominant vegetation is usually an open woodland dominated by Allocasuarina luehmannii (Bulloak) and/or eucalypts, particularly Eucalyptus largiflorens (Black Box) or Eucalyptus populnea (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Recorded in a wetland-grassland community comprising Eragrostis australasicus, Agrostis avenacea, Austrodanthonia duttoniana, Homopholis proluta, Myriophyllum crispatum, Utricularia dichotoma and Pycnosorus globosus, on waterlogged grey-brown clay. Also recorded from a Maireana pyramidata shrubland.	Associated PCT/s only	-	Moderate. Recently recorded near Narrabri and in the Pilliga area. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Monotaxis macrophylla	Large-leafed Monotaxis	-	E	Recorded from several highly disjunct populations in NSW: eastern edge of Deua NP, Bemboka portion of South East Forests NP, Cobar area (Hermitage Plains), Tenterfield area, Woodenbong, and recently in the eastern spur of the Nandewar Range in the Namoi catchment; also known in Queensland. Its distribution and supposed rarity in NSW is related to the occurrence of fire; in NSW it has not been found in the absence of fire. There is a great diversity in the associated vegetation within NSW, encompassing coastal heath, arid shrubland, forests and montane heath from almost sea level to 1300 m altitude. Plants have a short life span and do not seem to persist longer than six months. It typically grows on rocky ridges and hillsides.	Associated PCT/s only.	-	Low. A small amount of marginal habitat is present but lacks typical microhabitat features (rock outcrops) associated with the species. It has not been recorded in the relevant IBRA subregions. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Philotheca ericifolia	-	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 *Melaleuca uncinata*, *Eucalyptus crebra*, *E. rossii*, *E. punctata*, *Corymbia trachyphloia*, *Acacia triptera*, *A. burrowii*, *Beyeria viscosa*, *Philotheca australis*, *Leucopogon muticus* and *Calytrix tetragona*. Flowering time is in the spring. Fruits are produced from November to December.	PMST	-	Low – species not known from locality or relevant IBRA subregions. Some areas in study area may offer marginal habitat features. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Picris evae	Hawkweed	V	V	Hawkweed is a soft-stemmed annual plant. Known from Inverell area, in the NW slopes and plains regions; collected in and around Inverell, Tamworth and also from Dangar Falls in the Oxley Wild Rivers NP in the northern tablelands. It also occurs in the Darling Downs and Moreton regions of SE Queensland. Its main habitat is open Eucalypt forest including a canopy of Eucalyptus melliodora, E. crebra, E. populnea, E. albens, Angophora subvelutina, Allocasuarina torulosa, and/or Casuarina cunninghamiana with a Dichanthium grassy understory. Soils are black, dark grey or red-brown (specified as shallow, stony soil over basalt for one collection) and reddish clay-loam or medium clay soils.	Associated PCT/s only	-	Moderate A substantial area of potential habitat is present but the species has not been recorded in the relevant IBRA subregions. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Platyzoma microphyllum	Braid Fern	-	E	Recorded in NSW only in the Yetman district. The species is widespread across northern Australia, from WA to the NT, eastern Qld and just into central-northern NSW. Grows in sandy or swampy soils, or in clay soils adjacent to streams and lagoons and subject to periodic flooding. Other associated species include Hakea dactyloides, Brachyloma daphnoides, Jacksonia scoparia, Xylomelum cunninghamii and Calytrix tetragona.	-	Northern Basalts	None – species not known from locality but is known from a relevant IBRA subregion. Habitat in study area is unsuitable.

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Polygala linariifolia	Native Milkwort	-	E	North from Copeton Dam and the Warialda area to southern Queensland; also found on the NSW north coast near Casino and Kyogle, and there is an isolated population in far western NSW near Weebah Gate, west of Hungerford. This species also occurs in Western Australia. Sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi*, *Eucalyptus dealbata* and Callitris, and in yellow podsolic soil on granite in layered open forest. In the Pilliga area, this species has been recorded in Fuzzy Box woodland, White Cypress Pine-Bulloak - Ironbark woodland, Rough-barked Apple riparian forb-grass open forest, and Ironbark - Brown Bloodwood shrubby woodland. Other associated species include *Eucalyptus trachyphloia*, *Eucalyptus sphaerocarpa*, *Angophora floribunda*, *Angophora leiocarpa*, *Tristania suaveolens*, *Allocasuarina torulosa* and Wahlenbergia species in the understorey.	2 – OEH	Northern Basalts	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Pomaderris queenslandica	*Scant Pomaderris*	-	E	Widely scattered but not common in north-east NSW and in Queensland. It is known from several locations on the NSW north coast and a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolata. Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	18 – OEH	Northern Basalts	Low– Recorded in the locality but the study area contains only a small amount of possibly suitable habitat and the species was not recorded during surveys despite being quite conspicuous. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Prasophyllum sp. Wybong (C.Phelps ORG 5269)		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.	PMST	-	Low – Some areas in study area may offer marginal habitat features but it has not been recorded in the locality or relevant IBRA subregions. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Pterostylis cobarensis	Greenhood Orchid	-	V	Recorded from Bourke, Nyngan, Cobar, Nymagee, Warren, Gilgandra, Narrabri, Coonabarabran districts. Habitats are eucalypt woodlands, open mallee or Callitris shrublands on low stony ridges and slopes in skeletal sandy-loam soils. Associated species include Eucalyptus morrisii, E. viridis, E. intertexta, E. vicina, Callitris glaucophylla, Geijera parviflora, Casuarina cristata, Acacia doratoxylon, Senna spp. and Eremophila spp.	3 – OEH	-	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat: Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Sida rohlenae	Shrub Sida	-	E	It has a limited distribution in Qld, NT, SA and WA. In NSW; recorded south of Enngonia, south of Bourke and north-west of Coonamble with one collection north of Bourke. It grows on flood-out areas, creek banks and at the base of rocky hills. NSW specimens have been found along roadsides in hard red loam to sandy-loam soils. The species can become locally abundant and is often more common in disturbed sites. Flowers appear in spring and summer.	Associated PCT/s only	-	Moderate. Known from the Brigalow Belt south but not the relevant subregions. Associated habitat on site includes: Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Swainsona murrayana	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 Maireana species. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated.	10 – OEH PMST	Northern Basalts	Moderate– Recorded in the locality and the study area contains some possibly suitable habitat. Associated habitat on site includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)

Species name	Common name	EPBC Act Status	BC Act Status	Distribution and habitat	Records or modelled in the locality (number of records)	Associated with relevant IBRA subregions	Likelihood of occurrence
Swainsona plagiotropis	Red Darling Pea	V	V	Occurs in the upper Murray River valley in the south-western plains of NSW and into Victoria. Most NSW records are from the Jerilderie area, with possible collections from the Louth-Bourke area and a disjunct record in the north-western plains from Buttabone Stud Park 35 km NW of Warren. Grows on flat grassland and in heavy red soil, often on roadsides and especially in table drains. Soils are derived from quaternary sediments and are usually red-brown clay-loams. The species is absent from black low-lying soils. Recorded from roadsides, rail reserves, stock routes and areas of lightly grazed unimproved pasture comprising Austrodanthonia, Enteropogon acicularis and Austrostipa grassland communities.	Associated PCT/s only	-	Low – associated PCTs present but the species is not known or predicted to occur in the bioregion. Associated habitat on site includes: Weeping Myall open woodland (PCT 27).
Swainsona sericea	Silky Swainson-pea	-	V	Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Found in Natural Temperate Grassland and Snow Gum Eucalyptus pauciflora Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines Callitris spp. Habitat on plains unknown.	-	Northern Basalts	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat on site includes: Weeping Myall open woodland (PCT 27) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Thesium australe	Austral Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).	PMST	Northern Basalts	Low – species not known from locality but is associated with a relevant IBRA subregion. Some areas in study area may offer marginal habitat.
Tylophora linearis	-	E	V	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.	PMST	Northern Basalts	Moderate– Not recorded in the locality but associated with a relevant IBRA subregion and the study area contains some possibly suitable habitat. Associated habitat on site includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Habitat assessment table – Threatened Fauna

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Actitis hypoleucos*	Common Sandpiper	M	-	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.	PMST	-	Low – species not recorded in locality. Some areas in study area may offer marginal habitat features.
Bird	*Alectura lathami (endangered population)*	Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	-	EP	The Australian Brush-turkey has a largely coastal distribution from Cape York south as far as the Illawarra in NSW. A population of the Australian Brush-turkey is known from the Nandewar and Brigalow Belt South Bioregions. Recent records for the species show the population to range from north east of Warialda, to Narrabri, approximately 115 km to the south-west, and occur within the local government areas of Yallaroi, Bingara, Narrabri, Barraba and Moree Plains. Usually prefers dry rainforest that is found within the Semi-evergreen Vine Thicket. Birds build nesting mounds in areas of dense vegetation. This provides ample litter for the mound building and decomposition process, as well as shade to reduce moisture loss from the mound. Tall trees such as eucalypts are used for nocturnal and diurnal roosting (15 - 20m above the ground).	2 – OEH	Northern Outwash Northern Basalts	Low – the few records in the locality are from some well vegetated areas east of Narrabri. Some areas in study area may offer marginal habitat. Associated habitat in the study area includes: Mock Olive - Wilga - Peach Bush - Carissa (PCT 147).
Bird	*Anseranas semipalmata*	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.	7 – OEH Birdline	Northern Outwash	Low – may occur in ephemeral wetland habitats after periods of high rainfall. Birds reported in Narrabri Lake (in town) and on the Mehi River at Moree. At best, marginal potential nesting habitat in study area. Associated habitat in the study area includes pools in waterways, fam dams. Ephemeral wetlands within grassland areas are also likely to provide habitat; particularly with tin the following habitats: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Bird	*Anthochaera Phrygia*	Regent Honeyeater	CE	CE	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	1 – OEH PMST	Northern Basalts	Low – study area outside of species' known/predicted range. Single record 15 years old. Some areas of suitable habitat may be present.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
					most commonly associated with box-ironbark eucalypt woodland and dry sclerophyll forest, but also inhabits riparian vegetation such as sheoak (*Casuarina* 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.			
Bird	*Apus pacificus*	Fork-tailed Swift	M	-	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.	PMST	-	Moderate – would likely fly over the study area during migration.
Bird	*Ardea alba*	Great Egret	M	-	Widespread in Australia. Reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial).	PMST	-	High - confirmed north of Moree during field surveys.
Bird	*Ardea ibis*	Cattle Egret	M	-	Widespread and common according to migration movements and breeding localities surveys. Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands.	PMST	-	Moderate – may occur in study area when cattle are present.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Ardeotis australis*	Australian Bustard	-	E	The Australian Bustard mainly occurs in inland Australia and is now scarce or absent from southern and south-eastern Australia. In NSW, they are mainly found in the north-west corner and less often recorded in the lower western and central west plains regions. Occasional vagrants are still seen as far east as the western slopes and Riverine plain. Breeding now only occurs in the north-west region of NSW. Mainly inhabits tussock and hummock grasslands, though prefers tussock grasses to hummock grasses; also occurs in low shrublands and low open grassy woodlands; occasionally seen in pastoral and cropping country, golf courses and near dams. Breeds on bare ground on low sandy ridges or stony rises in ecotones between grassland and protective shrubland cover; roosts on ground among shrubs and long grasses or under trees.	3 – OEH	Northern Outwash Northern Basalts	Moderate – suitable habitat widespread in study area but the species has been infrequently recoded. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Bird	*Artamus cyanopterus*	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 and on golf courses.	11 – OEH	Northern Outwash Northern Basalts	High – recorded in the locality at moderate frequency and suitable habitat widespread in study area. Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Botaurus poiciloptilus*	Australasian Bittern	E	E	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus) or cutting grass (Gahnia) growing over a muddy or peaty substrate	PMST	Northern Basalts	Low – species is not known from the locality. Some small areas of suitable habitat may be present in the study area, although not of sufficient size or quality for a resident local population to persist.
Bird	*Burhinus grallarius*	Bush Stone-curlew	-	E	Open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	2 – OEH	Northern Basalts	Moderate – may utilise woodland habitats; recorded infrequently in the locality. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Bird	*Calidris acuminata*	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, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal	PMST Birdline	-	Low – Vagrant birds may infrequently use habitat in the study area after suitable rainfall on passage between more suitable habitats. Associated habitat in the study area includes ephemeral wetlands.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
					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.			
Bird	*Calidris ferruginea*	Curlew Sandpiper	CE	E	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.	PMST		Low – species not known from the locality. Some areas of suitable habitat may be present.
Bird	*Calidris melanotos*	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.	PMST		Low – species not known from the locality. Some areas of suitable habitat may be present.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Calyptorhynchus banksii samueli*	Red-tailed Black-Cockatoo (inland subspecies)	-	V	The Red-tailed Black-Cockatoo (inland subspecies) is known to occur around watercourses and overflows of the Darling, Paroo, Bogan, Macquarie and Barwon Rivers extending in an arc along the Darling River from Wentworth (though rare south of Menindee) in the south to Bourke and thence through to Brewarrina in the north. It extends east to Walgett and perhaps Boggabilla on the Barwon and south through to the Macquarie Marshes. Red-tailed Black-Cockatoos are found in a wide variety of habitats. Prefer Eucalyptus forest and woodlands, particularly river red gum and coolabah lined water courses. In the arid zone usually occur mainly near eucalypts along larger watercourses and associated Acacia and Casuarina woodlands nearby. Also utilise grasslands, scrublands, wetlands and vegetation on floodplains.	1 – OEH	-	Low – suitable habitat widespread in study area but the species has been infrequently recorded in the region. Probable only as a vagrant. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Bird	*Calyptorhynchus lathami*	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 (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, *Allocasuarina diminuta*, and *A. gymnanthera*. 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 (Casuarina cristata).	20 – OEH	Northern Outwash Northern Basalts	Recorded; likely presence confirmed by chewed cones in roadside Belah in N2MS4 during field surveys. Belah habitat widespread. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Chthonicola sagittata (Pyrrholaemus sagittatus)*	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.	58 – OEH Birdline	Northern Outwash Northern Basalts	Moderate – marginal (fragmented, liner and relatively small patch-size) habitat present and the species has been recorded in the locality, chiefly in larger patches of woodland in the east. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Bird	*Circus assimilis*	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.	7 – OEH Birdline	Northern Outwash Northern Basalts	High – known from locality. Suitable habitat widespread; the most suitable habitat includes the edges of wetlands and creeks. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Climacteris picumnus victoriae*	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 (Eucalyptus camaldulensis) 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.	12 – OEH	Northern Outwash Northern Basalts	Low – recorded in the locality and suitable habitat present in woodland vegetation, particularly riparian areas. However, the study area is west of the western boundary of the range of *Climacteris picumnus victoriae* which runs approximately through Inverell at this latitude and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper *Climacteris picumnus picumnus* which then occupies the remaining parts of the state. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Bird	*Daphoenositta chrysoptera*	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.	20 – OEH	Northern Outwash Northern Basalts	High. Frequently recorded in the locality and habitat is widespread in the study area. Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Ephippiorhynchus asiaticus*	Black-necked Stork	-	E	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).	7 – OEH Birdline	Northern Outwash Northern Basalts	Low – this species has been recorded numerous times around the Moree area, particularly in the Gwydir wetlands. This species would be sedentary in these habitat and may occasionally use creeks, dams, flooded grassland and wetlands in the study area, particularly after extended periods of heavy rain.
Bird	*Epthianura albifrons*	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).	Associated PCT/s only	-	Low – Not recorded in the locality since the 1930s. Associated (marginal) habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Erythrotriorchis radiatus*	Red Goshawk	V	CE	This unique Australian endemic raptor is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers.	PMST	-	Unlikely – species not known from locality. Habitat in study area unsuitable.
Bird	*Falco hypoleucos*	Grey Falcon	-	E	Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	Birdline	Northern Outwash	Moderate – not common in the locality however this species may pass through the study area on occasion. Associated habitat in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Falco subniger*	Black Falcon	-	V	Widely, but sparsely, distributed in MSW, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referrable to the Brown Falcon. There is assumed to be a single continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). It inhabits woodland, shrubland and grassland in the arid and semi-arid zones, especially wooded watercourses and agricultural land with scattered remnant trees. It is usually associated with streams or wetlands; in search of prey and often using standing dead trees as lookout posts. Habitat selection is generally influenced more by prey densities than by specific aspects of habitat floristics or condition, although in agricultural landscapes it tends to nest in healthy, riparian woodland remnants with a diverse avifauna.	4 – OEH Birdline	Northern Outwash Northern Basalts	Moderate – suitable habitat widespread. Recorded locations include Narrabri rubbish dump. This species may hunt and perch in the study area; nesting habitat in the study area is likely to be marginal due to its proximity to the highway. 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: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Weeping Myall open woodland (PCT 27)
Bird	*Gallinago hardwickii*	Latham's Snipe	M	-	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.	PMST Birdline		High; Confirmed during surveys near the study area in ephemeral wetland (impeded drainage associated with the highway) just south of Moree. Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
Bird	*Geophaps scripta scripta*	Squatter Pigeon (southern)	V	CE	Found from north Queensland to the North West Slopes of NSW and extending down to the Liverpool Plains and Dubbo. Today they are very rare in the southern parts of their range. Grassy woodlands and plains, preferring sandy areas and usually close to water. Grassy woodlands and plains, preferring sandy areas and usually close to water. Feed on the ground, on seeds of grasses, herbs and shrubs, as well as insects. Nest on the ground.	PMST	Northern Basalts	Low – species not known from the locality and hasn't been recorded in NSW in over a decade. Some areas of suitable habitat may be present. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Glossopsitta pusilla*	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 (*Melaleuca* 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.	6 – OEH Birdline	Northern Basalts	Moderate – this species has been seen near Moree. Not common in the area though is likely to pass through. Associated habitat in the study area includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Bird	*Grantiella picta*	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of birds, and almost all breeding, occur 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 Amyema.	19 – OEH PMST Birdline	Northern Outwash Northern Basalts	High – suitable habitat widespread, particularly in areas with mistletoes. This species has been recorded in the Little Bumble TSR (road reserve) between Narrabri and Moree. Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

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Bird	*Grus rubicunda*	Brolga	-	V	The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It is still abundant in the northern tropics, but very sparse across the southern part of its range. Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged.	2 – OEH Birdline	Northern Basalts	Low – this species has been observed on the Gwydir Wetlands. Some suitable habitat in study area around creeks and wetlands and larger areas after suitable rainfall. Associated habitat in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Weeping Myall open woodland (PCT 27).
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	M	V	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. Habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). It feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion. It generally forages over large expanses of open water; this is particularly true of birds that occur in coastal environments close to the sea-shore. However, the it will also forage over open terrestrial habitats (such as grasslands). Nests may be built in a variety of sites including tall trees (especially Eucalyptus species), bushes, mangroves, cliffs, rocky outcrops, caves, crevices, on the ground or even on artificial structures.	3 – OEH PMST Birdline	Northern Outwash	Low – this species has been seen occasionally in the locality. May hunt over the study area, particularly wetlands and creeks during wet years. There is a low likelihood that the habitat on the site would be used for breeding or be important foraging habitat. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27)
Bird	*Hamirostra melanosternon*	Black-breasted Buzzard	-	V	The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall, from north-western NSW and north-eastern South Australia to the east coast at about Rockhampton, then across northern Australia south almost to Perth, avoiding only the Western Australian deserts. Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.	2 – OEH	Northern Basalts	Moderate – occasionally recorded in the locality, this species may hunt around creeks, woodlands and grasslands in the study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Hieraaetus morphnoides*	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.	11 – OEH	Northern Outwash Northern Basalts	High – suitable habitat widespread and recorded at moderate frequency; including a record immediately adjacent to the study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Bird	*Hirundapus caudacutus*	White-throated Needletail	M, Priority assessment list for Vulnerable	-	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.	PMST Birdline		Moderate – likely to fly over the study area during migration.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Lathamus discolor*	Swift Parrot	CE	E	The swift parrot breeds in Tasmania during the summer and the entire population migrates north to mainland Australia for the winter. Whilst on the mainland the swift parrot disperses widely to forage on flowers and psyllid lerps in eucalypt species, with the majority being found in Victoria and NSW. In NSW they forage in forests and woodlands throughout the coastal and western slopes regions each year. Coastal regions tend to support larger numbers of birds when inland habitats are subjected to drought. Non-breeding birds preferentially feed in inland box-ironbark and grassy woodlands, and coastal swamp mahogany (*E. robusta*) and spotted gum (*Corymbia maculata*) woodland when in flower; otherwise often in coastal forests. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as *Eucalyptus robusta, Corymbia maculata, C. gummifera, E. sideroxylon*, and *E. albens*. Commonly used lerp infested trees include *E. microcarpa, E. moluccana* and *E. pilularis*.	PMST	Northern Basalts	Low – no records of this species in the locality. The study area is on the very northern-western boundary of this species known migration extent and only sparsely scattered records. Only *E. pilligaensis* provides a suitable winter flowering resource. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Bird	*Leipoa ocellata*	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.	PMST	-	Low – this species is not known from the locality. Closest records are from the Pilliga National Park. Only small amounts of likely marginal potential habitat for this species in the study area.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Limosa limosa*	Black-tailed Godwit	M	V	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	Associated PCTs only	Northern Basalts	Low – species not known from the locality. Some areas of suitable habitat may be present in ephemeral wetlands after rainfall.
Bird	*Lophochroa leadbeateri*	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.	Associated PCT/s only	-	Low – species not known from the locality; some areas of marginal habitat may be present. Low – species not known from the locality. Some areas of suitable habitat may be present in ephemeral wetlands after rainfall. Associated habitat in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Bird	*Lophoictinia isura*	Square-tailed Kite	-	V	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	3 – OEH Birdline	Northern Outwash Northern Basalts	Moderate – species seen 20km south-eat of Moree and in Moree. Likely to pass through the study area on occasion. May nest in large trees in the study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Melanodryas cucullata cucullata*	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.	3 – OEH	Northern Outwash Northern Basalts	Moderate – infrequently recorded but suitable habitat is present in study area. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Bird	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subsp.)	-	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 (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	2 – OEH	Northern Outwash Northern Basalts	Low– infrequently recorded and only a small amount of potential habitat is present in study area. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628)
Bird	*Merops ornatus*	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.	PMST Birdline	-	Moderate – species has been recorded in the locality. Suitable habitat in study area.
Bird	*Motacilla flava*	Yellow Wagtail	M	-	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.	PMST	-	Low – marginal habitat in the study area.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Myiagra cyanoleuca*	Satin Flycatcher	M	-	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.	PMST	-	Low – marginal habitat in the study area.
Bird	*Neophema pulchella*	Turquoise Parrot	-	V	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	14 – OEH	Northern Outwash Northern Basalts	Moderate – some suitable habitat found in the study area. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Bird	*Nettapus coromandelianus*	Cotton Pygmy-goose	-	E	Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-Goose is now only a rare visitor to NSW. Uncommon in Queensland. Occupies freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. The Cotton Pygmy-goose uses standing dead trees with hollows close to water for roosting and breeding.	-	Northern Basalts	Low– this species is not known from the locality but the related Green Pygmy Goose which has similar habitat prefers has been recorded in Narrabri Lake. Only scattered records in broader region. Marginal habitat in the study area; possible as a vagrant only.
Bird	*Ninox connivens*	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.	14 – OEH	Northern Outwash Northern Basalts	High – suitable habitat widespread through study area. Recorded in larger woodland areas NE of Narrabri and in close proximity to Moree. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Oxyura australis*	Blue-billed Duck	-	V	Endemic to south-eastern and south-western Australia. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.	ALA	Northern Basalts	Low – several records of this species are shown on the Atlas of Living Australia located on Narrabri Lake. However, habitat in the study area is not likely to be suitable for this species.
Bird	*Pandion cristatus*	Eastern Osprey	M	V	The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.	PMST Birdline	-	Low – species seen on Mehi and Gwydir Rivers. Few areas of suitable hunting habitat in study area. Vagrant birds may fly over and occasionally perch in trees in study area in areas closer to major waterways.
Bird	*Petroica boodang*	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. This species' nest is built in the fork of tree usually more than 2 metres above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub.	Associated PCT/s only	-	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Likely only as a vagrant. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Polytelis swainsonii*	Superb Parrot	V	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.	5 – OEH PMST Birdline	-	Moderate – this species previously recorded occasionally in and around Moree. Suitable habitat widespread in study area which is near the limit of species' range. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Bird	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler	-	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.	60 – OEH	Northern Outwash Northern Basalts	Recorded; confirmed in the study areas of Sections 1 and 2 during field surveys. Habitat widespread. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Bird	*Rhipidura rufifrons*	Rufous Fantail	M	-	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.	PMST ALA	-	Moderate – few records occur in the locality. Species has been recorded in Narrabri. May pass through the study area on occasion.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Rostratula australis*	Australian Painted Snipe	E, M	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.	2 – OEH PMST	Northern Basalts	Low – Suitable habitat represented in study area by some creeks and wetlands. Infrequently recorded in the locality. Suitable habitat likely to be widespread after suitable rainfall; persisting longer in ephemeral wetland areas. Latham's Snipe, a species with similar habitat preferences, observed in an ephemeral wetland just south of Moree. Associated habitat in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Pools in waterways, farm dams and areas of impeded drainage (ephemeral wetlands)
Bird	*Stagonopleura guttata*	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.	3 – OEH Birdline	Northern Outwash Northern Basalts	Moderate – suitable habitat widespread but few local records. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Stictonetta naevosa*	Freckled Duck	-	V	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	1 – OEH Birdline	Northern Basalts	Low – little suitable habitat in study area as this species requires open water. This species has been seen around Moree on farms dams.
Bird	*Tringa nebularia*	Common Greenshank	M	-	The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.	PMST Birdline		Low – Habitat confined to creeks and wetlands and larger areas after suitable rainfall.
Bird	*Turnix maculosus*	Red-backed Button-quail	-	V	The Red-backed Button-quail is recorded only infrequently in NSW, with most records from the North Coast Bioregion; there are historical records south as far as Sydney and three outlying records from western NSW. Over their Australian range, Red-backed Button-quail inhabit grasslands, open and savannah woodlands with grassy ground layer, pastures and crops of warm temperate areas, typically only in regions subject to annual summer rainfall greater than 400 mm. In NSW, said to occur in grasslands, heath and crops. Said to prefer sites close to water, especially when breeding. The species has been observed associated with the following grasses (in various vegetation formations): speargrass Heteropogon, Blady Grass Imperata cylindrica, Triodia, Sorghum, and Buffel Grass Cenchrus ciliaris. Observations of populations in other parts of its range suggest the species prefers sites near water, including grasslands and sedgelands near creeks, swamps and springs, and wetlands. Red-backed Button-quail usually breed in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter.	Associated PCT/s only	-	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. .
Bird	*Tyto longimembris*	Eastern Grass Owl	-	V	Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues. Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They are also found in agricultural land (mainly sugar cane and sorghum, and rice fields in fallow) (Birdlife Australia).	2 – OEH Birdline	Northern Outwash	Low – several birds have been seen near Bellata. May use habitat in study area for hunting, though not considered ideal due to an absence of tall grassed areas. Associated habitat includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Pools in waterways, farm dams and areas of impeded drainage (ephemeral wetlands)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Bird	*Tyto novaehollandiae*	Masked Owl	-	V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	3 – OEH	Northern Basalts	Moderate – several records of this species in Pilliga NP, Bobbiwaa Conservation Area and Moema NP. This species is likely to use the study area for hunting, though may also nest in the larger hollows. Associated habitat in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)
Birds	*Certhionyx variegatus*	Pied Honeyeater	-	V	Widespread in arid and semi-arid Australia. Occasionally occurs further east, on the slopes and plains and the Hunter Valley, typically during periods of drought. Inhabits wattle shrub, primarily Mulga (Acacia aneura), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (Eremophila spp.); also from mistletoes and various other shrubs (e.g. Grevillea spp.); also eats saltbush fruit, berries, seed, flowers and insects. Highly nomadic, following the erratic flowering of shrubs; can be locally common at times. Nests in a shrub or tree up to 5 m above the ground.	Associated PCT/s only	-	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Belah woodland on alluvial plains and low rises (PCT 55) Poplar Box - Belah woodland (PCT 56).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Ambassis agassizii*	Olive Perchlet	-	EP	In NSW Ambassis agassizii 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 to Low No records in the locality. No mapped habitat in the study area. The DPI indicative distribution for the species (high probability of occurrence) includes the following streams outside of, but in close proximity to the study area: Mehi River, Gwydir River and Duffys Creek near Moree Namoi River near Narrabri Unmapped but possibly marginal habitat in the study area includes: Halls Creek south of Moree (north of Halls Creek-Burrington Road).
Fish	*Bidyanus bidyanus*	Silver Perch	-	V	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.	1 - ALA	-	Low There is an old record of the species in the vicinity of Moree. No mapped habitat in the study area. Mapped habitat in the locality includes: Mehi River, Gwydir River and Duffys Creek near Moree Namoi River and Narrabri Creek near Narrabri.
Fish	*Maccullochella peelii*	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.	PMST ALA	-	Moderate – the species has been recorded from Narrabri Creek (Narrabri township) as recently as 2009 and from the Mehi River near Moree (east) as recently as 2014. The ephemerally flowing waterways (pools in waterways) in the study area may contain individuals dispersed from main rivers by floodwaters. Potential habitat includes: Halls Creek south of Moree (north of Halls Creek-Burrington Road) (standing water and riparian vegetation present).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Mogurnda adspersa*	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.	-	-	Moderate No records in the locality. The DPI indicative distribution for the species (high probability of occurrence) includes: Bobbiwaa Creek (2nd or 3rd order stream; braided) (no standing water) Tarlee Creek north of Edgeroi (1st order) and some small areas of shallow standing water) Unnamed stream south of Edgeroi (1st order) (ephemeral wetland and some small areas of standing water) Unnamed stream north of Bellata 1 (1st order) (no standing water – dammed upstream and downstream) Unnamed stream north of Bellata 2 (1st order) (standing water in Typha-fringed dam approximately 20m from road; dammed upstream and downstream) Tookey Creek (1st or 2nd order with moderate sized ephemeral ponds; no standing water) Unmapped but possible habitat in the study area includes: Halls Creek south of Moree (north of Halls Creek-Burrington Road) (standing water and riparian vegetation present).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Fish	*Tandanus tandanus*	Eel Tailed Catfish	-	EP	The western population was widely distributed in the Murray-Darling River System in NSW, Qld, Vic., and SA except in cooler parts. It is non migratory and lives in a wide range of habitats including rivers, creeks, lakes, billabongs and lagoons, and although it inhabits flowing streams, prefers sluggish or still waters. It can be found in clear to turbid waters, and over substrates ranging from mud to gravel and rock. It is rare in natural riverine habitats but can be found in farm dams through-out inland NSW and southern Qld. Moderate remnant populations occur in the Macquarie catchment, the Castlereagh catchment, the Namoi catchment upstream of Wee Waa, the Gwydir catchment upstream of Moree and the Border Rivers Goondiwindi (Fisheries Scientific Committee final determination).	1 -ALA		Moderate Apparently recorded via electrofishing in 2013 in Halls Creek south of Moree and in 2007 in Tycannah Creek. The DPI indicative distribution for the species (high probability of occurrence) includes: Bobbiwaa Creek (2nd or 3rd order stream; braided) (no standing water). Unmapped but possible habitat in the study area includes: Halls Creek south of Moree (north of Halls Creek-Burrington Road) (standing water and riparian vegetation present).
Frogs	*Crinia sloanei*	Sloane's Froglet	Priority assessment list for Endangered status			Associated PCT/s only	-	Low; Records exist from the adjacent Pilliga Outwash IBRA subregion; nearest record is in the Pilliga area. The authenticity of records north of Dubbo has been questioned (refer EPBC Act Consultation Document on Listing Eligibility and Conservation Actions Crinia sloanei (Sloane's froglet)). Possible habitat present in the study area includes ephemeral wetlands, areas of impeded drainage (e.g. table drains) on floodplains and farm dams in all communities but most likely within the following habitats: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56).
Frogs	*Litoria booroolongensis*	Booroolong Frog	E	-	Restricted to tablelands and slopes in NSW and north-east Victoria at 200–1300 m above sea level. Occurs along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	PMST	-	None – closest known occurrence of this species is in Mount Kaputar National Park. Habitat in the study area is unlikely to be suitable for this species.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Invertebrate	*Jalmenus eubulus*	Pale Imperial Hairstreak	-	CE	*Jalmenus eubulus* is found in Queensland and NSW. In Queensland it is restricted to the seasonally sub-humid central and southern areas of the state. In NSW it is found only in Brigalow-dominated open forests and woodlands in northern areas of the state. Only known to breed in old-growth forest or woodland and does not appear to colonise regrowth habitats following clearing or other major disturbance. Suitable habitat is dominated by Brigalow, *Acacia harpophylla* and Buloke, *Casuarina cristata* on clay soils on flat to gently undulating plains, usually with scattered emergent eucalypts such as Poplar Box, *Eucalyptus populnea* and low trees of Wilga, *Geijera parviflora*. In NSW, the species is currently known only from one location (one site).	Associated PCT/s only	Northern Outwash Northern Basalts	Moderate – suitable habitat present in study area. No records in the locality, however this does not discount the potential for this species to occur as it is only known from a single population. Associated habitat in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).
Mammals	*Aepyprymnus rufescens*	Rufous Bettong	-	V	In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter.	Associated PCT/s only	Northern Basalts	Moderate – species not recorded in locality (nearest records are in the Pilliga region) but the study area contains potential habitat. Associated habitats in the study area include: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147)
Mammals	*Antechinomys laniger*	Kultarr	-	E	Widespread across arid and semi-arid NSW but present in very low numbers. Records typically derive from captures by domestic cats or are collected after falling into steep-sided holes. Recent records have come primarily from the Cobar and Brewarrina region. A terrestrial insectivore that inhabits open country, especially claypans among Acacia woodlands. Nocturnal, sheltering by day in hollow logs or tree-stumps, beneath saltbush and spinifex tussocks, in deep cracks in the soil and in the burrows of other animals.	Associated PCT/s only	-	Low – potential habitat present but the study area is outside the species' known or predicted range. Associated habitats in the study area include: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Cercartetus nanus*	Eastern Pygmy-possum	-	V	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; soft fruits are eaten when flowers are unavailable. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Important habitat requirements include trees with hollows >2cm, loose bark of eucalypts or accumulations of shredded bark in tree forks for nesting; and associated vegetation types and with an understorey containing heath, banksias or myrtaceous shrubs and soft-fruited plants in rainforests.	2 – OEH	Northern Basalts	Low – records of this species in the locality are from Jacky Creek. Only a small area of generally disturbed and fragmented potential habitat exists in the study area is Associated habitats in the study area include: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Mammals	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	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.	1 – OEH PMST	Northern Basalts	Low – no favoured roosting habitat in the study area. May forage in vegetation in the study area on occasion. Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Chalinolobus picatus*	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.	9 – OEH	Northern Outwash Northern Basalts	High – this species is likely to forage in the study area and may roost in hollow-bearing trees and culverts there. Associated habitats in the study area include: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Mammals	*Dasyurus maculatus*	Spotted-tailed Quoll	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.	1 – OEH PMST	Northern Outwash Northern Basalts	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. Associated habitats in the study area include: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Leggadina forresti*	Forrest's Mouse	-	V	Sparsely distributed across arid and semi-arid inland Australia including north-west NSW where it has been found in Sturt National Park, Tibooburra, Fowler's Gap, Mutawintji National Park (as subfossil remains), between Wanaaring and Louth and, most recently, 15km north of Wilcannia. Arid and semi-arid plains habitats, especially tussock grassland and chenopod shrubland. Also mulga or savannah woodlands, claypans and sandy ridges.	Associated PCT/s only	-	None; Some potential habitat present but the study area is well outside the species' known range. Associated habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).
Mammals	*Macropus dorsalis*	Black-striped Wallaby	-	E	From the Townsville area in Queensland to northern NSW where it occurs on both sides of the Great Divide. On the north west slopes of NSW it occurs in Brigalow remnants to south of Narrabri. On the north coast it is confined to the upper catchments of the Clarence and Richmond Rivers. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, associated with dense vegetation, including Brigalow, Ooline and semi-evergreen vine thicket. On the north coast, closely associated with dry rainforest but also occur in moist eucalypt forest with a rainforest understorey or a dense shrub layer.	617 – OEH	Northern Outwash Northern Basalts	High – many of records of this species from the Pilliga National Park. Some records also along the road alignment. Suitable habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Mammals	*Miniopterus schreibersii oceanensis*	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.	1 – OEH	Northern Basalts	Moderate – this species may forage in and around woodland/forest and roost in culverts in the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Mormopterus eleryi*	Bristle-faced free-tailed bat, Hairy-nosed Freetail Bat	-	E	Distributed from the southern half of the Northern Territory to central Queensland and north-western NSW. In NSW, the species has been recently recorded from only three disjunct locations: thirteen individuals from Gundabooka National Park, south of Bourke; one individual from Dhinnia Dthinawan Nature Reserve (formerly Bebo State Forest), north of Warialda two individuals near Bonshaw. Knowledge of the ecology of the Hairy-nosed Freetail Bat is limited, however evidence suggests that the species depends on hollows and tree fissures for roosting sites. All other Australian species from the same family generally roost in tree hollows and fissures. Appears to be extremely rare throughout its range. Nationally, it has been recorded from only 15 locations.	Associated PCT/s only	Northern Outwash Northern Basalts	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Mammals	*Nyctophilus corbeni*	Corben's 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 *Allocasuarina luehmannii* 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.	4 – OEH PMST	Northern Outwash Northern Basalts	Moderate – this species may forage and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Petauroides volans*	Greater Glider	V	-	The Greater Glider occurs in eucalypt forests and woodlands along the east coast of Australia from north east Queensland to the Central Highlands of Victoria from sea level to 1200 m altitude. It feeds exclusively on eucalypt leaves, buds, flowers and mistletoe and favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. It roosts in tree hollows, with a particular selection for large hollows in large, old trees. Individuals use multiple hollows and a relatively high abundance of tree hollows (at least 4-8 suitable hollows per hectare) seems to be needed for the species to persist. Individuals occupy relatively small home ranges with an average size of 1 to 3 ha but the species has relatively low persistence in small forest fragments, and disperses poorly across vegetation that is not native forest. Forest patches of at least 160 km^2 may be required to maintain viable populations.	PMST	-	Low – this species is not known from the locality and the closest records are from Kaputar National Park. Some areas of marginal habitat (riparian areas with mature River Redgum) may be found in the in study area.
Mammals	*Petaurus norfolcensis*	Squirrel Glider	-	V	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	5 – OEH	Northern Basalts	Moderate – this species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. Although vegetation in the study area is very fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands (e.g. Bobbiwaa Creek is connected to the conservation area). Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Mammals	*Petrogale penicillata*	Brush-tailed Rock-wallaby	V	E	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	PMST	-	None– species not known from the locality. Only marginal habitat in the study area. Associated (marginal) habitat present in the study area includes: Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Phascolarctos cinereus*	Koala	V	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.	39 – OEH PMST	Northern Outwash Northern Basalts	High – this species was identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) .
Mammals	*Pseudomys delicatulus*	Delicate Mouse	-	E	The Delicate Mouse is distributed from the north-west of Western Australia, across northern Australia to the south east of Queensland. Until recently, no records of the species were known from NSW. In 2002, as part of intensive surveys at 160 sites in the Brigalow Belt South Bioregion, three individuals were trapped at two sites in Bebo State Forest, north of Warialda near the NSW-Queensland border (now Dthinna Dthinnawan National Park). One mouse was in Smooth-barked Apple *Angophora leiocarpa* woodland on deep sandy soil; and two were found in Broad-leaved Ironbark - Silver-leaved Ironbark *Eucalyptus fibrosa - E. melanophloia* woodland. These records represent a significant southern range extension for the species. Given the close relationship between this species and the Pilliga Mouse, habitat selection in NSW may be broad. The Delicate Mouse has been found to occupy grassy habitats and excavates simple burrows to 40cm in depth.	Associated PCT/s only	Northern Basalts	Low – most southern extent of this species is near the QLD border at Dthinna Dthinnawan National Park.

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Pseudomys pilligaensis*	Pilliga Mouse	V	V	Distribution restricted to the Pilliga region of New South Wales. However, a Pilliga Mouse was reportedly trapped in the Warrumbungles after a major wildfire in January 2013, suggesting a local population may have previously existed that could now respond to early stages of the post-fire succession. The Pilliga Mouse is very sparsely distributed and appears to prefer areas with a sparse ground cover. Some evidence exists of marked population fluctuations by this species. The Pilliga Mouse is restricted to an isolated area of low-nutrient deep sand which has long been recognised as supporting a distinctive vegetation type (Pilliga Scrub). Recent studies indicate that the Pilliga Mouse were found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of kurricabah (*Acacia burrowii*) with a bloodwood (*Corymbia trachyphloia*) overstorey. Consistent features of the latter two habitats were: a relatively high plant species richness; a moderate to high low shrub cover; and a moist groundcover of plants, litter and fungi. The gully where high rates of capture were encountered had an extensive cover by low grasses and sedges, with little shrub cover and large areas of ash-covered ground.	1 – OEH PMST	-	Low – infrequently recorded in the locality. There are numerous records in the Pilliga National Park. Some suitable areas of habitat may be present in the study area however these are small and fragmented. Associated (marginal) habitat present in the study area includes: Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397).
Mammals	*Pteropus poliocephalus*	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.	PMST	Northern Outwash Northern Basalts	Low – no camps within 150 km of the study area. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Saccolaimus flaviventris*	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.	17 – OEH	Northern Outwash Northern Basalts	High – this species may forage in woodland/forest and roost in hollow-bearing trees in the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Mammals	*Sminthopsis macroura*	Stripe-faced Dunnart	-	V	Throughout much of inland central and northern Australia, extending into central and northern NSW, western Queensland, Northern Territory, South Australia and Western Australia. They are rare on the NSW Central West Slopes and North West Slopes with the most easterly records of recent times located around Dubbo, Coonabarabran, Warialda and Ashford. Native dry grasslands and low dry shrublands, often along drainage lines where food and shelter resources tend to be better. They shelter in cracks in the soil, in grass tussocks or under rocks and logs. Co-occupies areas with the more common Fat-tailed Dunnart, but prefers relatively ungrazed habitats with greater diversity and healthier understorey vegetation.	2- ALA	Northern Outwash Northern Basalts	High– there are two records in the locality, between Tycannah and Moree, one of which is in contiguous habitat <1 km from the study area. Associated habitat present in the study area includes: Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Poplar Box - Belah woodland (PCT 56) Weeping Myall open woodland (PCT 27) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Mammals	*Vespadelus troughtoni*	Eastern Cave Bat	-	V	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals.	1 – OEH	Northern Basalts	Moderate – this species may forage in and around forest/woodland and roost in Fairy Martin mud nests in bridges and culverts in the study area. Associated habitat present in the study area includes: Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Mock Olive - Wilga - Peach Bush - Carissa (PCT 147) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397)
Reptiles	*Amalosia rhombifer*	Zigzag Velvet Gecko	-	E	The Zigzag Velvet Gecko was first recorded in NSW in 2001, and only a small number of records are known from locations on the north western slopes near the NSW-Queensland border. Two of these locations are from reserves: Dthinna Dthinnawan National Park and Arakoola Nature Reserve. Largely confined to woodland habitats, with such canopy species as *Eucalyptus sideroxylon, E. moluccana, E. blakelyi* and *Callitris* species. It has also been recorded from urban environments in Queensland. This species is largely arboreal, living and foraging in trees. NSW specimens have been found beneath the decorticating bark of standing trees.	Associated PCT/s only	Northern Basalts	Low – species not recorded in locality. Some areas in study area may offer marginal habitat features. Associated (marginal) habitat present in the study area includes: 35

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Reptiles	*Anomalopus mackayi*	Five-clawed Worm-skink	V	E	Patchy distribution on the North West Slopes and Plains of north-east NSW and south-east Queensland, from the Ashford area west to Mungindi and Walgett in NSW and north to Dalby in Queensland. Close to or on the lower slopes of slight rises in grassy White Box woodland on moist black soils, and River Red Gum-Coolabah-Bimble Box woodland on deep cracking loose clay soils. May also occur in grassland areas and open paddocks with scattered trees. Live in permanent deep tunnel-like burrows and deep soil cracks, coming close to the surface under fallen timber and litter, especially partially buried logs.	5 – OEH PMST	Northern Outwash Northern Basalts	Moderate – suitable habitat widespread. Additionally, all of the proposal is in the middle of the 'likely-to-occur' distribution (DSEWPaC 2011), with the floodplain area around Bellata also being in the 'known' distribution of the species. Belah woodland on alluvial plains and low rises (PCT 55) Carbeen +/- Coolabah grassy woodland on floodplain clay loam soil (PCT 628) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (56) Weeping Myall open woodland (PCT 27) Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)
Reptiles	*Antaresia stimsoni*	Stimson's Python	-	V	Occurs in north-west NSW, from Bourke and Gundabooka National Park in the east to Broken Hill and Wilcannia in the south. A terrestrial and semi-arboreal species that inhabits a wide range of arid and semi-arid environments including rock outcrops, sandy plains and dune fields where it is associated with larger trees and termite mounds. The species occupies a broad spectrum of habitats includes woodlands, shrublands (including *Acacia* and chenopods) and hummock grasslands, where rocky outcrops provide caves and deep crevices and where tree-lined watercourses provide numerous low hollows and fallen trees.	Associated PCT/s only	-	Low; study area outside of the species' known range and habitat is marginal. Associated (marginal) habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Reptiles	*Aprasia parapulchella*	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 (*Themeda australis*). 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.	PMST	-	Low – this species is not known from the area. Associated (marginal) habitat present in the study area includes:
Reptiles	*Demansia rimicola*	a whip snake	-	V	Collected in Tibooburra and the vicinity of Sturt National Park. A terrestrial, predominantly diurnal species that shelters under fallen timber, flat rocks, debris, in deep soil cracks, rock crevices, grass clumps, and animal burrows. Preferred habitats include open forests, woodlands or shrublands with an understorey of grass, shrubs or hummock grasslands on the slopes and plains.	Associated PCT/s only	-	Low; study area outside of the species' known range and habitat is marginal. Associated (marginal) habitat present in the study area includes: Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52).
Reptiles	*Furina dunmalli*	Dunmall's Snake	V	-	Occurs in south-east interior of Queensland, including the Darling Downs, and is thought to potentially extend into inland north-eastern NSW. Most locality records are between 200 and 500 m elevation. Preferred habitat is Brigalow forest and woodland with fallen timber and ground litter, growing on cracking clay soils and clay loam soils. Also occurs in eucalypt and Callitris woodland with fallen timber and ground litter.	Associated PCT/s only	Northern Basalts	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Associated (marginal) habitat present in the study area includes: Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35)

Type of animal	Species name	Common name	EPBC Act	BC Act (or FM Act)	Distribution and habitat	No. records in locality	Association with relevant sub-region	Likelihood of occurrence
Reptiles	*Hoplocephalus bitorquatus*	Pale-headed Snake	-	V	A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. The Pale-headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest.	9 – OEH	Northern Outwash Northern Basalts	Moderate – may occur in the study area, particularly around vegetated creek lines. Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52) Poplar Box - Belah woodland (PCT 56) Poplar Box - White Cypress Pine shrub grass tall woodland (PCT 397) Weeping Myall open woodland (PCT 27)
Reptiles	*Uvidicolus sphyrurus (Underwoodisaurus sphyrurus)*	Border Thick-tailed Gecko	V	V	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Occurs at sites ranging from 500 to 1100 m elevation. Populations are mostly fragmented, with over 50 discrete sites currently known that are separated by at least 2 km. As implied by another of its common names (Granite Thick-tailed Gecko), this species often occurs on steep rocky or scree slopes, especially granite. Recent records from basalt and metasediment slopes and flats indicate its habitat selection is broader than formerly thought and may have extended into areas that were cleared for agriculture. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey.	PMST	Northern Basalts	Low – Not recorded in the locality and there is only at best marginal habitat for this species in the study area. Associated (marginal) habitat present in the study area includes:

Appendix B – Assessments of significance – BC Act

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

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

Not applicable

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,**

In addressing this question, the local occurrence of the threatened ecological community is taken to be the community that occurs within the study area and all contiguous areas of the community (as defined in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (the TEC) is listed as an endangered ecological community and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The mapped local occurrence of the TEC extends outside the study area. It should be noted however that the broad scale mapping in the locality has proven to be somewhat inaccurate in relation to the study area. Therefore, the local occurrence can only be roughly estimated. The local occurrence of the TEC based on available mapping information is therefore considered to be about 235 hectares.

The proposal would remove about 3.17 hectares of the TEC from a local occurrence of about 235 hectares. The area that would be removed by the proposal represents about 1% of the local occurrence. The proposal is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion leading to indirect impacts.

A breakdown of the potential impacts to this TEC according to proposal segment is provided below in Table B.1. Redesign of the proposal for avoidance and minimisation of this TEC in N2MS2 has the potential to greatly reduce impacts to this TEC.

Table B.1 Breakdown of impacts to the Weeping Myall Woodland TEC by proposal segment

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions (Endangered)	0.04	2.95	-	-	0.21	3.17

The absolute impact in terms of hectares removed (approximately 3.17) is considered moderate and at about 2%, the proportion of the local occurrence of the TEC affected is considered low. The proposal will contribute to reducing the extent of the local occurrence but it is considered unlikely to have an adverse effect on the extent of the TEC such that its local occurrence is likely to be placed at risk of extinction. The local occurrence of the TEC, particularly in the surrounding lands outside the study area is already at risk of extinction due clearing, grazing and weed invasion associated with agricultural activity.

Modification of the adjacent retained TEC is likely to substantially and adversely modify the composition of the TEC through edge effects. However, this in itself is not likely to place the local occurrence 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, 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 development or activity, 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 locality1

The proposal is predicted to remove around 3.17 hectares of the TEC from a local occurrence of about 235 hectares (about 1 %).

The patches of the TEC that make up the local occurrence are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments so fragmentation is not an issue. However, the proposal is likely to increase the distance between the remaining fragments due to the road widening, as the distance between patches on either side of road would be increased, resulting in a level of increased isolation. This increased isolation may result in a reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments.

The patches of the TEC affected are of small to large size and vary in structure from old growth woodland (i.e. possibly never previously cleared) through regrowth shrubland to derived grassland. The TEC exists in two condition states; Moderate-to-Poor (small patches and derived grassland including some areas with substantial weed cover), and Moderate-to-Good (regrowth shrubland and old growth patches clearly dominated by native species). Due to their size, generally moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain moderate to high levels of ecological integrity and function. Due to the conservation significance of this TEC, all remaining moderate to large sized remnants in moderate to good condition are likely to be important for its long-term survival. As such, the moderate to good condition TEC patches within the study area (3.17 hectares) are considered to be of high importance to the long-term survival of the community in the locality. The 14.03 hectares of the TEC in Moderate-to-Poor condition are considered to be of moderate importance.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.2).

The proposal would undoubtedly result in an increase in the following three KTPs:

- Clearing of native vegetation
- Removal of dead wood and dead trees
- Invasion of native plant communities by exotic perennial grasses

The main effect on KTPs would be the substantial *Clearing of native vegetation* and *Removal of dead wood and dead trees*. Due to the scale of native vegetation loss, the impact on this KTP in the local context is considered to be significant.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Table B.2 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposal
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposal; dead wood and dead trees would be lost from the 3.17 hectares of the TEC.
Clearing of native vegetation	**Increased.** The proposal would result in clearing of approximately 3.17 hectares of the TEC.
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposal is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposal would result in the loss of a carbon sink consisting of native vegetation. The proposal will generate CO_2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may also be offset by increased woody vegetation associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Possibly increased. The construction phase of the proposal could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possible but low risk. The proposal would result in additional habitat isolation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Possibly increased. The proposal would result in additional fragmentation that may encourage proliferation of Bell Miners.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposal could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Possible but low risk. The proposal could result in the importation of Yellow Crazy Ant if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent importation.
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Possible. The proposal could result in the importation of Fire Ants if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent importation.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposal could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposal could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.

Key threatening process	Relevance to the TEC and proposal
Invasion and establishment of exotic vines and scramblers	Possible. The proposal could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Possible. The proposal could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Possible. The proposal could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Possible. The proposal could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera*.
Invasion, establishment and spread of Lantana camara	Possible. The proposal could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara*.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Possible. The proposal could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honey bees, Apis mellifera L.	Neutral. The proposal is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposal is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposal is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposal is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposal is unlikely to influence feral rabbit numbers.

Conclusion

The TEC within the study area is likely to be important to the long-term survival of the TEC in the locality as the patches are of moderate size and in moderate to good condition. The proportion of the local occurrence affected impact is low (3.17 ha of 235 ha; 1%) when considered in the context of the known extent of the TEC within the broader locality. The proposal is considered likely to substantially and adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects but not to the point of resulting in local extinction. There is likely to be an increase in isolation of patches within the local occurrence due to the increase in the width of cleared land associated with the road. The proposal would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees.

While the direct impact within the proposal area is large at 3.17 ha, and the remaining patches will be subject to degradation from edge effects, the overall low proportional impact on the local occurrence suggests that the proposal is unlikely to have an adverse effect on the extent of the TEC such that its local occurrence is

likely to be placed at risk of extinction. Modification of the adjacent retained TEC is likely to substantially and adversely modify the composition of the TEC through edge effects. However, this in itself is not likely to place the local occurrence at risk of extinction.

Considering the context of the TEC and intensity of the potential impacts to the TEC from the proposal, an overall conclusion has been made that the proposal is unlikely to result in a significant effect to this TEC.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

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.

Not applicable

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,**

In addressing this question, the local occurrence of this threatened ecological communities is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change, 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions is listed as an endangered ecological community and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The study area contains patches of the TEC in close proximity to one another totalling approximately 10.98 hectares. Outside of the study area, the nearest known occurrence of the TEC is in excess of 30 kilometres away to the north-east separated by a mixture of non-native vegetation (croplands) and other native vegetation types. It is possible that other unmapped areas of the TEC may exist in the local area, however it is unknown whether any such areas in the locality would be considered contiguous with the occurrence in the study area. The local occurrence of the TEC is therefore considered to be 10.98 hectares.

The proposal would remove approximately 0.66 hectares of the TEC from a local occurrence of about 10.98 hectares. The area that would be removed by the proposal represents about 6%of the local occurrence. The proposal is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The impact would mostly occur on one side of the road, the side where a smaller patch of the community occurs, and would mostly be restricted to highly to moderately disturbed edges. Due to its relatively small extent, largely edge location, and the proposed weed management and vegetation restoration which is part of the proposal, the clearing of the community is unlikely to significantly reduce the viability of the remaining area.

The absolute impacts in terms of hectares removed are not very high, and when the impacts are considered in the local context, and in proportion to the size of the local occurrence of the TEC, they are not considered significant. A breakdown of the potential impacts to this TEC according to proposal segment is provided below in Table B.3. Redesign of the proposal for avoidance and minimisation of impacts on this TEC in N2MS4 has greatly reduced impacts to this TEC.

Table B.3 Breakdown of impacts to the Brigalow TEC by proposal segment

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (Endangered)	-	-	-	0.66	-	0.66

The local occurrence of the TEC subject to this assessment is already at risk of extinction due to its relatively small size, high edge to area ratio and susceptibility to disturbance events such as the recent fire that has already affected, but not eliminated, the community. The proposal is considered likely to slightly increase the likelihood of the extinction of the local occurrence of the TEC due to a small reduction in area and modification of some adjacent areas due to edge effects.

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, 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 development or activity, 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.**

The proposal is predicted to remove around 0.66 hectares of the TEC from a local occurrence of about 10.98 hectares. This represents about 6%of the local occurrence.

The patches of the TEC that make up the local occurrence are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to slightly increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in slightly increased isolation. This increased isolation may result in a slight reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a small extent to an increased risk of extinction of the local occurrence of the TEC.

The patches of the TEC affected are of small to moderate size (totalling 10.5 ha) and part of the affected vegetation (except the last 2-3 metres between the core and clearing associated with the road) appears to be old growth; ie. not previously cleared. It ranges in condition from in moderate condition (recovering from recent fire and/or edge-effected) to high condition (core areas in apparently natural condition). Due to their size, moderate to good condition, and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Due to the conservation significance of this TECs all remaining moderate to large sized remnants in moderate to good condition are likely to be important for its long-term survival. As such, the TEC patches within the study area are considered to be important for the long-term survival of the community in the locality.

While the proposal would remove some important habitat, the area to be removed is relatively small and much of the vegetation to be removed is already moderately disturbed. With the inclusion in the proposal of intensive weed control and vegetation restoration, a significant impact on habitat for the community may be avoided.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.4).

The proposal would result in an increase in the following KTPs:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation
- Removal of dead wood and dead trees

The main effect on KTPs would be the *Clearing of native vegetation*. Brigalow is currently threatened by clearing, fire and weed invasion. Due to the scale of clearing proposed (i.e. 6%of the remnant present in the locality), the impact of the proposal on this KTP in the local context is not considered to be significant and it is unlikely contribute significantly to the long-term decline of remaining areas. Removal of dead wood will occur and the proposal may increase invasion by exotic perennial grasses. These impacts may, however, be adequately mitigated through management of vegetation clearing, weed management and habitat restoration.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

While the proposal would involve clearing of native vegetation and may contribute to other KTPs, the area to be removed is relatively small and much of the vegetation to be removed is already moderately disturbed. With the inclusion in the proposal of intensive weed control and vegetation restoration, a significant increase in the local effects of KTPs may be avoided.

Table B.4 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposal
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposal; dead wood and dead trees would be lost from the 0.66 hectares of the TEC).
Clearing of native vegetation	**Increased.** The proposal would result in clearing of approximately 0.66 hectares of the TEC.).
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposal is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposal would result in the loss of a carbon sink consisting of 0.66 hectares of Brigalow. The proposal will generate CO_2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may be offset by increases in woody native vegetation elsewhere, associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Unlikely. The construction phase of the proposal could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possibly increased. The proposal would result in additional fragmentation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Low risk. Bell miners not associated with this habitat.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposal could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.

Key threatening process	Relevance to the TEC and proposal
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Low risk
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Low risk.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposal could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposal could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.
Invasion and establishment of exotic vines and scramblers	Low risk. The proposal could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Low risk. The proposal could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Low risk. The proposal could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Low risk. The proposal could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera.*
Invasion, establishment and spread of Lantana camara	Low risk. The proposal could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low risk. The proposal could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honey bees, Apis mellifera L.	Neutral. The proposal is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposal is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposal is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposal is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposal is unlikely to influence feral rabbit numbers.

Conclusion

The TEC within the study area is likely to be important to the long-term survival of the TEC in the locality. Outside of the study area, the nearest known occurrence of the TEC is in excess of 30 kilometres away to the north-east separated by a mixture of non-native vegetation (croplands) and other native vegetation types. Consequently, the TEC within the study area is the only known occurrence in the locality. The proportion of the local occurrence affected is low (0.66 ha of 10.5 ha; 5%) 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 to have potential to adversely modify the composition of some adjacent areas of the TEC. There is likely to be a small increase in isolation of patches within the local occurrence due to the increase in the width of cleared land associated with the road. The proposal would result in a relatively small increase to some KTPs, some of which may be mitigated against. In summary, with the inclusion in the proposal of intensive weed control and vegetation restoration, the proposal is considered unlikely to have a significant effect on the local occurrence of the *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions* TEC.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

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.

Not applicable

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,

In addressing this question, the local occurrence of these threatened ecological communities is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the Threatened Species Assessment Guidelines: The Assessment of Significance Department of Environment and Climate Change, 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions is listed as an endangered ecological community and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The study area contains patches of the TEC in close proximity to one another totalling about 12 hectares. The TEC is composed of the following PCTs:

- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (dry rainforest) mainly on basalt soils in the Brigalow Belt South Bioregion (147) – 0.08 ha.
- Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (55) – 0.98 ha. This TEC is a partial subset of the PCT.

Within the study area the TEC is restricted to N2MS4. The extent and distribution of vegetation containing the TEC, comprising the local occurrence, is unknown. However, based on existing vegetation mapping and aerial photography, the area of contiguous native vegetation containing known or likely to contain patches of the TEC is estimated at around 45 hectares.

The proposal would remove about 1.07 hectares of vegetation containing small patches of the TEC from a presumed local occurrence of similar vegetation of about 45 hectares. Based on this assumption, the area that would be removed by the proposal would about 2% of the local occurrence, a small proportional impact.

The proposal is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The absolute impact in terms of hectares removed is not high, and when the impacts are considered in the local context,

and in proportion to the size of the presumed local occurrence of the TEC, they are unlikely significant and likely to have an adverse effect on the extent of the TEC and its local occurrence is unlikely to be placed at significantly elevated risk of extinction.

Ground-truthing of contiguous vegetation between the north of N2MS4 and Waterloo Creek is recommended in order to provide greater certainty about this conclusion.

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, 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 development or activity, 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.**

The proposal would remove about 1.07 hectares of vegetation containing small patches of the TEC from a presumed local occurrence of similar vegetation of about 45 hectares. Based on this assumption, the area that would be removed by the proposal would about 2% of the local occurrence, a relatively small proportional impact.

The patches of the TEC that make up the local occurrence are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to slightly increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in slightly increased isolation. This increased isolation may result in a small reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a slightly increased risk of extinction of the local occurrence of the TEC.

The patches of the TEC affected are of small to moderate size and most of the affected vegetation (except the last 2-3 metres between the core and clearing associated with the road) appears to be old growth; ie. not previously cleared. It ranges in condition from moderate condition (recovering from recent fire) to high condition (core areas in apparently natural condition). Due to their size, moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Due to the conservation significance of this TEC all remaining moderate to large sized remnants in moderate to good condition and are likely to be important for its long-term survival, particularly those (like the occurrence of PCT 147) with a high diversity and abundance of typical SEVT species. The most important area of the TEC in the study area is that comprising PCT 147. A very small area, only about 0.08 ha, of this PCT, would be directly impacted. The patches of the TEC which are part of PCT 55 are considered to be of lower importance as they contain a lower diversity and abundance of typical SEVT species and are considered to be transitional in nature between pure SEVT (like PCT 147) and the broader PCT 55.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.6).

The proposal would result in an increase in the following KTPs:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation
- Removal of dead wood and dead trees.

The main effect on KTPs would be the *Clearing of native vegetation*. The TEC is currently threatened by clearing, fire and weed invasion. Due to the scale of clearing proposed (i.e. about 3% of the associated PCT in the locality), the impact of this KTP in the local context is considered to be a minor reduction in extent and

would not significantly contribute to a long-term decline of remaining areas. Removal of dead wood will likely occur and the proposal has potential to increase invasion by exotic perennial grasses.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Table B.6 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposal
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposal; dead wood and dead trees would be lost from the 0.48 hectares of the TEC.
Clearing of native vegetation	**Increased.** The proposal would result in clearing of approximately 0.48 hectares of the TEC.).
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposal is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposal would result in the loss of a carbon sink. The proposal will generate CO2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may be offset by increases in woody native vegetation elsewhere, associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Unlikely. The construction phase of the proposal could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possibly increased. The proposal would result in additional fragmentation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Low risk. Bell miners not associated with this habitat.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposal could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Low risk.
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Low risk.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposal could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposal could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.

Key threatening process	Relevance to the TEC and proposal
Invasion and establishment of exotic vines and scramblers	Low risk. The proposal could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Low risk. The proposal could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Low risk. The proposal could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Low risk. The proposal could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera.*
Invasion, establishment and spread of Lantana camara	Low risk. The proposal could result in the invasion and establishment of *Lantana camara.* However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low risk. The proposal could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honey bees, Apis mellifera L.	Neutral. The proposal is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposal is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposal is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposal is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposal is unlikely to influence feral rabbit numbers.

Conclusion

Part of the TEC within the study area (PCT 147) is likely to be important to the long-term survival of the TEC in the locality as the patches are of moderate size and in moderate to good condition. The areas of the TEC associated with PCT 55 are not likely to be of high importance to the long-term survival of the TEC in the locality. The presumed proportion of the local occurrence affected is low at about 2% when considered in the context of the presumed extent of the vegetation associated with the TEC within the broader locality and the known threats to this community.

The proposal is also considered likely to substantially and adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects. There is also likely to be an increase in isolation of patches within the local occurrence due to the increase in the width of cleared land associated with the road. The proposal would contribute to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees. In summary, the proposal is considered unlikely to have a significant impact on the extent and condition of the *Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions* TEC and unlikely to place its local occurrence at a significantly greater risk of extinction.

Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

Not applicable

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,**

In addressing this question, the local occurrence of these threatened ecological communities is taken to be the community that occurs within the study area and all contiguous vegetation (as defined in the *Threatened Species Assessment Guidelines: The Assessment of Significance* Department of Environment and Climate Change, 2007). Risk of extinction is used here as the likelihood that the local occurrence of the ecological community would become extinct either in the short-term or in the long-term as a result of direct or indirect impacts on the threatened ecological community from the proposal. Composition refers to the assemblage of species and the physical structure of the community.

Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions is listed as an endangered ecological community and is considered likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

The study area contains small areas of the TEC, associated with minor waterways and in disturbed narrow roadside strips. The patches of the community affected extend beyond the study areas into adjacent grazing paddocks. The patches of the TEC in the study area total about 2.98 hectares. Outside of the study area, the nearest known mapped occurrence of the TEC is in excess of 7 kilometres away to the east of N2MS2 separated by a mixture of non-native vegetation (croplands) and other native vegetation types. The extent and distribution of vegetation consistent with the TEC, comprising the local occurrence, is unknown. However, based on existing vegetation mapping and aerial photography, the area of contiguous native vegetation possibly consistent with the TEC is estimated at around 140 hectares in N2MS2, and in N2MS5 at around 100 hectares, representing two separate local occurrences. Assuming that these estimates are reasonably accurate, the absolute and proportional impacts of the proposal on these populations would be low at about:

- 2.95 ha in N2MS2 equating to about 2 % of the presumed local occurrence
- 0.04 ha in N2MS5 equating to 0.04 % of the presumed local occurrence.

The proposal would remove about 0.66 hectares of the TEC from two local occurrences. The area that would be removed by the proposal is estimated, based on limited desktop-derived data, to represent less than 0.5 % of each local occurrence. The proposal is also likely to slightly reduce the quality of some of the adjacent retained area of the TEC due to increased edge effects such as increased light, increased wind, altered hydrology and weed invasion. The absolute impact in terms of hectares removed is low, and when the impacts are considered in the local context, and in proportion to the size of the local occurrence of the TEC, they may be considered to be insignificant.

A breakdown of the potential impacts to this TEC according to proposal segment is provided below in Table B.7. Redesign of the proposal for avoidance and minimisation of this TEC in N2MS2 and N2MS5 has the potential to avoid and/or greatly reduce impacts to this TEC.

Table B.7 Breakdown of impacts to the Carbeen TEC by proposal segment

Threatened Ecological Community (BC Act)	N2MS1 (ha)	N2MS2 (ha)	N2MS3 (ha)	N2MS4 (ha)	N2MS5 (ha)	Total (ha)
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions (Endangered)	-	2.95	-	-	0.04	2.98

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, 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 development or activity, 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.

Based on existing vegetation mapping and aerial photography, the area of contiguous native vegetation possibly consistent with the TEC is estimated at around 140 hectares in N2MS2, and in N2MS5 at around 100 hectares, representing two separate local occurrences. Assuming that these estimates are reasonably accurate, the absolute and proportional impacts of the proposal on these populations would be low at about:

- 2.95 ha in N2MS2 equating to less than 0.5 % of the presumed local occurrence
- 0.04 ha in N2MS5 equating to 0.04 % of the presumed local occurrence.

The proposal would remove about 2.98 hectares of the TEC from two local occurrences. The area that would be removed by the proposal is estimated, based on limited desktop-derived data, to represent less than 0.5 % of each local occurrence.

The patches of the TEC that make up the local occurrences are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to slightly increase the distance between the remaining fragments on either side of road, resulting in increased isolation. This increased isolation may result in a slight reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a slightly increased risk of extinction of the local occurrence of the TEC.

The areas of the TEC affected are of a very small size and most of the affected vegetation is in moderate condition (relatively native canopy and mixed native and exotic understorey) to poor condition (substantially reduced canopy with exotic species dominant in the understorey). Due to their size, moderate to poor condition and moderate continuity with other native vegetation, the TEC patches in the study area are considered to have moderate levels of ecological integrity and function.

Due to the conservation significance of this TEC all remaining moderate to large sized remnants in moderate to good condition are likely to be important for its long-term survival. As the TEC patches within the study area are relatively small, linear and in moderate to poor condition, they are not considered to be important for the long-term survival of the 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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. Of the 38 listed KTPs under the BC Act, 23 are applicable to the TECs subject to this assessment (see Table B.8).

The proposal would result in an increase in the following KTPs:

- Invasion of native plant communities by exotic perennial grasses
- Clearing of native vegetation
- Removal of dead wood and dead trees.

The main effect on KTPs would be the *Clearing of native vegetation*. Brigalow is currently threatened by clearing, fire and weed invasion. Due to the scale of clearing proposed, the impact of this KTP in the local context is considered to be a significant reduction in extent and may contribute to the long-term decline of

remaining areas. Removal of dead wood will likely occur and the proposal may increase invasion by exotic perennial grasses.

While there is potential for other KTPs of relevance to this TEC to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Table B.8 Key threatening processes that may result from the proposal that may affect threatened ecological communities

Key threatening process	Relevance to the TEC and proposal
Removal of dead wood and dead trees	**Increased.** Some dead wood and dead trees would be removed as part of the proposal; dead wood and dead trees would be lost.
Clearing of native vegetation	**Increased.** The proposal would result in clearing of approximately 2.98 hectares of the TEC.
Invasion of native plant communities by exotic perennial grasses	**Likely.** The proposal is likely to result in the invasion and establishment of exotic perennial grasses. However, weed control measures would be followed to minimise invasion and establishment of exotic perennial grasses.
Anthropogenic Climate Change	Possibly increased. The proposal would result in the loss of a carbon sink consisting of 10.5 hectares of Brigalow. The proposal will generate CO_2 emissions; these emissions may be somewhat countered by increased efficiency of vehicles on the upgraded road. The loss of a carbon sink may be offset by increases in woody native vegetation elsewhere, associated with biodiversity offsets.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	Unlikely. The construction phase of the proposal could result in accidental fire and associated disruption to native vegetation. Part of this community has recently been affected by fire and is recovering. Another fire in the short-term may be very detrimental.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Possibly increased. The proposal would result in additional fragmentation that may encourage proliferation of Noisy Miners.
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Low risk. Bell miners not associated with this habitat.
Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Possible but low risk. The proposal could result in the importation of Large Earth Bumblebee if plant/vehicles or materials are imported from areas containing the species. However, control measures would be followed to prevent introduction.
Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Low risk.
Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Low risk.
Infection of native plants by Phytophthora cinnamomi	Possible. The proposal could result in the introduction or spread of *Phytophthora cinnamomi*. However, hygiene measures would be followed to prevent spread of *Phytophthora cinnamomi*.
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	Possible. The proposal could result in the introduction or spread of Exotic Rust Fungi. However, hygiene measures would be followed to prevent spread of Exotic Rust Fungi.

Key threatening process	Relevance to the TEC and proposal
Invasion and establishment of exotic vines and scramblers	Low risk. The proposal could result in the invasion and establishment of exotic vines and scramblers. However, weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (Cytisus scoparius)	Low risk. The proposal could result in the invasion and establishment of Scotch Broom. However, weed control measures would be followed to prevent invasion and establishment of Scotch Broom.
Invasion of native plant communities by African Olive Olea europaea L. subsp. cuspidata	Low risk. The proposal could result in the invasion and establishment of African Olive. However, weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	Low risk. The proposal could result in the invasion and establishment of *Chrysanthemoides monilifera*. However, weed control measures would be followed to prevent invasion and establishment of *Chrysanthemoides monilifera.*
Invasion, establishment and spread of Lantana camara	Low risk. The proposal could result in the invasion and establishment of *Lantana camara*. However, weed control measures would be followed to prevent invasion and establishment of *Lantana camara.*
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Low risk. The proposal could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent invasion and establishment of escaped garden plants.
Competition from feral honey bees, Apis mellifera L.	Neutral. The proposal is unlikely to influence feral bee numbers.
Herbivory and environmental degradation caused by feral deer	Neutral. The proposal is unlikely to influence feral deer numbers.
Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Neutral. The proposal is unlikely to influence feral goat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Neutral. The proposal is unlikely to influence Feral Pig numbers.
Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Neutral. The proposal is unlikely to influence feral rabbit numbers.

Conclusion

The TEC within the study area is likely to be moderate to low importance to the long-term survival of the TEC in the locality as the area within the study area is small and in moderate to poor condition. The presumed proportion of the local occurrences affected is low at less than 0.5%. However, further survey and mapping of this TEC in the local area is suggested to gain a better understanding of its total extent before a definitive conclusion can be made that a significant impact to the local occurrence is unlikely to occur. The proposal is also considered likely to have a minor adverse effect on the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects. There is also likely to be a slight increase in isolation of patches within the local occurrence due to the increase in the width of cleared land associated with the road. The proposal would contribute to a small extent to some KTPs that cannot be mitigated against including clearing of native vegetation and removal of dead wood and dead trees.

Based on current information the proposal, including associated weed management and vegetation restoration, is likely to be able to avoid a significant adverse effect on the extent and condition of the known local occurrence *Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions* TEC.

Homopholis belsonii (Belson's Panic)

Belson's Panic (*Homopholis belsonii*) occurs on the northwest slopes and plains of NSW, mostly between Wee Waa, Goondiwindi and Glen Innes. It also occurs in Queensland, mainly in the Brigalow Belt South bioregion. It generally grows in dry woodland (e.g. Belah) often on poor soils, although it is sometimes found in basalt-enriched sites and on alluvial clay soils. The species' habitat and ecology appear to be poorly known.

The impact of the proposal include loss of about 19.04 ha of known and probable habitat constituting the following Plant Community types (PCTs):

- Belah woodland on alluvial plains and low rises (PCT 55); loss = 0.98 ha.
- Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35); loss = 0.66 ha.
- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147); 0.08 ha.
- Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56); loss = 2.86 ha (S4).
- Queensland Bluegrass +/- Mitchell Grass grassland on cracking clay floodplains and alluvial plains (PCT 52); loss = 11.31 ha.
- Weeping Myall open woodland (PCT 27); loss = 2.95 ha (S2).

Belson's Panic was recorded in the study areas of N2MS2, N2MS4 and N2MS5 during the field surveys, associated with all of the above mentioned PCTs except for PCT 147. The species appeared to be most abundant within PCTs 27, 35, 52 and 55. The density of the species at recorded locations varied from scattered individuals to extensive areas in which the species was the dominant ground layer species. The species is strongly associated with partially shaded areas created by an overstorey of trees and/or shrubs in the study area, and rarely extends into areas which lack a tree or shrub layer.

Spot surveys undertaken in contiguous habitat outside of but in close proximity to the study area indicate that the species local range extends well beyond the study area in remnant vegetation associated with the Newell Highway, local roads and the adjacent railway line. These data suggest that the species is more widespread and abundant in the locality than suggested by the very small number of pre-existing local records on wildlife databases.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

At least three separate areas are occupied by the species in the study area however, only a representative sample of the study area was traversed on foot and it is likely that the species also occurs in adjacent areas of suitable habitat which were not surveyed in detail. The occurrences of this species in the study area are separated from one-another by areas of vegetation outside of the study area, between segments of the proposal, that are likely to be only marginal as potential habitat. As there is likely to be little interaction between plants in these separate areas, each is considered to represent a separate local population. Accurately estimating the number of individuals of this species is problematic as the species is rhizomatous; with individuals intertwined. Due to the species' habit and the representative rather than comprehensive nature of surveys on-foot, population numbers are only an estimate.

These populations and the impacts of the proposal are summarised in the Table B.9 below.

Table B.9 Summary of the *Homopholis belsonii* populations and potential habitat in the study area

Segment	Local Population	Associated habitat	Estimated area occupied by the population in the study area and contiguous habitat	Area removed by proposal	Percentage loss of population
N2MS2	Edgeroi South (moderate to high density - estimated at 200-500 individuals)	Weeping Myall Woodland (PCT 27)	4.4 ha	~2.2 ha	~50%
N2MS4	Brigalow Lane (moderate to high density - estimated at 1000+ individuals)	Belah woodland on alluvial plains and low rises (PCT 55) Brigalow - Belah open forest / woodland on alluvial often gilgaied clay (PCT 35) Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (PCT 147) Poplar Box - Belah woodland on clay-loam soils on alluvial plains (PCT 56)	~280 ha	~4.59 ha	~2%
N2MS5	Tycannah North (scattered - estimated at roughly 500-1000 individuals)	Queensland Bluegrass +/- Mitchell Grass grassland (PCT 52)	~635 ha	~11.31 ha	~2%

While the Brigalow Lane population is likely to be reduced in size, it is also likely to be larger and less susceptible to associated impacts on the lifecycle of the species. The Tycannah North local population is of low density and likely to be spread over a large area of habitat. While a substantial area of habitat for the species in the Tycannah North local population would be affected, the habitat affected makes up a relatively small proportion of similar habitat in the likely distribution of the local population. The impacts of the proposal on the lifecycle of the species in the Brigalow Lane and Tycannah North populations are unlikely to be significant.

The removal of a substantial proportion of the habitat for the Edgeroi South population, and degradation of the remaining habitat due to edge effects such as increased sunlight and wind could to result in a substantial reduction in the size of this local population. Such a reduction in population could reduce the genetic diversity of the remaining population which may result in reduced reproductive rates due to inbreeding depression. The reduction in population size and degradation of habitat that could be caused by the proposal could have an adverse effect on the life cycle of the species such that the Edgeroi South local population is likely to be placed at significantly increased risk of extinction. Refinement of the proposal is planned to minimise impacts on this species in N2MS2 during detailed design. This design refinement is likely to reduce impacts on this population sufficiently to avoid a significant impact on the life cycle of the population.

The proposal is therefore unlikely to cause a viable local population of the species to be placed at significantly elevated risk of extinction.

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,**

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove around 19.04 hectares of habitat for Belson's Panic, consisting of 6.94 hectares of high suitability woodland habitat (dominated or co-dominated by Weeping Myall, Belah and/or Brigalow) and 24.08 hectares of seemingly lower suitability habitat (natural grassland, Poplar Box woodland) across all five segments. There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) the due to edge effects.

Clearing of habitat for the Tycannah population will increase the distance between areas of habitat by a small amount in some locations but it is unlikely to fragment habitat. The habitat of the Edgeroi South population is all on the eastern side of the road and the proposal is unlikely to affect isolation or fragmentation of this population. Clearing of habitat of the Brigalow Lane population would result in increased isolation of habitats and would hypothetically result in habitat fragmentation through the creation of a thin island of vegetation between the existing and new road. As this island would only be approximately 5 m wide, it may become unsuitable for the species due to edge effects and invasion of exotic grasses.

The Tycannah population occurs at low density in marginal habitat (natural grassland TEC) but may nonetheless be moderately important as it is part of a large contiguous area of habitat that may support a moderately large number of individuals. The road reserve is likely to be under a less intense disturbance regime than some of the adjacent habitat on private lands, is likely to contain a disproportionately high percentage of the population of the species and to be of moderate importance to the long-term survival of the species in the locality.

The Edgeroi South population is found in an area of moderate to good condition habitat (Weeping Myall Woodland TEC). The species is quite abundant in the vegetation to be removed by the proposal and the habitat removed is considered to be moderately important to the long-term survival of the species in the locality.

The habitat of the Brigalow Lane population that would be affected is of high quality (good condition Brigalow TEC and Belah woodland), is part of a large contiguous area of habitat in the road reserve and adjacent riparian lands in the north. As part of one of the largest contiguous areas of habitat in the locality, it is considered moderately important to the long-term survival of the species 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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the *Clearing of native vegetation* with the removal of 19.04 hectares of suitable habitat for Belson's Panic. Other KTPs that may influence the quality of habitat and may be increased by the proposal include:

- Invasion of native plant communities by exotic perennial grasses – Likely
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition – Possibly increased due to the drying of vegetation associated with edge effects.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The proposal will result in the removal of 19.04 hectares of moderately important habitat for three local populations of Belson's Panic. Earthworks within areas of suitable habitat would result in direct mortality of some individuals. Due to the stoloniferous, mat-forming habit of the species the number of individuals affected is difficult to quantity as a single individual may cover a substantial area. A reduction of available

habitat and increases in habitat isolation may indirectly affect the ability of this species to survive due to lower breeding success and reduced dispersal and recolonization after disturbance events.

The proposal is considered unlikely to place the local populations of Belson's Panic in the study area at significantly elevated risk of extinction. The degree to which the risk of extinction of the Brigalow Lane and Tycannah population would be elevated is considered to be low as only a relatively small proportion of their area would be impacted. With the planned design refinement of the proposal for avoidance and minimisation of impacts on this species in N2MS2, the risk that the proposal would result in the eventual extinction of the Edgeroi South population is also considered to be low.

The assessment of significance is a qualitative analysis of the likely impacts and it is not a 'pass or fail' test. In this case, although there will be impacts on populations of the species, due to the populations extending beyond the impact area and the planned refinement of the proposal, a significant impact on the species is unlikely.

Digitaria porrecta (Finger Panic Grass)

Finger Panic Grass (*Digitaria porrecta*) occurs in four disjunct areas extending over 1000 km. In Queensland, it occurs in the Nebo district, south-west of Mackay; the Central Highlands between Springsure and Rolleston; and from Jandowae south to Warwick (41 sites). In NSW, it occurs from Graman and Croppa Creek (near Inverell), south to the Liverpool Plains near Coonabarabran and Werris Creek (33 sites). It grows in grasslands on extensive basaltic plains, and in undulating woodlands and open forests with an underlying basaltic geology. It grows on dark and fine textured soils with some degree of seasonal cracking. It also persists in disturbed habitats, such as fallow paddocks, but its capability to maintain a viable population in such situations is unknown.

Flowering season is summer or late summer from mid-January to late February, with seeds maturing and falling from the plant soon after. Fire, livestock grazing and trampling, and physical disturbance of habitat by road and farm machinery are types of disturbances known to occur in Finger Panic Grass sites. Field observations indicate that the grass does continue to persist in such habitats but the effect of the disturbances on the long term capability of the species to maintain a viable population is unknown. Its population is estimated to be 200 000 individuals with 75% occurring near Premer (approximately 41 500 individuals) and Tambar Springs (114 000 individuals) in NSW. Plants have been recorded as occurring occasionally and frequently in populations.

Considering this species was found in multiple locations across segments 2 to 5, it is likely that it could occur anywhere in these segments in appropriate habitat.

The impact on the species would include the loss of about 35.64 ha of known and potential habitat constituting the following Plant Community types (PCTs):

- Belah woodland (PCT 55) (0.98 ha – intact, 0.22 ha - derived)
- Brigalow viney scrub open forest (PCT 445) (0.66 ha - intact, 0.53 -derived)
- Carbeen +/- Coolabah grassy woodland (PCT 628) (2.98 ha intact, 0.04 ha derived)
- Poplar Box - Belah woodland (PCT 56) (3.643.64 ha - intact, 1.05 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (PCT 52) (11.31 ha - intact)
- Weeping Myall open woodland (PCT 27) (3.17 ha - intact, 11.06 ha - derived).

Finger Panic Grass was recorded at 22 locations across the study area (many within the proposal area) during field surveys, however only a representative sample of the study area was traversed on foot and it is likely that the species also occurs in other areas of suitable habitat, both within and outside of the study area, which were not surveyed in detail. This species was found in N2MS2, N2MS4 and N2MS5 during the survey. It was more commonly found in PCT 52, PCT 27 and the edges of PCT 55 in intact and derived grassland areas and occasionally in non-native (exotic-species dominant) roadside grassland. The occurrences of the species at recorded locations generally consisted of scattered individuals and small groups.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

Finger Panic Grass was recorded in multiple locations across the study area and in contiguous areas of vegetation outside of the study area, both within and outside of the proposal area during. However only a

representative sample of the study area was traversed on foot and it is likely that the species also occurs in other areas of suitable habitat, both within and outside of the study area, which were not surveyed in detail. The density of the species at recorded locations generally consisted of a few scattered individuals.

The proposal will result in direct removal of individual plants and also a reduction in the extent of available habitat for this species. The impact to available habitat will total 35.64 hectares. The removal of habitat, and degradation of some of the remaining habitat due to edge effects such as increased sunlight and wind are likely to result in a reduction in the size of local populations. The reduction in population size and degradation of habitat that would be caused by the proposal is likely to have a negative effect on the life cycle of the species.

The recording of the species in multiple locations in contiguous habitat outside of the proposal area suggests that the local populations/s of the species extend well beyond the study area and that the locality is likely to contain one or more large populations of *Digitaria porrecta*. The proposal would therefore have a small proportional impact on the local occurrence and it is unlikely that the impacts of the proposal would significantly increase the risk of the local extinction of the species.

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,

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove at least 35.64 hectares of known and potential habitat within the proposal area for the species, consisting of:

- Belah woodland (PCT 55) (0.98 ha – intact, 0.22 ha - derived)
- Brigalow viney scrub open forest (PCT 445) (0.66 ha - intact, 0.53 -derived)
- Carbeen +/- Coolabah grassy woodland (PCT 628) (2.98 ha intact, 0.04 ha derived)
- Poplar Box - Belah woodland (PCT 56) (3.643.64 ha - intact, 1.05 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (PCT 52) (11.31 ha - intact)
- Weeping Myall open woodland (PCT 27) (3.17 ha - intact, 11.06 ha - derived).

There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) the due to edge effects.

Based on the distribution of records in NSW, the individuals found within the study area appear to be part of a thin north-south portion (approximately 40km wide) of the NSW population, connecting two wider areas (one north of the Gwydir Highway and the other south of Boggabri). Although these records cannot be assumed to be perfectly representative of the true distribution and extent of the species, it appears the individuals found in the study area may form part of an important connection link for the NSW population. Removal of plants and reduction of available habitat could increase the distance between local populations and therefore increase threat of fragmenting the NSW population into two separate populations. However, given that the clearing associated with the proposal is relatively small in proportion to the likelihood of population fragmentation.

The road reserve in the study area may be important habitat for this species. As part of one of the largest contiguous areas of habitat in the locality, it may be important to the long-term survival of the species in the locality. The most important habitats for this species in the locality are unknown and the road reserves in the study area and other travelling stock routes may be some of the last surviving habitats in the locality. However, it appears that the local populations/s of the species extend well beyond the study area within contiguous habitat, and it is unlikely that the impacts of the proposal would affect a significant proportion of this habitat.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the *Clearing of native vegetation* with the removal of 68.28 hectares of suitable habitat for Finger Panic Grass. Other KTPs that may influence the quality of habitat and may be increased by the proposal include:

- Invasion of native plant communities by exotic perennial grasses – Likely
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition – Possibly increased due to the drying of vegetation and increase in fuel load of grasslands due to weed invasion associated with edge effects.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, the extent of the impact of these KTPs is likely to be small in relation to the area occupied by the species are likely to be able to be adequately mitigated by Roads and Maritime' standard environmental management measures.

Conclusion

The proposal will result in the removal of 35.64 hectares of habitat for the local occurrence of Finger Panic Grass which is part of a broader area that may be important to the long-term survival of this species. Earthworks within areas of suitable habitat would result in direct mortality of individuals. A reduction of available habitat and increase in the distance between north and south occurrences may increase the potential of fragmenting the population to a small degree. However, this species appears to be widespread in similar roadside habitats in the locality and the impacts associated with the proposal are likely to affect only a relatively small proportion of the population. As the local populations/s of the species appear to extend well beyond the study area, it is unlikely that the impacts of the proposal would be significant.

Desmodium campylocaulon (Creeping Tick-trefoil)

Creeping Tick-trefoil (*Desmodium campylocaulon*) occurs chiefly in the Collarenebri and Moree districts in the north-western plains of NSW. Also occurs in the NT and Darling Downs district of south-eastern Queensland. In NSW Creeping Tick-trefoil grows on cracking black soils in the Narrabri, Moree and Walgett local government areas. Creeping Tick-trefoil is said to be hardy, but grazed where sheep and cattle have regular access. Plants are strongly stoloniferous.

The proposal is predicted to remove at least 15.23 hectares of known and potential habitat for the species within the proposal area, consisting of:

- Queensland Bluegrass +/- Mitchell Grass (PCT 52) (11.31 ha)
- Weeping Myall open woodland (PCT 27) (0.21 ha - intact, 3.80 ha - derived).

Creeping Tick-trefoil was recorded in a single area just south of Moree in Section 5 during field surveys, however only a representative sample of the study area was traversed on foot and it is likely that the species also occurs in other areas of suitable habitat in section 5, both within and outside of the study area, which were not surveyed in detail. It was mostly found in PCT 52, however there was one occurrence in PCT 27 derived grassland. The density of the species at recorded locations varied from a few scattered individuals to around one stem per square metre (based on finding 215 stems within a 300m^2 transect/plot in the study area). Considering this species is stoloniferous and grows stems from an underground rootstock, it was difficult to estimate the number of individuals likely to be affected.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

The individuals identified during surveys appear to be part of a regional population that is bounded approximately by Bellata, Boggabilla, St George and Collarenebri (an area of approximately 30,000 square kilometres). While the species may persist during unfavourable conditions as underground rootstocks, producing above ground plant tissue when conditions are favourable, the degree to which it can persist under continual grazing, is unknown. This species may be widespread this area or may be largely restricted to areas, such as travelling stick reserves, which are not cropped and only infrequently grazed. It is therefore unknown whether the plants in the study area are part of an extensive local/regional population, or form part of a relatively discrete local population centred on the infrequently grazed TSR/s surrounding the Newell Highway and the adjacent railway line. Based on the data collected, and other local studies, the population within and contiguous with the study area appears to be large.

The proposal will result in direct removal of individuals and also a reduction in the extent of available habitat for this species. The impact to suitable habitat will total 15.23 hectares. These impacts may negatively impact the lifecycle of individuals constituting the local population through reduced population size, reduced habitat and increased isolation. However, as the local populations of the species appears to be large and to extend well beyond the proposal area and beyond the study area, it is unlikely that the impacts of the proposal would be significant.

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,**

Not applicable

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, 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 development or activity, 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.**

The proposal is predicted to remove individuals and around 15.23 hectares of habitat for Creeping Tick-trefoil, consisting of:

- Queensland Bluegrass +/- Mitchell Grass (11.31 ha)
- Weeping Myall open woodland (3.92 ha – including derived grassland).

There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) the due to edge effects.

Considering the current fragmentation caused by the existing road corridor, the small increase in road width is unlikely to result in additional fragmentation of habitat for Creeping Tick-trefoil.

Creeping Tick-trefoil was found primarily in a large area of Queensland Bluegrass +/- Mitchell Grass in Section 5. This area contains a relatively high abundance of individuals and may be important to the long-term survival of the local occurrence of this species. The most important habitats for this species in the locality are unknown and the study area may form part of one of the last surviving habitats in the locality. However, the local population of the species appears to be large and to extend well beyond the proposal area and beyond the study area. It is therefore unlikely that the impacts of the proposal on this important habitat would be significant.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the *Clearing of native vegetation* with the removal of 39.85 hectares of suitable habitat for Creeping Tick-trefoil. Other KTPs that may influence the quality of habitat and may be increased by the proposal include:

- Invasion of native plant communities by exotic perennial grasses – Likely

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The proposal will result in the removal of individuals and about 15.23 hectares of habitat for the local occurrence of Creeping Tick-trefoil. This includes 11.31 hectares of Queensland Bluegrass +/- Mitchell Grass that may be important to the long-term survival of this species. Earthworks within areas of suitable habitat (in Section 5 where this species was identified) would result in direct mortality of individuals. This species appears to be more widespread and abundant than is represented by current recorded sightings and a large population appears to exist in the study area, the large majority of which would be unaffected by the proposal. As it appears that the local population of the species is large and extends well beyond the study area, it is unlikely that the impacts of the proposal would be significant.

Five-clawed Worm-skink (*Anomalopus mackayi*)

On the floodplains within its range in north-eastern New South Wales, the Five-clawed Worm-skink occurs in grasslands and grassy, open woodlands on heavy black and grey, alluvial cracking clay soils from 135–200 m above sea level (Spark 2010). During dry periods, the species is likely to shelter where moisture is available. For example, they may take refuge in deep cracks within alluvial clay soils or ephemeral drainage lines and soaks where moisture is retained. Sufficient rainfall following extended dry conditions is likely to bring the skink to the surface (Brigalow Belt Reptiles Workshop 2010).

Thirty-minute targeted reptile searches were undertaken at each of 20 locations in the study area. Additionally, logs, rocks and other debris were turned opportunistically when encountered during other field activities. The Five-clawed Worm-skink was not identified, however much of the vegetation in the study area contains suitable habitat for this species and this species is difficult to detect, sheltering under decaying leaf litter, coarse woody debris or artificial debris, in deep cracks within alluvial clay soils, rotting tree bases, logs and in tussock bases, and is also known to dig permanent tunnel-like burrows. A minimum of three survey days and nights, plus at least one replicate survey employing all the survey techniques (i.e. establishment and monitoring of artificial shelter sites) is the recommended minimum survey effort for this cryptic species (DoEE 2018). Active searching of microhabitats is only considered to be effective during periods when topsoils underneath are likely to be moist, bringing individuals close to the surface. Such conditions were not present during the survey. The very low abundance of burrowing reptiles recorded during searches (only a single specimen of a *Lerista* species) is also indicative of less than ideal survey conditions. Due to these limitations, the presence of a relatively recent record (2008) approximately 4 km east of the study area at Bellata, and the presence of suitable habitat, this species is considered likely to occur within the study area.

The Five-clawed Worm-skink is a difficult animal to assess as it is widespread but there are few known locations in NSW and most of these are represented by single records. It is also very difficult to detect by targeted survey. There are about five locations in NSW where it has been recorded multiple times. Advice regarding the species was sought from Terry Mazzer (Senior Project Officer, Saving Our Species Regional Ops North West). Terry advised that the potential for significant impacts on the species along the Newell Highway would be low except where habitat affected includes any of the locations with multiple records, in which case impacts might be significant. The creek corridor south of Bellata is one of the locations where the species has been recorded on multiple occasions. Elsewhere the proposal would impact on potential habitat but it would be unlikely to have any real effect on the species as far as is known.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

The proposal will result in the removal of 34.50 hectares of potential habitat for the Five-clawed Worm-skink. This species spends most of its time just below the soil surface and is not highly mobile. Any machine works within areas of suitable habitat could result in direct mortality to individuals. A reduction of available habitat

could affect the ability of this species to survive (i.e. impact foraging and breeding life-cycle activities) within a viable local population present in the locality.

The proposal would impact on approximately two hectares of habitat, and three hectares of marginal grassland habitat, in the creek corridor south of Bellata in an area contiguous with habitat of a known population. The affected habitat is moderately to highly disturbed consisting of the fill batter of the existing highway, the table drain and adjacent disturbed land. The habitat in this area has been modified through changes in landform and vegetation associated with the construction of the existing highway. The affected habitat is considered to be of similar or lower quality for the species to that found in the broader habitat of the creek corridor and is unlikely to support a significant proportion of the population. The impact of the proposal on the life cycle of the population south on Bellata is unlikely to be significant. If present, any other local populations/s of the species are likely to extend well beyond the proposal area and it is unlikely that the impacts of the proposal on such populations would be significant.

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,

Not applicable

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, 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 development or activity, 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.

The proposal would impact on approximately five hectares of habitat in the creek corridor south of Bellata. The affected habitat is moderately to highly disturbed consisting of the fill batter of the existing highway, the table drain and adjacent disturbed land. The habitat in this area has been modified through changes in landform and vegetation associated with the construction of the existing highway. The affected habitat is considered to be of similar or lower quality for the species to that found in the broader habitat of the creek corridor.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to slightly increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. It is difficult to predict whether the species would currently cross between habitats on either side of the road as very little is known about the species' biology and behaviour. This may also result in a slightly increased prevalence of mortality by vehicle strike as individuals close to the current road may cross at night during dispersal and mate-searching activity.

The proposal is predicted to remove around 34.50 hectares of potential habitat for the Five-clawed Worm-skink. There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) due to edge effects. However, only five hectares of habitat would be affected in an area where the species has been recorded on multiple occasions; i.e. in the creek corridor south of Bellata. Elsewhere the proposal would impact on potential habitat but it would be unlikely to have any real effect on the species as far as is known.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would result in the *Clearing of native vegetation* (a key threatening process) with the removal of 34.50 hectares of suitable habitat for the Five-clawed Worm-skink. It may also increase the impact of

Removal of dead wood and dead trees. Other KTPs that may influence the soil surface of suitable habitat and may be increased by the proposal include:

- Invasion of native plant communities by exotic perennial grasses – Likely

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The proposal is predicted to remove around 34.50 hectares of potential habitat for the Five-clawed Worm-skink. There may be additional indirect impacts to remaining areas of habitat (i.e. drying/modification of the soil surface) due to edge effects. However, only five hectares of habitat would be affected in an area where the species has been recorded on multiple occasions; i.e. in the creek corridor south of Bellata. Elsewhere the proposal would impact on potential habitat but it would be unlikely to have any real effect on the species as far as is known. Earthworks within areas of suitable habitat could result in direct mortality to individuals. The potential impact of the proposal on fragmentation and movement of the species is difficult to predict as the species' biology is poorly understood but given the pre-existing reduced connectivity created by the existing highway, the impact on fragmentation is unlikely to be substantial.

Based on the findings of this assessment, the proposal is considered unlikely to place a local population of the Five-clawed Worm-skink at significantly elevated risk of extinction.

Pale Imperial Hairstreak (*Jalmenus eubulus*)

There are only four records of the Pail Imperial Hairstreak (*Jalmenus eubulus*) in NSW, which are located north of the proposal area near North Star. One of the records is directly adjacent to the Newell Highway. These four records were the result of a survey of 37 locations around Croppa Creek, Yallaroi and North Star (Taylor 2014) which included the following observations:

- *Jalmenus eubulus* was only found in areas where Brigalow (Acacia harpophylla) is a highly dominant canopy species.
- The species was not found in areas where Belah (Casuarina cristata) and/or Bimble Box (Eucalyptus populnea) were the dominant species and Brigalow was sub-dominant.
- The species was not found in areas where patches of Brigalow were imbedded in a grassland mosaic.
- Many areas of apparently suitable habitat were not occupied by the species at the time of survey
- The species has been reported by other authors to be very localised or patchy in distribution with the location of colonies also being ephemeral.

Given the small number of recorded sites, available information is inconclusive regarding whether or not strong dominance by Brigalow is an essential feature of the species' habitat. Given the possibly ephemeral nature of colonies, the failure of a single survey to record the species at a site would not necessarily mean that the site does not contain habitat for the species. No surveys for this species were undertaken for this study.

Although there are no records of this species in the proposal area, several patches of vegetation are present that meet the description of suitable habitat by Taylor (2014). Without having conducted targeted surveys as part of this proposal, the Pale Imperial Hairstreak is deemed to have a moderate likelihood of occurring in the study area based on the presence of suitable habitat. This may also be the case for areas surrounding the study area, however the extent of Brigalow in the locality is unknown. A review of regional mapping has shown that the nearest mapped area of Brigalow habitat is in excess of 30 kilometres away. While it is possible that other areas of Brigalow that could support a more widely distributed population may occur in the locality, the presence or absence and condition of such habitat are unknown.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats*:*

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.

There is currently only one known population of the Pale Imperial Hairstreak consisting of at least four sub-populations. There is no evidence of a viable local population at the site, however judging by the low prevalence of records of butterflies and moths recorded for the region in the Atlas of Living Australia (see excerpt below), the locality does not appear to have been surveyed in detail for butterfly species. Given that

potential habitat was identified in the proposal area, and that surveys for the species are not likely to have occurred in the study area, the presence of a viable local breeding population of the species cannot be discounted.

The proposal will result in the removal of 0.66 hectares of Brigalow-dominated woodland that may be habitat for a viable local population of Pale Imperial Hairstreak. Considering this species has only been found in scattered locations, and the extent of Brigalow-dominated woodland in the region is restricted to small isolated patches, any substantial impact to habitat currently occupied by the Pale Imperial Hairstreak would directly impact the life cycle of this species. However, given that the proposal would result in the loss of only about 2.98 ha of possible habitat, from an area of potential habitat of about 10.5 ha (5%), it is considered unlikely to result in the loss and modification of enough habitat to significantly affect the lifecycle of the local population of the species or significantly increase the likelihood of local extinction.

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,**

Not applicable

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, 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 development or activity, 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.**

The proposal is predicted to remove around 0.66 hectares of habitat for the Pale Imperial Hairstreak. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in slightly increased mortality by vehicle strike and a slight reduction in breeding success between individuals travelling between fragments. This disruption of ecological processes would contribute to a slightly increased risk of extinction of the local occurrence of the species.

The patches of suitable habitat that will be affected are small in size (totalling 0.66 hectares). The total area of suitable habitat mapped by Tyler (2014) within the extent of occurrence of this species (47.2 km^2) is 1.25 hectares, indicating that relatively small areas may be important to the species. However, this does not include the habitat in the study area and Tyler states that the mapping exercise is likely missing areas of suitable habitat. If a population were to be present in the study area, it would represent the most southerly known population of the species and a significant range extension. Populations of the species are ephemeral and breeding seems to be reliant on the presence of mixed age-structure Brigalow. If any more than a single individual were to be found, the presence of a breeding population would need to be assumed.

Therefore, in the absence of information and suitable survey effort it is difficult to make a determination on the importance of the habitat in the study area. However, given that the area of habitat affected is small and that it is highly edge-affected, it is unlikely to be important for the long-term survival of the species 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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs. The proposal would result in the 'Clearing of native vegetation' with the removal of 0.66 hectares of suitable habitat for the

Pale Imperial Hairstreak. While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

If the Pale Imperial Hairstreak is currently utilising Brigalow-dominated vegetation in the study area, then all this vegetation is likely to be important to the long-term survival of this species. Considering the lack of ecological data concerning this species and the limited known distribution of the single population, any substantial impacts to habitat occupied by the species would be considered significant. Additionally, the proposal is also considered likely to adversely modify the composition of some immediately adjacent areas of habitat that would not be cleared, due to increased edge effects. In summary, if the species is present, the proposal is considered to have a small adverse, but not significant, effect on the extent and condition of habitat important to the Pale Imperial Hairstreak. As the amount of habitat loss is small (0.58 ha) and weed management and vegetation will form part of the proposal, the risk of a significant impact of the proposal is low. However, due to a lack of survey data and general ecological understanding of the species, and in keeping with the precautionary principle, a survey for the species prior to the commencement of construction should be undertaken. If the species is detected a species-specific management plan should be developed to facilitate management of potential impacts and restoration of habitat.

Koala (*Phascolarctos cinereus*)

The Koala was identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area is likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes:

- Belah woodland (PCT 55)
- Brigalow viney scrub open forest (PCT 445)
- Carbeen +/- Coolabah grassy woodland (PCT 628)
- Poplar Box - Belah woodland (PCT 56)
- Poplar Box - White Cypress Pine woodland (PCT 397)

Koala are generally solitary except during the mating season and have a home range of about 3 hectares (although the size of this area is influenced by the distribution, abundance and quality of feeding resources). In the Pilliga State Forest of central-western New South Wales, the average home range is 10–15 ha (Department of Environment and Climate Change 2008). The Office of Environment and Heritage has published regional lists of koala food trees in separate primary and secondary food tree categories. Surveys identified low to high abundances of Koala secondary (*Eucalyptus populnea*) food trees within the study area Considering the reported home range sizes of this species and the widespread occurrence of feed tree species, a low density population is considered likely to utilise the study area.

There are numerous published criteria for determining the importance of koala habitat, however the most recent, relevant and measureable is the habitat assessment tool described in the *EPBC Act referral guidelines for the vulnerable koala* (Commonwealth of Australia 2014). Using this tool, impact areas that score five or more contain habitat critical to the survival of the koala. Table B.4 lists the five primary koala habitat attributes, the score given for each criterion and results of the habitat assessment tool for the two vegetation communities within the study area which contain a relatively high proportion of food trees. Several other communities also contain scattered food trees and also contribute to the viability of the landscape as Koala habitat, particularly in relation to their contribution to movement corridors between the main food tree areas. The result indicates that the habitats in the study area are not considered to be habitat critical to the survival of the Koala.

Table B.4 Results of the koala habitat assessment tool for the main habitat types

Attribute	Score and criteria (inland)	Score for habitat in the study area
Koala occurrence	**+2 (high)** = Evidence of one or more koalas within the last 5 years. **+1 (medium)** = Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years **0 (low)** = None of the above.	**0 (low)** = None of the above. The habitats in the northern section are near the Mehi River where the Koala is known but the majority of habitats are more than 2 km away.
Vegetation composition	**+2 (high)** = Has forest, woodland or shrubland with emerging trees with 2 or more known koala	The habitats in the study area are considered secondary foraging habitats. The secondary

Attribute	Score and criteria (inland)	Score for habitat in the study area
	food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata. **+1 (medium)** = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present. **0 (low)** = None of the above.	feed tree species *Eucalyptus populnea* is most common with some *Eucalyptus pilligaensis* also present. The habitat would score **+1 (medium)** = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.
Habitat connectivity	**+2 (high)** = Area is part of a contiguous landscape ≥ 1000 ha. **+1 (medium)** = Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha. **0 (low)** = None of the above.	Habitat connectivity would score **0 (low)** = None of the above.
Key existing threats	**+2 (high)** = Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and have no dog or vehicle threat present. **+1 (medium)** = Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present. **0 (low)** = Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present, OR Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	The habitats in the study area would score **0 (low)** as it is an area that scores 0 for koala occurrence and has a significant vehicle threat present.
Recovery value	**+2 (high)** = Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. **+1 (medium)** = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. **0 (low)** = Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	The study area would score **+1 (medium)** = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.
TOTAL		2

The factors to be considered when determining whether proposal is likely to significantly affect the Koala or its habitats are outlined below:

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

Koala habitat can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees, from which they feed on the leaves (Department of Environment and Climate Change 2008). The breeding season for the koala peaks between September and February and animals are most active during this period. Following birth, the young remains in the pouch for approximately six months and on leaving the pouch remains dependent on its mother and is carried on her back. Young reach independence at about 12 months, although they can remain in the mother's home range for a further 2–3 years (Mitchell and Martin, 1990). Koalas reach sexual maturity at 2 years (Martin and Handasyde, 1990).

At least one low density breeding population is expected to be present in the locality and potentially to occupy all at least moderately connected areas of habitat associated with the presence of feed trees. Potential habitat is likely to be widespread beyond the study area, however available habitat within the region is highly fragmented due to a history of clearing for agricultural purposes and it is likely that only a relatively small proportion of such habitat is occupied by Koalas. Within the study area Koala habitat is present where the secondary (*Eucalyptus populnea* and *Eucalyptus pilligaensis*) feed trees are located and all other adjoining habitats that may be used for movement and other non-foraging activities. Long movements in search of a mate or new food source are sometimes undertaken by Koalas, signifying the importance of dispersal corridors in secure koala habitat (Phillips 1990). Considering the highly fragmented nature of the landscape, individuals from the local population likely travel along vegetated corridors associated with waterways and road reserves. Clearing of vegetation associated with the proposal would remove approximately 13.71 hectares of marginal habitat for this species. The habitat removal includes:

- Belah woodland (0.98 ha - intact)
- Brigalow viney scrub open forest (0.66 ha - intact)
- Carbeen +/- Coolabah grassy woodland (2.98 ha intact)
- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (0.08 ha intact)
- Poplar Box - Belah woodland (3.64 ha - intact)
- Poplar Box - White Cypress Pine woodland (8.21 ha - intact).

This habitat is not critical to the Koala but is still likely to be valuable for Koala movement, shelter and dispersal in the landscape. The proposed clearing will reduce the availability of habitat for this population. It may also contribute to habitat isolation by widening the road corridor and increasing barriers between habitat patches. The proposal may also lead to an increased mortality by vehicular collision due to increased average vehicle speeds.

As no critical breeding habitat will be affected and a large proportion of a population is not likely to be present in the study area, the proposal is considered unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species.

The proposal would not result in the removal of a substantial amount of habitat categorised as critical to the survival of this species, and is unlikely to significantly affect Koala movement or road-related mortality. The risk of a significant impact on the life cycle of the local population/s of the Koala is considered to be low.

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.

Not applicable.

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, 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 development or activity, 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.

Clearing of vegetation associated with the proposal would remove approximately 13.71 hectares of marginal habitat for this species. The habitat removal includes:

- Belah woodland (0.98 ha - intact)
- Brigalow viney scrub open forest (0.66 ha - intact)
- Carbeen +/- Coolabah grassy woodland (2.98 ha intact)
- Mock Olive - Wilga - Peach Bush - Carissa semi-evergreen vine thicket (0.08 ha intact)
- Poplar Box - Belah woodland (3.64 ha - intact)

- Poplar Box - White Cypress Pine woodland (8.21 ha - intact).

Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes. Generally, the only option for Koalas to access vegetation containing *E. populnea* on both sides of the road is by crossing the road. As the proposal will involve widening of the current road corridor, it will slightly reduce east-west habitat connectivity through increased habitat isolation.

The habitat in the study are is not critical to the Koala but is still likely to be valuable for Koala movement, shelter and dispersal in the landscape.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

Of the 38 listed KTPs under the BC Act, the proposal will contribute to, or may indirectly contribute to the clearing of native vegetation which is a key impact affecting the Koala. Introduction and spread of weeds and pathogens will be managed with the mitigation measures and the CEMP so these KTPs are not expected to be a major impact of the proposal. Any introduction and spread of exotic pests and predators would not be increased significantly.

Conclusion

The proposal will result in the clearing of some potential foraging habitat and habitat that is likely to be valuable for Koala movement, shelter and dispersal in the landscape. However, the population is low density and is unlikely to be reliant on the habitats in the study area for survival. The proposal is likely to cause a small reduction in east-west connectivity and a small increase in the risk to Koalas of road-related mortality due to the widening of the current highway.

The habitat affected is not likely to be critical to the low density local population of the species, and the proposal is considered unlikely to have a significant effect on the Koala.

Black-striped Wallaby (*Macropus dorsalis*)

Field surveys did not identify the Black-striped Wallaby within the study area, however no targeted surveys were undertaken for the species. Individuals and small groups of wallabies were observed in several locations in the study area, particularly just north of Bellata where strips of vegetation run along both sides of the highway, however as many observations were only fleeting, an identification of species was not always possible. There are 617 records of the species in the locality; most records area from the Pilliga National Park but there is a record of the species from 2001, approximately 3 km south-east of the study area at Tycannah. The species was also recorded in 2017 in a Travelling Stock Reserve on the Newell Highway in a camera-trap survey conducted on behalf of North West Local Land Services however, the precise location of this record is yet to be published. Given that the species has been recorded nearby and suitable habitat is represented by five PCTs in the study area, there is high potential for this species to occur.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

Preferred habitat for the Black-striped Wallaby is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, the species is associated with dense vegetation including Brigalow, Ooline and semi-evergreen vine thicket. Most of the daylight hours are spent resting undercover; feeding normally takes place from dusk to dawn. Although Black-striped Wallabies are a social species during the day, often congregating in groups of 20 or more of both sexes and all ages, aged males live as solitary individuals. Breeding occurs year round (Strahan 1995).

Considering the number of records in the Pilliga National Park, it is likely that there is a local viable population of the Black-striped Wallaby, extending broadly across the region. Highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation reserves are likely to hold the greatest number of individuals, however some may disperse throughout the landscape in vegetation

remnants along waterways and roads. The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 8.95 hectares of suitable habitat for the Black-striped Wallaby along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Additionally, widening the road and increasing the speed limit will increase the potential for vehicle strike. Considering there may be a stronghold for this population within highly vegetated areas in the region, these impacts are likely going to only affect dispersing individuals. It is unlikely that the proposal will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

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,

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove around 8.95 hectares of potential habitat for the Black-striped Wallaby. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments.

As mentioned, individuals of the local population that will be impacted by the proposal are those dispersing throughout the landscape. A reduction in 8.95 hectares of suitable habitat for the Black-striped Wallaby along the current alignment will reduce the ability of this species to disperse, forage and successfully breed. However, highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation areas likely contain a vast majority of the local population. Therefore, it is unlikely that the impacts to Black-striped Wallaby habitat associated with the proposal will significantly affect the long-term survival of the species.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the 'Clearing of native vegetation' with the removal of 8.95 hectares of suitable habitat for the Black-striped Wallaby.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The region likely supports a viable local population of the Black-striped Wallaby, with most individuals located in highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation areas. Individuals that disperse from these areas are likely do so throughout the landscape in

vegetation remnants along waterways and roads. The proposal would cause a reduction in 8.95 hectares of suitable habitat for the Black-striped Wallaby. However, these impacts to Black-striped Wallaby habitat are not considered to significantly impact this species as the proposal is unlikely to reduce the ability of this species to disperse, forage and successfully breed and the affected habitat makes up a relatively small proportion of habitat available in the region.

There is likely to be an increase in distance between patches within the local occurrence due to the increase in the width of cleared land associated with the road, slightly increasing the fragmentation of the species habitat. The greatest threat to this species associated with the proposal is increased posed risk by vehicle strike. This potential impact may, however, be adequately mitigated through road design and is unlikely to significantly affect the local population of the species.

In summary, the proposal is considered unlikely to have a significant adverse effect on the Black-striped Wallaby due to the relatively low number of individuals using habitat in the study area compared to more vegetated areas in the region. The proposal is unlikely to place the Black-striped Wallaby at a significantly elevated risk of extinction.

Painted Honeyeater (*Grantiella picta*)

Twenty-minute bird census surveys were undertaken throughout patches of suitable habitat in the study area. The Painted Honeyeater was not identified, however there were no areas of vegetation containing profusely fruiting or flowering resources which limited the detectability of this species. There are nine recorded sightings on the Bionet Atlas database from the search area, mostly from Killarney State Conservation Area and one on Millie Rd (east of Bellata). Birdline also contains multiple sightings in the area.

Many of the vegetation types in the study area along the Newell Highway present suitable habitat for the Painted Honeyeater, including areas with a high abundance of mistletoe species. Based on the presence of suitable habitat and location of nearby records, the Painted Honeyeater is considered moderately likely to occur in vegetation within the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

The species exhibits seasonal north-south movements governed principally by the fruiting of mistletoe, with which its breeding season is closely matched (Barea and Watson, 2007). Many birds move after breeding to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. Considering its dispersive habits, the species is considered to have a single population. The painted honeyeater is the most specialised of Australia's honeyeaters. Its diet mainly consists of mistletoe fruits, but also includes nectar (from flowering mistletoe, eucalypts and possibly banksias) and arthropods, especially in the non-breeding season (Garnett et al., 2011).

The Painted Honeyeater is likely an occasional visitor in the study area, coming in to feed on flowering and fruiting resources when available. This species may also nest in the study area, though nesting is generally reported from areas that contain a high abundance of mistletoes, e.g. 10 per tree (Barea 2008), which was not a common feature of vegetation in the study area. A reduction in 16.08 hectares of suitable foraging habitat with some nesting opportunities for the Painted Honeyeater along the current alignment will impact the feeding and possibly the breeding of this species. There are likely areas in the locality containing a higher prevalence of mistletoes more suitable for nesting. Any individuals that use vegetation in the study area are likely passing through the landscape while foraging. It is unlikely that the proposal will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

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,

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove around 16.08 hectares of foraging habitat for the Painted Honeyeater. Some areas of this may also present nesting opportunities. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape.

The Painted Honeyeater is a widely nomadic species that travels throughout its range in search of fruiting and flowering resources. Vegetation that will be impacted by the proposal includes mostly foraging habitat for the Painted Honeyeater. No areas considered to contain a high prevalence of mistletoes were observed (i.e. mean of 10 per tree), so the impact to potential nesting habitat is likely to be minor. Vegetation in the study area is likely to be important for individuals travelling through the landscape. Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposal is unlikely to be highly important to the long-term survival of the Painted Honeyeater.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would result in the ‘Clearing of native vegetation’ with the removal of 16.08 hectares of suitable habitat for the Painted Honeyeater.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime’ standard environmental management measures.

Conclusion

Any Painted Honeyeaters that occur in vegetation within the study area are part of a single population that occurs right across the range of this species. The Painted Honeyeater is highly nomadic and is likely to utilise vegetation in the study area as a foraging resource when mistletoes and trees are flowering and fruiting. There were no areas of vegetation observed during field surveys that contained a high prevalence of mistletoes considered preferential for nesting, therefore the impact to nesting habitat is likely to be minor.

The impact of widening the current road corridor is not considered likely to significantly impact the Painted Honeyeater as it is highly mobile. Further isolation of patches of suitable habitat will affect this species ability to move throughout the landscape.

In summary, the proposal is considered unlikely to have a significant adverse effect on the Painted Honeyeater due to the relatively low impact on habitat resources when the amount of higher value habitat in the region is considered (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas). The proposal is unlikely to place the Painted Honeyeater at a significantly elevated risk of extinction.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

Twenty-minute bird census surveys were undertaken throughout patches of suitable habitat in the study area. The Grey-crowned Babbler was identified within the study area in Sections 1 and 2 during field surveys. This species was observed in large family groups, moving through the roadside vegetation. Both occurrences were near large patches of vegetation away from the road that may provide some suitable nesting opportunities, however the habitat affected is more likely used occasionally for foraging by species passing through. Many of the vegetation types in the study area along the Newell Highway present suitable habitat for the Grey-crowned Babbler.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

The Grey-crowned Babbler was confirmed in the study areas of Sections 1 and 2 during field surveys. Likely to also be present in N2MS3 and N2MS4. Habitat is widespread and includes:

- Belah woodland (PCT 55)
- Carbeen +/- Coolabah grassy woodland (PCT 628)
- Poplar Box - Belah woodland (PCT 56)
- Poplar Box - White Cypress Pine woodland (PCT 397)
- Weeping Myall open woodland (PCT 27).

The habitat affected is likely to be used for foraging and dispersal but due to its edge location, it is unlikely to be important for breeding. It is unlikely to be important foraging habitat for this species due to its location and level of disturbance. Some of the narrow strips of roadside vegetation habitat affected are likely to be important as cover during dispersal. While these patches will be reduced, their functionality as cover is unlikely to be lost. The works are unlikely to have a significant adverse effect on the life cycle of the species and are unlikely to place a viable local population at significantly elevated risk of extinction.

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,

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove around 18.98 hectares of foraging habitat for the Grey-crowned Babbler. Some areas of this may also present nesting opportunities but no nests were observed during the survey. There may be additional indirect impacts to remaining areas of habitat due to edge effects. The habitat to be impacted includes:

- Belah woodland (0.98 ha - intact)
- Carbeen +/- Coolabah grassy woodland (2.98 ha intact)
- Poplar Box - Belah woodland (3.64 ha - intact)
- Poplar Box - White Cypress Pine woodland (8.21 ha - intact)
- Weeping Myall open woodland (3.17 ha - intact)

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem,

however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape.

Vegetation in the study area is likely to be important for individuals travelling through the landscape. Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposal is unlikely to be highly important to the long-term survival of the Grey-crowned Babbler.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would result in the 'Clearing of native vegetation' with the removal of 18.98 hectares of suitable habitat for the Grey-crowned Babbler.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

Any Grey-crowned Babblers that occur in vegetation within the study area are part of a single population that occurs right across the range of this species. The Grey-crowned Babbler is likely to utilise vegetation in the study area as a foraging resource. There were no nests observed so therefore the impact to nesting habitat is likely to be minor. The impact of widening the current road corridor is not considered likely to significantly impact the Grey-crowned Babbler as it is highly mobile. Further isolation of patches of suitable habitat will affect this species ability to move throughout the landscape.

In summary, the proposal is considered unlikely to have a significant adverse effect on the Grey-crowned Babbler due to the relatively low impact on habitat resources when the amount of higher value habitat in the region is considered (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas). The proposal is unlikely to place the Grey-crowned Babbler at a significantly elevated risk of extinction.

Squirrel Glider (*Petaurus norfolcensis*)

Field surveys did not identify the Squirrel Glider within the study area, however no targeted surveys were undertaken for the species. This species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area. Although vegetation in the study area is very fragmented, it offers an abundance of hollow-bearing trees suitable for this species, particularly in River Red Gum Woodlands (e.g. Bobbiwaa Creek connects the study area to the conservation area). As such, this species is considered to have a moderate likelihood of occurring within suitable habitat in the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

Squirrel Gliders nest in a bowl shaped, leaf-lined nest in a tree hollow. Typically, family group comprises one mature male (more than two years old), one or more adult females and their associated offspring of the season. Breeding usually begins in June or July, each female producing two young which remain in the pouch for about 70 days and are then deposited in the group nest for a further 40-50 days. Young leave the nest after 110-120 days to forage. Young leave their family group at the age of 7-10 months. The reproductive biology of the Squirrel Glider is strikingly similar to the Sugar Glider (*Petaurus breviceps*) and the two have interbred in captivity, producing fertile offspring (Strahan, 1995).

Habitat for the Squirrel Gilder is widespread in the study area, however not all of it is likely to be used by this species. This species has been recorded in Kaputar National Park and Bobbiwaa State Conservation Area

where they likely breed. Squirrel Gliders may come down from these large areas of vegetation along vegetated creek lines line (such as Bobbiwaa Creek) and pass through the study area. There is an abundance of hollow-bearing trees that represent suitable rooting habitat for this species, however breeding is unlikely due to the level of disturbance.

The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 5.63 hectares of potential habitat for the Squirrel Glider along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Additionally, widening the road and increasing the speed limit will increase the potential for vehicle strike. Considering there may be a stronghold for this population within highly vegetated areas in the region, these impacts are likely going to only affect dispersing individuals. It is unlikely that the proposal will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

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,

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove around 5.63 hectares of potential habitat for the Squirrel Glider. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments. Connectivity for the Squirrel Glider can be retained in certain areas (i.e. riparian corridors) by fauna crossing design.

As mentioned, individuals of the local population that will be impacted by the proposal are those dispersing throughout the landscape. A reduction in 5.63 hectares of potential habitat for the Squirrel Glider along the current alignment is unlikely to reduce the ability of this species to disperse, forage and find breeding partners. Breeding habitat will not be impacted. Highly vegetated areas such as Kaputar National Park and Bobbiwaa State Conservation Area likely contain a vast majority of the local population. Therefore, it is unlikely that the impacts to Squirrel Glider habitat associated with the proposal will significantly affect the long-term survival of the species.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the ‘Clearing of native vegetation’ with the removal of 5.63 hectares of suitable habitat for the Squirrel Glider.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The region likely supports a viable local population of the Squirrel Glider, with most individuals located in highly vegetated areas such as the Kaputar National Park and Bobbiwaa State Conservation Area. Individuals that disperse from these areas likely do so throughout the landscape in vegetation remnants along waterways and roads. A reduction in 5.63 hectares of suitable habitat for the Squirrel Glider along the current alignment will unlikely reduce the ability of this species to disperse, forage and successfully breed. These impacts to Squirrel Glider habitat are not considered to significantly impact this species due to the proportion of higher quality habitat available throughout the region.

There is also likely to be an increase in distance between patches within the local occurrence due to the increase in the width of cleared land associated with the road. A large threat to this species associated with the proposal is increased risk by vehicle strike. The design of the road should consider fauna crossing structures to retain connectivity for this species, particularly around riparian corridors.

In summary, the proposal is considered unlikely to have a significant adverse effect on the Squirrel Glider due to the relatively low number of individuals using habitat in the study area compared to more vegetated areas in the region. The proposal is unlikely to place the Squirrel Glider at a significantly elevated risk of extinction.

Rufous Bettong (*Aepyprymnus rufescens*)

Field surveys did not identify the Rufous Bettong within the study area, however no targeted surveys were undertaken for the species. However, suitable habitat is present.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

Habitat for the Rufous Bettong is widespread in the study area, however not all of it is likely to be used by this species. There are reports that the Rufous Bettong has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. The nearest records to the study area are in the Pilliga region and the study area contains potential habitat including habitat that could be used for breeding. Associated habitats in the study area include:

- Brigalow viney scrub open forest
- Mock Olive - Wilga - Peach Bush - Carissa

The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 0.74 hectares of potential habitat for the Rufous Bettong along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Widening the road and increasing the speed limit will increase the potential for vehicle strike. These impacts are likely going to only affect dispersing individuals and it is unlikely that the proposal will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

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,

Not applicable

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, 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 development or activity, 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.**

The proposal is predicted to remove around 0.74 hectares of potential habitat for the Rufous Bettong consisting of:

- Brigalow viney scrub open forest (0.66 ha - intact)
- Mock Olive - Wilga - Peach Bush - Carissa (0.08 ha - intact).

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments. Connectivity for the Rufous Bettong can be retained in certain areas (i.e. riparian corridors) by fauna crossing design.

The individuals of the local population that may be impacted by the proposal are those dispersing throughout the landscape. A reduction in 0.74 hectares of potential habitat for the Rufous Bettong along the current alignment is unlikely to reduce the ability of this species to disperse, forage and find breeding partners. Breeding habitat may be impacted but a high density population is not expected to occur in the study area. Therefore, it is unlikely that the impacts to Rufous Bettong habitat associated with the proposal will significantly affect the long-term survival of the species.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the 'Clearing of native vegetation' with the removal of 0.74 hectares of suitable habitat for the Rufous Bettong.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The region may support a viable local population of the Rufous Bettong with most individuals located in highly vegetated areas such as the Pilliga National Park, Mount Kaputar National Park and nearby conservation areas. Individuals that disperse from these areas likely do so throughout the landscape in vegetation remnants along waterways and roads. A reduction in 0.74 hectares of suitable habitat for the Rufous Bettong along the current alignment will unlikely reduce the ability of this species to disperse, forage and successfully breed. However, these impacts to Rufous Bettong habitat are not considered to significantly impact this species due to the proportion of higher quality habitat available throughout the region.

Stripe-faced Dunnart (*Sminthopsis macroura*)

Field surveys did not identify the Stripe-faced Dunnart within the study area, however no targeted surveys were undertaken for the species. Suitable habitat is present and this species is considered to have a moderate likelihood of occurring within the study area.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

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.

There are no records of the Stripe-faced Dunnart in locality, however this species occupies the same habitat as the common fat-tailed dunnart, of which there are records in Narrabri, Bellata and Moree. It is unlikely there has been comprehensive surveys for this species in the study area. Associated habitat present in the study area includes:

- Belah woodland (PCT 55)
- Brigalow viney scrub open forest (PCT 445)
- Carbeen +/- Coolabah grassy woodland (PCT 628)
- Poplar Box - Belah woodland (PCT 56)
- Queensland Bluegrass +/- Mitchell Grass (PCT 52)
- Weeping Myall open woodland (PCT 27).

The Newell Highway currently supports long stretches of vegetation that may be used by a range of fauna species to travel through the landscape. A reduction in 35.64 hectares of potential habitat for the Stripe-faced Dunnart along the current alignment is unlikely to reduce the ability of this species to disperse, forage and successfully breed. Additionally, widening the road and increasing the speed limit will increase the potential for vehicle strike. Considering there may be a stronghold for this population within highly vegetated areas in the region, these impacts are likely going to only affect dispersing individuals. It is unlikely that the proposal will have adverse effect on the life cycle of the species such that the viable local population is likely to be placed at risk of extinction.

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,

Not applicable

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, 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 development or activity, 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.

The proposal is predicted to remove around 35.64 hectares of potential habitat for the Striped-face Dunnart including:

- Belah woodland (0.98 ha – intact, 0.22 ha - derived)
- Brigalow viney scrub open forest (0.66 ha - intact, 0.53 -derived)
- Carbeen +/- Coolabah grassy woodland (2.98 ha intact, 0.04 ha derived)
- Poplar Box - Belah woodland (3.64 ha - intact, 1.05 ha - derived)
- Queensland Bluegrass +/- Mitchell Grass (11.31 ha - intact)
- Weeping Myall open woodland (3.17 ha - intact, 11.06 - derived).

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in increased mortality by vehicle strike, a reduction in breeding success between individuals travelling between fragments. Connectivity for the Stripe-faced Dunnart can be retained in certain areas (i.e. riparian corridors) by fauna crossing design.

As mentioned, individuals of the local population that will be impacted by the proposal are those dispersing throughout the landscape. A reduction in 35.64 hectares of potential habitat for the Stripe-faced Dunnart along the current alignment is unlikely to reduce the ability of this species to disperse, forage and find breeding partners. Highly vegetated areas such as the Pilliga, Mount Kaputar National Park and Bobbiwaa State Conservation Area likely contain a vast majority of the local population. Therefore, it is unlikely that the impacts to Stripe-faced Dunnart habitat associated with the proposal will significantly affect the long-term survival of the species.

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),

The proposal will not impact on any declared area of outstanding biodiversity value.

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.

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the BC Act and at the present there are currently 38 listed KTPs.

The proposal would undoubtedly result in an increase to the 'Clearing of native vegetation' with the removal of 35.64 hectares of suitable habitat for the Stripe-faced Dunnart.

While there is potential for other KTPs of relevance to this species to be affected by the proposal, these KTPs are likely to be able to be adequately managed by Roads and Maritime' standard environmental management measures.

Conclusion

The region may support a viable local population of the Stripe-faced Dunnart with most individuals located in highly vegetated areas such as the Pilliga, Mount Kaputar National Park and nearby conservation areas. Individuals that disperse from these areas likely do so throughout the landscape in vegetation remnants along waterways and roads. A reduction in 35.64 hectares of suitable habitat for the Stripe-faced Dunnart along the current alignment will unlikely reduce the ability of this species to disperse, forage and successfully breed. These impacts to Stripe-faced Dunnart habitat are not considered to significantly impact this species due to the proportion of higher quality habitat available throughout the region.

Remaining species – table format tests

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 (see Footnote 1)						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.	(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), (see Note 2)	(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.	
Plants (sandy and sandy-loam soils containing White Cypress Pine and Belah): • *Cyperus conicus* • *Diuris tricolor* • *Lepidium aschersonii* • *Polygala linariifolia* • *Pterostylis cobarensis* • *Tylophora linearis* • *Sida rohlenae*	None of these species were identified during field surveys, however there are some suitable areas of habitat in the study area. Much of this habitat was surveyed and found to be modified due to edge effects such as weed invasion, so in the event that any of these species are present within the study area, the number of individual and the proportion of the local population affected is likely to be relatively small. Seed dispersal in these 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.	Based on associated PCTs/habitat, the proposed works will remove to following habitat: • *Cyperus conicus* – 17.12 ha • *Diuris tricolor* – 8.21 ha • *Lepidium aschersonii* – 7.08 ha • *Polygala linariifolia* – 8.21 ha • *Pterostylis cobarensis* – 8.21 ha • *Tylophora linearis* – 8.21 ha • *Sida rohlenae* – 7.71 ha	The habitat to be cleared is mostly an already isolated thin strip between the highway and rail corridor. 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.	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.	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 *clearing of native vegetation* 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
Plants (cracking-clay and clay-loam soils): • *Lepidium monoplocoides* • *Swainsona murrayana* • *Swainsona sericea*	None of these species were identified during field surveys, however there are some suitable areas of habitat in the study area. Much of this habitat was surveyed, so in the event that any of these species are present within the study area, the number of individual and the proportion of the local population affected is likely to be relatively small. Seed dispersal in these species is likely to be mainly via wind and floodwater and is	Based on associated PCTs/habitat, the proposed works will remove to following habitat: • *Lepidium monoplocoides* – 19.02 ha • *Swainsona murrayana* – 25.64 ha • *Swainsona sericea* – 21.94 ha	The habitat to be cleared is mostly a thin strip along the existing edge of the highway. The works will not result in substantial fragmentation of habitat for the species. Seed dispersal in these 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	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.	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 *clearing of native vegetation* 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 (see Footnote 1)						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.	(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), (see Note 2)	(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.	
	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.		also unlikely to be affected. The works will not substantially affect the level of isolation of populations of these species.				
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 8.21ha 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 *clearing of native vegetation* 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
Superb Parrot	The study area is in the very north of the migration range for this species and is likely only used on occasion for foraging and roosting by birds during seasonal migration (i.e. non-breeding season). 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	Based on associated PCTs/habitat, the proposed works will remove 48.01 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	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	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 *clearing of native vegetation* 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 (see Footnote 1)						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.	(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), (see Note 2)	(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.	
	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.		movement corridor for this species.	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.			
Black-cockatoos: • Glossy-black Cockatoo	No likely breeding habitat (woodland or forest with areas of tall dense shrubbery and/or mature trees in areas distant from regular human disturbance) occurs in the areas affected by the works. Some vegetation in the larger patches away from the road may provide some suitable nesting opportunities, however the habitat affected is more likely used occasionally for foraging by individuals passing through. Large stands of Belah offer foraging resources for the Glossy Black Cockatoo. Belah is common and widespread through the locality. It is unlikely to be important foraging habitat 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 the species.	Based on associated PCTs/habitat, the proposed works will remove: 15.81 ha of habitat for the Glossy-black Cockatoo	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.	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.	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 *clearing of native vegetation* 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 (see Footnote 1)						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.	(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), (see Note 2)	(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.	
Woodland birds: • Diamond Firetail • Dusky Woodswallow • Hooded Robin (south-eastern form) • Speckled Warbler • Varied Sittella • Turquoise Parrot	These species may occur in the study area based on the presence of records and suitable habitat. Breeding habitat likely occurs further away from the road edge (woodland or forest with areas of tall dense shrubbery and/or mature trees in areas distant from regular human disturbance) in areas that will not be affected by the works. 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.	Based on associated PCTs/habitat, the proposed works will remove: 16.08 habitat for the Diamond Firetail 35.64 habitat for the Dusky Woodswallow 16.55 habitat for the Speckled Warbler 16.08 habitat for the Hooded Robin and Varied Sittella. 14.83 habitat for the Turquoise Parrot	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.	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.	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 *clearing of native vegetation* 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
Forest/Woodland Owls: • Barking Owl • Masked Owl	Large hollow-bearing trees are scattered across the study area and may provide some nesting opportunities, however due to their close proximity to the road they are unlikely to present high quality breeding habitat. These species are 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.	Based on associated PCTs/habitat, the proposed works will remove: 19.64 ha of habitat for the Barking Owl 46.26 ha of habitat for the Masked Owl	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.	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.	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 *clearing of native vegetation* 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 (see Footnote 1)						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.	(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), (see Note 2)	(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 of open woodland and grassland habitats: • Australian Bustard • Bush Stone-curlew	No potential breeding habitat occurs in the study area (i.e. too disturbed and close to the highway). 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 widening of the highway and associated increases in traffic/speeds may slightly increase the risk of vehicle strike. 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: 35.64 ha of habitat for the Australian Bustard 43.31 ha of habitat for the Bush Stone-curlew	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.	The habitat to be affected is unlikely to be used as breeding habitat, as all species nest on the ground and the study area is likely to be too disturbed. 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 *clearing of native vegetation* 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
Birds of prey: • Square-tailed Kite • Spotted Harrier • Little Eagle • Grey Falcon • Black Falcon • Black-breasted Buzzard	Many of the large trees in the study area may provide nesting opportunities, however due to their close proximity to the road they are unlikely to present high quality breeding habitat. 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.	Based on associated PCTs/habitat, the proposed works will remove: 16.08 ha of habitat for the Square-tailed Kite 35.64 ha of habitat for the Spotted Harrier 48.2 ha of habitat for the Little Eagle 35.64 ha of habitat for the Grey Falcon 28.56 ha of habitat for the Black Falcon 16.51 ha of habitat for the Black-breasted Buzzard	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.	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.	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 *clearing of native vegetation* 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 (see Footnote 1)						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.	(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), (see Note 2)	(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.	
Insectivorous bats: • Little Pied Bat • Yellow-bellied Sheathtail-bat • Bristle-faced free-tailed bat • Eastern Cave Bat • Corben's Long-eared Bat • Eastern Bentwing-bat	Hollow-bearing trees are a common feature of the vegetation in the study area and are likely to present suitable roosting habitat for the hollow-roosting species. Bridges and culverts may also provide roosting opportunities. There is unlikely to be a maternity roost in the study area for cave-dwelling species, except possibly in the bridges which would be unaffected by the proposal. Maternity roosts of hollow-dependent species may be found in the broader sections of the study area but are unlikely to be located at the disturbed road edge, where the clearing would take place, due to existing noise and light disturbance and edge effects disturbance. All these species are likely to forage around the vegetation in the study area. The habitat affected is unlikely to be important for these species due to its location and 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: 49.28 habitat for the Little Pied Bat and Yellow-bellied Sheathtail-bat. 7.28 habitat for the Bristle-faced free-tailed bat. 16.74 habitat for the Corben's Long-eared bat. 14.91 habitat for the Eastern Cave bat. 15.89 habitat for 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 *clearing of native vegetation* 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

Appendix C – Assessments of Significance – EPBC Act

Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland

Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland occurs on the Darling Downs, Liverpool Plains and Moree Plains, mostly in the Brigalow Belt South and Darling Riverine Plains bioregions of Queensland and New South Wales (NSW). The following descriptions and information used in the assessment is soured from the Commonwealth advice for listing this ecological community under the EPBC Act, and the results of the targeted survey.

The distribution of the ecological community is strongly reliant on soil type as it is associated with fine textured, often cracking clays derived from either basalt or quaternary alluvium. The development of deep cracks as the soils dry, and the tearing of tap roots during the soil contraction and expansion cycle are possible reasons why trees and large woody shrubs are typically lacking in these grasslands.

The ecological community generally occurs on flat to low slopes, of no more than 5 percent inclination. As slope increases, grassy woodlands dominated by trees such as *Acacia pendula* (Weeping Myall), *Eucalyptus coolabah* (Coolabah), *E. populnea* (Poplar Box) or *E. melliodora* (Yellow Box) occur. The ground layer component of these woodlands may be similar to the grassland but the soils will not be the same cracking clays as on the plains.

It is important to note that native grasslands comprise not only the more obvious grass species, but also a great diversity of other herbaceous plants such as native daisies, orchids, lilies and other wildflowers. Many of these plants are only easily seen in the spring. The native grassland flora also includes herbaceous legumes such as Desmodium, Glycine, Lotus and Rhynchosia that have an important role in soil nitrogen fixation. The native legumes of grasslands on the Liverpool Plains are now mainly restricted to sites that have not been heavily degraded by past land management practices.

The shrub cover is typically a very minor component of the grassland however in some areas such as Kirramingly (south of Moree) the cover of shrubs, such as *Acacia farnesiana* (Mimosa), can be quite thick. At sites like this, the thick shrub cover does not affect the abundance of grass species. The total projective canopy cover of woody shrubs over 0.5 m tall can be up to 50% in this ecological community but is typically much less. A tree canopy is typically absent. Where trees are present, they are of variable species composition and comprise less than 10% of projective crown cover.

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*:*

Reduce the extent of an ecological community

The listing advice for the community concluded that the ecological community has undergone a very severe decline in extent, likely to be at least 95%, from about 683 000 hectares to about 29 000 hectares.

The proposal would remove approximately 11.31 hectares of the TEC from two patches, one the east and one on the west of the highway. Each of these patches is estimated to have an extent of around 300 hectares and the impact of the proposal would affect each to a similar extent. The proposal is likely to result in a reduction in the extent of each of these populations by around 2%.

The reduction in the extent of the community is considered to be substantial at a local context.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposal will result in a minor increase reduction in the connectivity of patches due to the increase in the width of cleared land associated with the road widening. The slight increase in isolation of patches as a result of road widening is unlikely to significantly impact their long-term viability.

Adversely affect habitat critical to the survival of an ecological community

According to the MNES SIG 1.1 EPBC Act (DoE 2013) Habitat critical to the survival of an ecological community refers to areas that are necessary:

- for the long-term maintenance of the ecological community (including the maintenance of species essential to the survival of the ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

There are very few undisturbed patches of the community remaining in existence; most remaining patches have some degree of disturbance and degradation. While habitat critical to the survival of the community has not been formally identified, important habitat for the community is assumed to consist of large patches in 'best' and/or 'good' condition as defined in the condition thresholds for the community and shown in Table 1.

Table C.1 - Condition thresholds for the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland ecological community.

Condition thresholds	Best quality	Good quality
Patch size	Minimum patch size at least 0.5 ha, **AND**	Minimum patch size at least 2 ha AND
Grasses	At least 4 native perennial grass species from the indicator species list **AND**	At least 3 native perennial grass species from the indicator species list AND
Tussock cover	At least 200 native perennial grass tussocks **AND**	At least 200 native perennial grass tussocks **AND**
Woody shrub cover	Total projected canopy cover of shrubs is less than 30% **AND**	Total projected canopy cover of shrubs is less than 50% **AND**
Introduced species	Perennial non-woody introduced weed species are less than 5% of the total projected crown cover	Perennial non-woody introduced weed species are less than 30% of the total projected crown cover
Notes: • Shrubs are typically absent. When present, they are defined as woody plants more than 0.5 m tall that occupy the mid vegetation layer. The upper, tree canopy layer also is typically absent but may comprise scattered trees to less than 10% projective crown cover • Sampling should be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, a site must be assessed during a good season, two months after cessation of disturbance (fire, grazing, mowing or slashing) and within two months of effective rain.		

Most of the occurrence of the community in the impacted areas and broader study area meets the thresholds for inclusion in the best quality category while edge areas that have been subject to a moderate level of disturbance (typically within 5 metres of the edges of the community) would only meet the good quality thresholds. Both of the patches affected are large (~300 hectares) and are considered to be of high importance to the survival of the community.

The removal of approximately 11.31 hectares of habitat for the community, from patches considered to be critical to the survival of the ecological community, is considered to have a substantial adverse impact on habitat critical to the survival of the community.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion.

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

The proposal is likely to reduce the quality of a small proportion of the immediately adjacent retained area of the TEC due to edge effects such as increased wind, altered hydrology and weed invasion.

These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space. This impact would be restricted to areas immediately adjacent to the proposal and would not substantially affect the broader patch of the community.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

Unless the proposal includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community. This impact would be restricted to areas immediately adjacent to the proposal and would not substantially affect the broader patch of the community.

Interfere with the recovery of an ecological community.

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposal:

- Ensure road widening and maintenance activities (or other infrastructure or development activities as appropriate) in areas where the ecological community occurs do not adversely impact on known sites.
- Manage disruptions to water flows and any changes to hydrology which may result in changes to the water table levels, increased salinity and increased run off or sediment.
- Develop and implement a management plan for the control of weeds such as Lippia (Phyla canescens), Coolatai Grass (Hyparrhenia hirta), African Love Grass (Eragrostis curvula) and Buffel Grass (Cenchrus ciliaris) in the region.
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the ecological community, using appropriate methods.
- Implement good hygiene measures for mowing and grading equipment and observe appropriate state protocols for moving stock.

The proposal is not consistent with the first priority action through removal of 11.31 hectares of this critically endangered ecological community. Mitigation measures for the proposal would be designed to ensure it does not interfere with the remaining actions.

Conclusion

The extent of the critically endangered ecological community that would be lost is 11.31 ha. This represents a loss of ~2% when considered in the context of the contiguous extent of the TEC in the surrounding environment. The proposal is also considered likely to adversely modify the composition of some immediately adjacent areas of the TEC that would not be cleared, due to increased edge effects.

The TEC within the study area is likely to be important to the long-term survival of the TEC as the patches are of large size and are in moderate to good condition.

There is likely to be minor increase in fragmentation and isolation of patches due to the increase in the width of cleared land associated with the road.

In summary, the proposal is considered likely to have a significant impact on the extent of the *Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland*.

Weeping Myall Woodlands

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*:*

Reduce the extent of an ecological community

The EPBC Act listing for Weeping Myall Woodlands only includes areas that have the following characteristics:

- Tree canopy dominated (at least 50% of trees present) by living and/or dead Weeping Myall; and
- At least 5% tree canopy cover; and
- An area of at least 0.5 ha; and
- Has more than two layers of regeneration of Weeping Myall present; or the tallest layer of living or dead Weeping Myall is at least 4 m tall and of the vegetative cover present, at least 50% is comprised of native species.

The proposal would result in the loss of approximately 3.17 hectares of vegetation which meets these criteria. The loss in the extent of the community includes the area to be cleared and the remaining small fragments of patches which would be reduced to a size at which they no longer meet the criteria for inclusion in the community. The local, contiguous extent of the community is estimated at approximately 235 hectares. The local, contiguous extent of the community would be reduced by around 2 %.

The reduction in the extent of the community is considered to be substantial both in absolute terms and in proportion to the local occurrence.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The proposal will result in a minor increase in fragmentation due to the loss of some small patches which contribute to landscape scale connectivity for the community and would reduce the connectivity of patches due to the increase in the width of cleared land associated with the road.

Adversely affect habitat critical to the survival of an ecological community

No recovery plan has been prepared for the community and no formal identification of critical habits has been undertaken to date. While habitat critical to the survival of the community has not been formally identified, important habitat for the community is assumed to consist of larger patches of the community in areas where land management practices are conducive to the regeneration of *Acacia pendula* after cyclical natural die-off events. Such conditions generally do not exist in continually grazed farmland where the highly palatable seedlings are often consumed by livestock. Larger remnants in travelling stock reserves and road reserves are therefore considered particularly important as livestock grazing in these areas is absent or of low frequency and the community is likely to be able to regenerate and persist indefinitely under such conditions. The largest and most contiguous patches affected include two patches (3.5 ha and 45.5 ha) in close proximity to one another on both sides of Couradda Road south of Edgeroi, a patch of approximately 2.0 ha immediately south of the Couradda Road patches which contains a substantial population of *Homopholis belsonii* (EPBC Act-Vulnerable), and a patch of 3.4 ha south of the entrance to the Bellbowrie property at 4274 Newell Hwy Edgeroi. Due to their moderate size and close proximity to one-anther, in aggregate these patches are considered to be important to the survival of the local occurrence of the community.

The loss of approximately 3.17 hectares of habitat for the community, from patches considered to be moderately to highly important, is considered to have a small adverse impact on habitat critical to the survival of the community.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The area over which such impacts are likely to occur is estimated at 0.77 hectares assuming a width of substantial additional edge effects of 5 metres.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The area over which such impacts are likely to occur is estimated at 0.77 hectares assuming a width of substantial additional edge effects of 5 metres.

These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

Unless the proposal includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

The area over which such impacts are likely to occur is estimated at 0.77 hectares assuming a width of substantial additional edge effects of 5 metres.

Interfere with the recovery of an ecological community.

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposal:

- Protecting remnants of the listed ecological community through the development of conservation agreements and covenants.
- Replanting of understorey species where they have been depleted.
- Avoiding the application of fertilisers and herbicides in or near remnants.
- Protecting remnants from weeds including the speedy eradication of any new invasions.

The proposal would interfere substantially with the first of these actions as it would adversely impact remnants of the community that may otherwise be suitable for conservation through loss of 3.17 hectares of the community.

There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposal.

Mitigation measures for the proposal would be designed to ensure that the proposal does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The extent of the community that would be lost is substantial (3.17 ha) and the proportion of community lost is considered low (2%) when considered in the context of the contiguous extent of the TEC in the surrounding environment. The proposal is also considered likely to adversely modify the composition of adjacent areas of the TEC that would not be cleared, due to increased edge effects.

The TEC within the study area is likely to be important to the long-term survival of the TEC as the patches are of moderate to large size and in moderate to good condition.

There is likely to be minor increase in fragmentation and isolation of patches due to the increase in the width of cleared land associated with the road.

In summary, the proposal is considered unlikely to have a significant adverse effect on the extent and condition of the *Weeping Myall Woodlands* community.

Brigalow (*Acacia harpophylla* dominant and co-dominant)

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*:*

Reduce the extent of an ecological community

The EPBC Act listing for Brigalow only includes areas that have the following characteristics:

- The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably) *Casuarina cristata*, other species of Acacia, or species of Eucalyptus), and
- In New South Wales - the patch meets one of the following NSW Vegetation Classification and Assessment (VCA) community descriptions. The NSW VCA communities are: VCA IDs 29, 31 and 35; as described in Benson et al. (2006), and/or
- The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Qld REs or NSW vegetation communities (although species density may be reduced). This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise, and
- The patch is 0.5 ha or more in size, and
- Exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.

The proposal would result in the loss of about 0.66 hectares of vegetation which meets these criteria in N2MS4. The local, contiguous extent of the community is estimated at approximately 10.5 hectares. The local, contiguous extent of the community would be reduced by around 5 %. The proposal is also likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. The impact only occurs on one side of the road, the side where most of the community occurs, however, the reduction in the area of the community is likely to reduce the viability of the remaining area, even if it is not directly impacted, due to a reduction in the population size and reduced genetic diversity of the species (e.g. Brigalow). which make it unique.

The absolute impacts in terms of hectares removed are low, and when the impacts are considered in the local context, and in proportion to the size of the local occurrence of the TEC, they are considered unlikely to be significant.

The local occurrence of the TEC subject to this assessment is already at risk of extinction due to its relatively small size, high edge to area ratio and susceptibility to disturbance events such as the recent fire that has already affected, but not eliminated, the community.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The patches of the TEC that make up the local occurrence are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in a reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a very small, insignificant, increased risk of extinction of the local occurrence of the TEC.

Adversely affect habitat critical to the survival of an ecological community

The Brigalow (Acacia harpophylla dominant and co-dominant) ecological community states:

The areas considered critical to the survival of the Brigalow ecological community includes all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community; plus the buffer zones, particularly where these include native vegetation.

About 0.66 hectares of Brigalow vegetation that will be cleared as part of the proposed works are critical to the survival of the ecological community. As this habitat is already somewhat disturbed and edge-affected, this loss is unlikely to be significant.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind and altered hydrology. The area over which such impacts are likely to occur is estimated at 0.59 hectares assuming a width of substantial additional edge effects of 5 metres. However, the level of impact will largely be dependent on the design of the road and potential impacts can likely be avoided.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion.

These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

Such impacts would, however be mitigated by weed control and revegetation undertaken as part of the proposal.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

The patches of the TEC affected are of small to moderate size (totalling 10.5 ha) and most of the affected vegetation (except the last 2-3 metres between the core and clearing associated with the road) appears to be old growth; ie. not previously cleared. It ranges in condition from in moderate condition (recovering from recent fire) to high condition (core areas in apparently natural condition). Due to their size, moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Unless the proposal includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

Interfere with the recovery of an ecological community.

There is no adopted or made Recovery Plan for this ecological community. The conservation advice for the community includes the following priority actions of relevance to the proposal:

- Protect and conserve remnant and regrowth areas of the ecological community. Prevent clearance of this endangered ecological community and of nearby native vegetation including buffer zones and connecting corridors.
- Where further clearance is unavoidable:
    - Mitigate the severity of impacts (e.g. avoid higher quality areas, avoid dissection of patches, act to minimise hydrological disruption and the spread of weeds); and,
    - Offsetting should consider the location and emulate qualities of affected patches.
- Manage areas of the Brigalow ecological community to reduce threats, including through:
    - Fire management that considers Brigalow conservation, protection, and ecological heterogeneity; and,

- Targeted weed and feral animal control with a particular focus on high biomass exotic grasses (buffel grass, Rhodes grass, green panic grass) and feral pigs.

- Manage all weeds appropriately within and close to the Brigalow ecological community; e.g.: spot application of herbicides, rather than aerial spraying; avoid fertiliser application; minimise tree thinning and soil disturbance.
- Manage foxes and cats (as well as feral pigs) using a coordinated approach, preferably among groups of neighbours and across regions.
- Help woodland birds to avoid aggression from noisy miners by: encouraging and protecting shrubby understorey; managing grazing pressure so that it does not degrade native vegetation; and retaining dense stands of trees and regrowth.

The proposal would interfere to a small degree with the first of these actions as it would adversely impact remnants of the community, including buffer zones, that may otherwise be suitable for conservation through loss of 0.66 hectares of the community.

There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposal.

Mitigation measures for the proposal would be designed to ensure that the proposal does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The extent of the community that would be lost is small (0.66 ha) and the proportion of community lost is considered low when considered in the context of the contiguous extent of the TEC in the surrounding environment. The proposal is also considered likely to adversely modify the composition of adjacent areas of the TEC (about 0.59 ha) that would not be cleared, due to increased edge effects.

There is also likely to be an increase in isolation of patches within the local occurrence due to the increase in the width of cleared land associated with the road.

In summary, although the proposal will have an adverse impact on the community, the impact is considered unlikely to have a significant adverse impact on the extent and condition of the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community.

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

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*:*

Reduce the extent of an ecological community

The proposal is predicted to remove around 0.48 hectares of the TEC from a local occurrence of approximately 4.4 hectares. The area that would be removed by the proposal represents about 11% of the local occurrence, a relatively small proportional impact.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The patches of the TEC that make up the local occurrence are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. This increased isolation may result in a reduction in the function of ecological processes such as pollination and seed dispersal (e.g. seed dispersal by ants) between fragments. This disruption of ecological processes would contribute to a very slightly increased risk of extinction of the local occurrence of the TEC.

Adversely affect habitat critical to the survival of an ecological community

There is no critical habitat identified for the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions TEC.

The small road side remnants in the study area are unlikely to be considered critical to the survival of this TEC as a whole.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind and altered hydrology. The level of impact will largely be dependent on the design of the road and potential impacts can likely be avoided.

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

The proposal is likely to reduce the quality of some of the adjacent retained area of the TEC due to edge effects such as increased light, increased wind, altered hydrology and weed invasion. These changes in environmental conditions may result in a change in the species constitution and vegetation structure. This would likely involve a proliferation of tolerant species (typically grasses), a reduction in floristic diversity (particularly of small herbs) and reduced structural complexity due to the development of a continuous grass cover with little or no inter-tussock space.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:

- **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
- **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**

The patches of the TEC affected are of small to moderate size and most of the affected vegetation (except the last 2-3 metres between the core and clearing associated with the road) appears to be old growth; ie. not previously cleared. Due to their size, moderate to good condition and continuity with other native vegetation, the TEC patches in the study area are considered to retain high levels of ecological integrity and function.

Unless the proposal includes very careful soil management, weed monitoring and management and intensive vegetation restoration, weed proliferation is likely to occur on the newly created fill batters. Weeds on the fill batters are likely to invade the adjacent edges of the community.

Interfere with the recovery of an ecological community.

There is a National Recovery Plan for this ecological community that outlines the following priority actions:

- Complete and refine mapping of remnant SEVT EC.
- Determine the extent and condition of areas of the SEVT EC affected by invasive plant species, particularly weeds of national significance (WONS), e.g. rubber vine and lantana.
- Survey poorly known species, especially fungi, herpetofauna and invertebrates.
- Monitor selected populations of the EPBC Act-listed species across their distribution within the EC.
- Identify key areas of the SEVT EC for addition to the Queensland and NSW conservation reserve systems.
- Encourage landholders to enter into conservation agreements over semi-evergreen vine thickets.
- Liaise with landholders to develop appropriate burning practices and other procedures to minimize fire damage to remnant areas of SEVT on private and public lands.
- Determine the impact of grazing animals, both domestic and native, on remnant areas of SEVT. Develop guidelines and recommendations for fencing.
- Develop and implement a pest management program to control or manage feral animals and native animals in SEVT remnants.
- Encourage landholders through appropriate incentive programs to protect and foster regrowth SEVT and associated vegetation in buffer areas.
- Research and develop use of SEVT species for landscape rehabilitation and encourage mining companies, Main Roads and others to use native species in plantings.

- Undertake consultation with traditional owner groups to determine the level of indigenous knowledge of and association with the SEVT EC.
- Develop and implement education programs to increase the awareness of government and non-government organisations regarding SEVT conservation, and their responsibilities for SEVT protection and management

The proposal would interfere with some of these actions as it would adversely impact remnants of the community, including buffer zones, that may otherwise be suitable for conservation. There may be opportunities to contribute to the replanting of understorey species during revegetation works associated with the proposal. Mitigation measures for the proposal would be designed to ensure that the proposal does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The extent of the community that would be lost is small as the proposal is predicted to remove around 0.48 hectares of the TEC from a local occurrence of approximately 4.4 hectares. The proposal is also considered likely to adversely modify the composition of a small amount of the adjacent area of the TEC that would not be cleared, due to increased edge effects. There is also likely to be a small increase in isolation of patches within the local occurrence due to the increase in the width of cleared land associated with the road.

In summary, the proposal is considered unlikely to have a small impact on the EPBC Act listed TEC as a whole. The impacts are unlikely to be significant in terms of their context or intensity.

Homopholis belsonii (Belson's Panic)

The following information regarding 'important populations' is taken from the EPBC Act Significant Impact Guidelines 1.1.

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- A geographically distinct regional population, or collection of local populations, or
- A population, or collection of local populations, that occurs within a particular bioregion.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

There are no specific populations listed in the SPRAT profile or conservation advice for the species.

The local populations of the species in the study area are considered to form an important population as they are:

- Large and hence may constitute key source populations for dispersal
- Distributed across a variety of plant community types and hence are likely to have relatively high genetic diversity, reflecting environmental differences between habitats
- At or near the south-west limit of the species' known range.

Based on this assessment process, the population of the species in the study area can be considered and important population. Therefore, by this assessment process, the study area is likely to contain an important population of this species within suitable habitat.

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 proposal will result in the removal of 19.04 hectares of habitat for an important population of the species, consisting of a collection of three local populations. The clearing will result in direct mortality to individuals and loss of habitat. Due to fact that this species is stoloniferous, forming small patches to extensive mats of

intertwined stems, and that the accuracy of GPS data collection is typically limited to plus or minus approximately five metres, it is difficult to determine an accurate number of individuals affected. This assessment is therefore based on the amount of habitat affected that includes locations where the species was recorded and similar areas of contiguous habitat. The proposal will lead to a long-term decrease in the size of an important population by about 19.04 hectares due to the loss of this habitat.

Reduce the area of occupancy of an important population

Area of occupancy is defined as the area within a species' 'extent of occurrence' (shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species) which is occupied by the species. To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, IUCN (2016) recommends standardization of estimates by applying a 2 x 2 km grid to occurrence data and this is the approach adopted by the Threatened Species Scientific Committee in its assessment of the conservation status of native species (Threatened Species Scientific Committee, 2017). By this definition of area of occupancy, the proposal will not reduce the area of occupancy of an important population as it would not cause the species to be lost from an entire 2 x 2 km grid cell.

At a fine scale, however, the proposal will result in the removal of 19.04 hectares of habitat for an important population of the species, reducing the fine scale area of occupancy by that amount.

Fragment an existing important population into two or more populations

There is likely to be an increase in distance between patches within the population due to the increase in the width of cleared land associated with the road. Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes and road construction. However, considering the wind pollination and wind seed dispersal mechanisms in this species, the increase in distance between patches of habitat is unlikely to affect the species to such an extent that an existing important population would be split into two or more populations.

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 of the species in the study area is considered to be part of an area of critical habitat as it:

- Contains a large population and hence may be necessary for dispersal and may be of value for the reintroduction and recovery of the species
- Contains a variety of plant community types, is at or near the south-west limit of the species' known range and is hence likely to be of value in the maintenance of genetic diversity and facilitation of long-term evolutionary development of the species.

The proposal will result in the removal of 19.04 hectares of habitat critical to the survival of the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species.

Disrupt the breeding cycle of an important population

The reduction in population size and degradation of habitat that would be caused by the proposal is likely to have an adverse effect on the life cycle of the species but is unlikely to disrupt the breeding cycle as it would not substantially affect the wind pollination or wind dispersal mechanisms used by 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

Clearing of vegetation associated with the proposal would remove 19.04 hectares of important habitat for the species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering habitat suitability for this species. This clearing is likely to lead

to a one-off reduction in the population of the species in the study area but not an ongoing decline in the population beyond the construction phase of the proposal.

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

The clearing of habitat is recognised as a major factor contributing to the threatened status of the species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. 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 on the species or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback and associated habitat degradation. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interfere substantially with the recovery of the species

There is currently no specific recovery plan for Belson's Panic but the following regional priority recovery and threat abatement actions of relevance to the proposal are recommended in the conservation advice for the species:

- Ensure road widening and maintenance and mining activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where *H. belsonii* occurs do not adversely impact on known populations.
- Protect populations of the listed species through the development of conservation agreements and/or covenants.
- Identify populations of high conservation priority
- Undertake survey work in suitable habitat and potential habitat to locate any additional populations/occurrences/remnants
- Ensure fertilisers used in agriculture, and chemicals or other mechanisms used to eradicate weeds, do not have a significant adverse impact on *Homopholis belsonii*.
- Develop and implement a management plan for the control of invasive weeds such as Green Panic Grass (*Panicum maximum var. trichoglume*), Coolatai Grass (*Hyparrhenia hirta*) and Tiger Pear (*Opuntia aurantiaca*) in the local region.
- Manage sites to prevent introduction of invasive weeds, which could become a threat to the *H. belsonii*, using appropriate methods.
- Investigate options for linking, enhancing or establishing additional populations.

The proposal may interfere with the first two of these actions as it would adversely impact remnants of the community, that may otherwise be suitable for conservation, through loss of 19.04 hectares of the habitat for the species.

The surveys conducted for the proposal will contribute to a better understanding of the abundance and distribution of the species in the locality and the conservation priority of populations.

- Environmental management during construction and landscaping associated with the proposal will include weed control and hygiene protocols to minimise weed dispersal, will be designed to minimise risks associated with herbicide use and will not include the use of fertilisers.
- The offset package for the proposal may provide opportunities for linking, enhancing or establishing additional populations.

- While the proposal will interfere with the recovery of the species through removal of individuals and habitat, it may also provide opportunities for increasing the information available about the distribution of the species and its restoration.

Conclusion

Based on the information available, a conservative approach finds this proposal is at moderate risk of causing a significant impact, as defined under the EPBC Act, on *Homopholis belsonii*.

Five-clawed Worm-skink (*Anomalopus mackayi*)

The following information regarding 'important populations' is taken from the EPBC Act Significant Impact Guidelines 1.1.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity, and/or
- Populations that are near the limit of the species range.

Given the difficulty in detecting this species, the Commonwealth environment department considers that an occurrence of important habitat for the Five-clawed Worm-skink is a surrogate for an 'important population' of the species (DoEE, 2018). Known important habitat for the Five-clawed Worm-skink is listed in the Dr*aft Referral guidelines for the nationally listed Brigalow Belt reptiles* (Commonwealth of Australia 2011) and includes:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands.
- Suitable habitat within the Known / Likely-to occur distribution of the species (see Map 3 in Appendix 1 of the report).

Based on this assessment process, much of the vegetation in the study area can be considered important habitat for the Five-clawed Worm-skink. This species is known to be associated with five of the PCTs in the study area, including many areas of grassland. Additionally, all of the proposal is in the middle of the 'likely-to-occur' distribution, with the floodplain area around Bellata also being in the 'known' distribution of the species. Therefore, by this assessment process, the study area is likely to contain an important population of this species within suitable habitat. Considering the length of the proposal boundary, it is also possible that the study area contains multiple populations.

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 proposal will result in the removal of 34.50 hectares of important habitat for a local population/s of the Five-clawed Worm-skink. Any earthworks within areas of suitable habitat could result in direct mortality to individuals. A reduction of available habitat could directly affect the ability of this species to survive (i.e. foraging and breeding life cycle activities) within its local distribution. Without a detailed understanding of the local occurrence of this species, it must be assumed that these impacts associated with the proposal may lead to a long-term decrease in the size of an important population.

Reduce the area of occupancy of an important population

The proposal will result in the removal of 34.50 hectares of important habitat for the Five-clawed Worm-skink. Additionally, there will be a further removal of 34.50 hectares of habitat listed as being associated with this species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. Without a detailed understanding of the local occurrence of this species, it must be assumed that the proposal would reduce the area of occupancy of an important population.

Fragment an existing important population into two or more populations

There is likely to be an increase in distance between patches within the local occurrence due to the increase in the width of cleared land associated with the road. Vegetation and potential habitat within the landscape is

already highly fragmented due to a history of clearing for agricultural purposes and road construction. This species may cross the road surface at night. As the proposal will involve widening of the current road surface, it will reduce east-west habitat connectivity, therefore increasing fragmentation. This may also increase the risk of mortality by vehicle strike. However, considering the, at least partial, barrier created by the existing road surface, the increase in distance between patches of habitat is unlikely to affect the species to such an extent that an existing important population would be split into two or more populations.

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.

On the floodplains within its range in north-eastern New South Wales, the Five-clawed Worm-skink occurs in grasslands and grassy, open woodlands on heavy black and grey, alluvial cracking clay soils from 135–200 m above sea level. Known important habitat for the Five-clawed Worm-skink is listed in the Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (Commonwealth of Australia 2011) and includes:

- All suitable habitat within floodplains and riparian zones, uncultivated grassy headlands and strips between cropped areas, road reserves, travelling stock routes and remnant vegetation on vacant lands.
- Suitable habitat within the Known / Likely-to occur distribution of the species (see Map 3 in Appendix 1 of the report).

This species is known to be associated with five of the PCTs in the study area, including many areas of shrub and grassland. Additionally, all of the proposal is in the middle of the 'likely-to-occur' distribution, with the floodplain area around Bellata also being in the 'known' distribution of the species. Based on this assessment process, much of the vegetation in the study area can be considered habitat critical to the survival of the Five-clawed Worm-skink.

The proposal will result in the removal of 34.50 hectares of important habitat for the Five-clawed Worm-skink. Additionally, there will be a further removal of exotic-dominated grassland habitat listed as being associated with this species. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering its suitability for this species. Table 1 details impact risk thresholds listed specifically for the Five-clawed Worm-skink taken from the *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles* (Commonwealth of Australia 2011). Based on these guidelines, a referral is recommended for impacts to the Five-clawed Worm-skink associated with the proposal.

Table C.2 Referral guidelines

Risk of significant impact	Impact threshold listed for Five-clawed Worm-skink
Example of low-risk significant impact	Clearing two or less hectares of important habitat (providing that important habitat connectivity is not compromised)
Example where uncertainty may arise as to the risk of significant impact	Clearing between two and four hectares of important habitat
Example of high-risk significant impact: referral recommended	Clearing four or more hectares of important habitat

Disrupt the breeding cycle of an important population

Very little is known about the biology of the Five-clawed Worm-skink. Average clutch size or mortality rates for newborns is unknown. One specimen was observed laying three eggs in spring (DoEE, 2018)

The process of habitat removal will reduce areas available for mating, breeding and foraging. Earthworks associated with the proposal may also alter behavioural patterns of this species such that the breeding cycle is disrupted. Without adequate knowledge regarding the breeding biology, the precautionary principle must

be applied and the assumption made that these impacts may disrupt at least one breeding cycle of a local population of the species.

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

Clearing of vegetation associated with the proposal would remove 34.50 hectares of important habitat as defined by the *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*. Approximately 34.50 hectares of habitat listed as being associated with this species is will be impacted by the proposal. Remaining areas of habitat are also likely to be modified by edge effects that may change the soil surface and microhabitat conditions, altering habitat suitability for this species. This clearing will lead to a reduction in habitat

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

The clearing of habitat is recognised as a major factor contributing to the threatened status of the Five-clawed Worm-skink. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. 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 on the Five-clawed Worm-skink or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback and associated degradation of habitat. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interferes substantially with the recovery of the species

There is currently no specific recovery plan for the Five-clawed Worm-skink. This species was included in The Action Plan for Australian Reptiles (Cogger *et. al.* 1993). The recovery plan objectives for this species include:

- 14.1: To obtain sufficient information on the species biology, ecology and distribution to determine its current conservation status and formulate appropriate management strategies,
- 14.2: To ensure that secure, viable populations of the species are maintained within a reserve system
- 14.3: To implement land management practices which promote the maintenance of secure viable populations of the species outside reserves.

The Action Plan for Australian Reptiles (Cogger *et. al.* 1993) is now becoming a relatively old document, although not much has changed regarding the level of understanding of this species' biology. The proposal could be considered as interfering substantially with objective 14.3, through the removal of 34.50 hectares of important habitat.

Conclusion

Based on the information available, a conservative approach finds this proposal is at moderate risk of causing a significant impact, as defined under the EPBC Act, on a viable local population of the Five-clawed Worm-skink.

Koala (*Phascolarctos cinereus*)

The Koala was identified north of the Mehi River in Moree during field surveys but no conclusive evidence was found within the study area. A single previous record is known from the study area (Bellata) and there are multiple other records in the locality, in larger woodland remnants further to the east. Habitat in the study area is likely to be part of the home range of a low-density population. Associated (marginal) habitat present in the study area includes:

- Belah woodland (PCT 55)
- Brigalow viney scrub open forest (PCT 445)
- Carbeen +/- Coolabah grassy woodland (PCT 628)
- Poplar Box - Belah woodland (PCT 56)
- Poplar Box - White Cypress Pine woodland (PCT 397)

Koalas are generally solitary except during the mating season and have a home range of about 3 hectares (although the size of this area is influenced by the distribution, abundance and quality of feeding resources). In the Pilliga State Forest of central-western New South Wales, the average home range is 10–15 ha (Department of Environment and Climate Change 2008). The Office of Environment and Heritage has published regional lists of koala food trees in separate primary and secondary food tree categories. Surveys identified low to high abundances of Koala secondary (Eucalyptus populnea) food trees within the study area Considering the reported home range sizes of this species and the widespread occurrence of feed tree species, a low density population is considered likely to utilise the study area.

There are numerous published criteria for determining the importance of koala habitat, however the most recent, relevant and measureable is the habitat assessment tool described in the EPBC Act referral guidelines for the vulnerable koala (Commonwealth of Australia 2014). Using this tool, impact areas that score five or more contain habitat critical to the survival of the koala. Table C.3 lists the five primary koala habitat attributes, the score given for each criterion and results of the habitat assessment tool for the two vegetation communities within the study area which contain a relatively high proportion of food trees. Several other communities also contain scattered food trees and also contribute to the viability of the landscape as Koala habitat, particularly in relation to their contribution to movement corridors between the main food tree areas. The result indicates that the habitats in the study area are not considered to be habitat critical to the survival of the Koala.

Table C.3 Results of the koala habitat assessment tool for the main habitat types

Attribute	Score and criteria (inland)	Score for habitat in the study area
Koala occurrence	+2 (high) = Evidence of one or more koalas within the last 5 years. +1 (medium) = Evidence of one or more koalas within 2 km of the edge of the impact area within the last 10 years 0 (low) = None of the above.	0 (low) = None of the above. The habitats in the northern section are near the Mehi River where the Koala is known but the majority of habitats are more than 2 km away.
Vegetation composition	+2 (high) = Has forest, woodland or shrubland with emerging trees with 2 or more known koala food tree species, OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata. +1 (medium) = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present. 0 (low) = None of the above.	The habitats in the study area are considered secondary foraging habitats. The secondary feed tree species *Eucalyptus populnea* is most common with some *Eucalyptus pilligaensis* also present. The habitat would score +1 (medium) = Has forest, woodland or shrubland with emerging trees with only 1 species of known koala food tree present.
Habitat connectivity	+2 (high) = Area is part of a contiguous landscape ≥ 1000 ha. +1 (medium) = Area is part of a contiguous landscape < 1000 ha, but ≥ 500 ha. 0 (low) = None of the above.	Habitat connectivity would score 0 (low) = None of the above.
Key existing threats	+2 (high) = Little or no evidence of koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and have no dog or vehicle threat present. +1 (medium) = Evidence of infrequent or irregular koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for koala occurrence, OR Areas which score 0 for koala occurrence and are likely to have some degree dog or vehicle threat present. 0 (low) = Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the study area at present,	The habitats in the study area would score 0 (low) as it is an area that scores 0 for koala occurrence and has a significant vehicle threat present.

Attribute	Score and criteria (inland)	Score for habitat in the study area
	OR Areas which score 0 for koala occurrence and have a significant dog or vehicle threat present.	
Recovery value	+2 (high) = Habitat is likely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. +1 (medium) = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1. 0 (low) = Habitat is unlikely to be important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.	The study area would score +1 (medium) = Uncertain whether the habitat is important for achieving the interim recovery objectives for the relevant context, as outlined in Table 1.
TOTAL		2

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 study area only provides secondary habitat for the Koala and an important population has not been identified. Due to the lack of primary feed tree species the habitat is not considered likely to support a dense Koala population. If a koala population is present, the study area is considered likely to support only a low density Koala population and represents supplementary habitat for transient or dispersing individuals.

The removal of the habitat within the study area is not considered likely to have a large impact on the size of the Koala population as the proposed removal of a small amount of secondary habitat is not considered likely to detrimentally impact an important population. The habitat is not considered critical for the Koala.

Reduce the area of occupancy of an important population

An important population has not been identified in the study area. In NSW, Koalas occur along the coast, extending west to the Darling Riverine Plains and Mulga Lands bioregions in the north of the state; to the Cobar Peneplain bioregion in the centre of the state; and to the Riverina and eastern most parts of the Murray-Darling Depression bioregions in the south. The Proposal will not reduce this area of occupancy of an important population.

Fragment an existing important population into two or

The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. However, the proposal will not fragment the Koala population into two or more populations.

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 are numerous published criteria for determining the importance of koala habitat, however the most recent, relevant and measureable is the habitat assessment tool described in the *EPBC Act referral guidelines for the vulnerable koala* (Commonwealth of Australia 2014). Using this tool, impact areas that score five or more contain habitat critical to the survival of the koala. The result for the study area indicates that the habitats in the study area are not considered to be habitat critical to the survival of the Koala (see Table C.3).

Disrupt the breeding cycle of an important population

The study area does not contain any breeding habitat for the Koala. There would be a minor impact on secondary foraging habitat but the habitat within the study area is not considered high enough quality to support a sedentary breeding population. No impacts to breeding Koalas are predicted.

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

The impacts from the proposal are limited to removal of secondary Koala habitat. Clearing of vegetation associated with the proposal would remove approximately 13.71 hectares of marginal habitat for this species. The habitat removal includes:

- Belah woodland (0.98 ha - intact)
- Brigalow viney scrub open forest (0.66 ha - intact)
- Carbeen +/- Coolabah grassy woodland (2.98 ha intact)
- Poplar Box - Belah woodland (3.64 ha - intact)
- Poplar Box - White Cypress Pine woodland (8.21 ha - intact)

Vegetation and potential habitat within the landscape is already highly fragmented due to a history of clearing for agricultural purposes. Generally, the only option for Koalas to access vegetation containing *E. populnea* on both sides of the road is by crossing the road. As the proposal will involve widening of the current road corridor, it will reduce east-west habitat connectivity through increased habitat isolation. However, this habitat removal, modification and isolation is not likely to cause the species to decline in itself.

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

Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. 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 on the Koala or its habitat.

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. The proposal is considered unlikely to introduce or result in the spread of chlamydiosis or Koala Retrovirus.

Interferes substantially with the recovery of the species

The Threatened Species Scientific Committee identifies threat abatement actions that would support the recovery of the Koala in Queensland, NSW and the ACT, including:

- Develop and implement a development planning protocol to be used in areas of Koala sub-populations or sub-population fragments to prevent loss of Koala sub-populations, habitat critical to the survival of the species and vital habitat connectivity.
- Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat.
- Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them, if necessary.
- Identify populations of high conservation priority.
- Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations, including inland regions in which Koala populations were diminished by drought and coastal regions where development pressures have isolated Koala populations.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and, for both Crown and private land, investigate and/or secure inclusion of habitat critical to the survival of the Koala in reserve tenure, if possible.

- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.
- Manage any other known, potential or emerging threats such a Bell Miner (Manorina melanophrys) Associated Dieback or Eucalyptus rust.

The proposal is not expected to interfere substantially with the recovery actions identified for the Koala as listed above.

Conclusion

The Koala will suffer a reduction in extent of suitable secondary habitat from the proposal. No primary foraging habitat will be affected. No known breeding habitat will be affected. The proposal is considered unlikely to reduce the population size of the Koala or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Koala. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Koala.

Painted Honeyeater (*Grantiella picta*)

The following information regarding 'important populations' is taken from the EPBC Act Significant Impact Guidelines 1.1.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

No important populations have been identified for the Painted Honeyeater. The species exhibits seasonal north-south movements governed principally by the fruiting of mistletoe, with which its breeding season is closely matched (Barea and Watson, 2007). Many birds move after breeding to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. Considering its dispersive habits, the species is considered to have a single population.

This species was not identified during field surveys, however there were no areas of vegetation containing profusely fruiting or flowering resources at the time, which limited the detectability of this species. There are nine recorded sightings on the Bionet Atlas database from the search area, mostly from Killarney State Conservation Area and one on Millie Rd (east of Bellata). Birdline also contains multiple sightings in the area.

Many of the vegetation types in the study area along the Newell Highway present suitable habitat for the Painted Honeyeater, including areas with a high abundance of mistletoe species. Based on the presence of suitable habitat and location of nearby records, it is moderately likely that an important population of the Painted Honeyeater uses habitat in the study area.

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 Painted Honeyeater is likely an occasional visitor in the study area, coming in to feed on flowering and fruiting resources when available. This species may also nest in the study area, though nesting is generally reported from areas that contain a high abundance of mistletoes, e.g. 10 per tree (Barea 2008), which was not a common feature of vegetation in the study area. A reduction in 16.08 hectares of suitable foraging habitat with some nesting opportunities for the Painted Honeyeater along the current alignment will impact the feeding and possibly the breeding of this species. There are likely areas in the locality containing a higher prevalence of mistletoes more suitable for nesting. Any individuals that use vegetation in the study area are likely passing through the landscape while foraging. It is unlikely that the proposal will have adverse effect on the life cycle of the species that will lead to a long-term decrease in an important population.

Reduce the area of occupancy of an important population

The area of occupancy of this species is estimated to be 1000 km^2. The proposal is predicted to remove around 16.08 hectares of foraging habitat for the Painted Honeyeater across the whole proposal. Some

areas of this may also present nesting opportunities. The study area lies close to the centre of the likely distribution of this species. The potential for this species to occur in the area is not expected to be impacted by the proposal. The proposal is unlikely to reduce the area of occupancy of the population.

Fragment an existing important population into two or more populations

The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape. The proposal is unlikely to Fragment an existing important population into two or more populations.

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.

No critical habitat has been identified for the Painted Honeyeater. The Painted Honeyeater is a widely nomadic species that travels throughout its range in search of fruiting and flowering resources. Vegetation that will be impacted by the proposal includes mostly foraging habitat for the Painted Honeyeater. No areas considered to contain a high prevalence of mistletoes were observed, i.e. mean of 10 per tree (Barea 2008), so the impact to potential nesting habitat is likely to be minor. Vegetation in the study area is likely to be important for individuals travelling through the landscape. Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposal is unlikely to be habitat critical to the survival of the Painted Honeyeater.

Disrupt the breeding cycle of an important population

The Painted Honeyeater is likely an occasional visitor in the study area, coming in to feed on flowering and fruiting resources when available. This species may also nest in the study area, though nesting is generally reported from areas that contain a high abundance of mistletoes, e.g. 10 per tree (Barea 2008), which was not a common feature of vegetation in the study area. A reduction in 16.08 hectares of suitable foraging habitat with some nesting opportunities for the Painted Honeyeater along the current alignment will impact the feeding and possibly the breeding of this species, however the study area is unlikely to be an important breeding location. There are likely areas in the locality containing a higher prevalence of mistletoes more suitable for nesting. Any individuals that use vegetation in the study area are likely passing through the landscape while foraging. It is unlikely that the proposal will disrupt the breeding cycle of an important population.

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

The proposal is predicted to remove around 16.08 hectares of foraging habitat for the Painted Honeyeater. Some areas of this may also present nesting opportunities. There may be additional indirect impacts to remaining areas of habitat due to edge effects.

The patches of habitat are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments. However, it is likely to increase the distance between the remaining fragments, as the distance between patches on either side of road would be increased, resulting in increased isolation. For highly mobile species like birds, this is not a large problem, however the reduction of suitable habitats into small isolated patches inhibits movement throughout the landscape.

Considering the amount of higher value vegetation in the region (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas), the habitat that will be impacted by the proposal 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

Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. 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 on the Painted Honeyeater or its habitat.

Introduce disease that may cause the species to decline

Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the proposal has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species as it may lead to a reduction in the quality of the soil surface microhabitat. This can be suitably mitigated through the development and implementation of suitable control measures for vehicle and plant hygiene such as the current best practice hygiene protocols as detailed in RTA (2011).

Interferes substantially with the recovery of the species

There is currently no specific recovery plan for the Painted Honeyeater. This species was included in The Action Plan for Australian Birds 2010 (Garnett *et al.* 2011). The recommended actions for this species that relate to the proposal include:

- 11.3: Protect all woodland in which Painted Honeyeaters have been recorded regularly from clearing, and monitor compliance biennially.
- 11.4: Secure all Painted Honeyeater sub-populations found on public land through conservation management, particularly those in timber reserves, or transport corridors or on local government land.
- 11.5: Within the honeyeater's range manage at least 15% of the pre-European area of all woodland communities on public or private land for nature conservation, using incentives where necessary.
- 11.6: Using appropriate incentives, undertake extension with land-holders that have suitable woodland habitat to promote sound management of remnants and encourage greater connectivity between sub-populations.
- 11.7: Promote revegetation and land reclamation that recreates woodland habitat with a full complement of biodiversity, including the honeyeater.
- 11.8: Control and reduce firewood collection from areas occupied by Painted Honeyeaters, promoting wood-lot development close to markets, and reduce grazing densities where necessary.

The proposal would interfere with the first of these actions as it would impact 16.08 hectares of suitable foraging habitat for the Painted Honeyeater. However, the number of records of this species in the locality may not be classified as a regular occurrence.

These recommended actions primarily relate to actions for the government to complete. There may be opportunities to contribute to revegetation works associated with the proposal. Mitigation measures for the proposal would be designed to ensure that the proposal does not interfere with the remaining actions relating to fertilisers and weeds.

Conclusion

The proposal is considered unlikely to have a significant adverse effect on the Painted Honeyeater due to the relatively low impact on habitat resources when the amount of higher value habitat in the region is considered (i.e. Pilliga National Park, Mount Kaputar National Park and nearby conservation areas). The proposal is unlikely to place the Painted Honeyeater at a significantly elevated risk of extinction.

Remaining species – table format tests

Species assessed	Vulnerable species significant impact criteria An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:									Conclusion
	Lead to a long-term decrease in the size of an important population of a species	Reduce the area of occupancy of an important population	Fragment an existing important population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduce disease that may cause the species to decline, or	Interfere substantially with the recovery of the species.	
Corben's Long-eared Bat	Hollow-bearing trees are a common feature of the vegetation in the study area and are likely to present suitable roosting habitat for the Corben's Long-eared Bat. There is unlikely to be a maternity roost in the study area. The works are unlikely to lead to a long-term decrease in the size of an important population of this species as breeding won't be impacted.	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments.	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated PCTs/habitat, the proposed works will remove about 16.74 ha of potential roadside foraging habitat for the Corben's Long-eared bat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. 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	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.	Recovery of this species will not be affected by the proposal.	Not significant
Superb Parrot	The study area is in the very north of the migration range for this species and is likely only used on occasion for foraging and roosting by birds during seasonal	Current area of occupancy will not be affected.	The works will not result in fragmentation of habitat for the Superb Parrot. This species is highly mobile and will freely	No habitat critical to this species will be affected.	No breeding habitat is present in the impact area.	Based on associated PCTs/habitat, the proposed works will remove about 48.01 ha of foraging habitat. This impact is low	Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the	There are no known disease issues affecting this species in relation to the proposal. The proposal would be unlikely to	Recovery of this species will not be affected by the proposal.	Not significant

Species assessed	Vulnerable species significant impact criteria An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:									Conclusion
	Lead to a long-term decrease in the size of an important population of a species	Reduce the area of occupancy of an important population	Fragment an existing important population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduce disease that may cause the species to decline, or	Interfere substantially with the recovery of the species.	
	migration (i.e. non-breeding season). 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 lead to a long-term decrease in the size of an important population of this species as breeding won't be impacted.		fly long distances over open areas to move between roost sites and foraging sites.			in terms of the available habitat in the locality and not likely to result in the decline of this species.	proliferation of invasive species. 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	increase feral animal abundance or the potential for significant disease vectors to affect local populations.		

Species assessed	Vulnerable species significant impact criteria An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:									Conclusion
	Lead to a long-term decrease in the size of an important population of a species	Reduce the area of occupancy of an important population	Fragment an existing important population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduce disease that may cause the species to decline, or	Interfere substantially with the recovery of the species.	
Lepidium aschersonii	Not known form the study area but suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals, however the works are unlikely to lead to a long-term decrease in the size of an important population of this species.	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments.	No habitat critical to this species will be affected.	Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.	Based on associated PCTs/habitat, the proposed works will remove about 7.08 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	Habitat loss is a key threat to this species. The associated indirect impacts of this key threatening process are well documented and include increased potential for the proliferation of invasive species. 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	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.	Recovery of this species will not be affected by the proposal.	Not significant

Species assessed	Vulnerable species significant impact criteria An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:									Conclusion
	Lead to a long-term decrease in the size of an important population of a species	Reduce the area of occupancy of an important population	Fragment an existing important population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduce disease that may cause the species to decline, or	Interfere substantially with the recovery of the species.	
Swainsona murrayana	Not known form the study area but suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals, however the works are unlikely to lead to a long-term decrease in the size of an important population of this species.	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments.	No habitat critical to this species will be affected.	Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.	Based on associated PCTs/habitat, the proposed works will remove about 50.28 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	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.	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.	Recovery of this species will not be affected by the proposal.	Not significant
Tylophora linearis	Not known form the study area but suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals, however the works are unlikely to lead to a long-term decrease in the size of a population of this species.	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments.	No habitat critical to this species will be affected	Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.	Based on associated PCTs/habitat, the proposed works will remove about 8.21 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	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.	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.	Recovery of this species will not be affected by the proposal.	Not significant

Species assessed	Vulnerable species significant impact criteria An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:									Conclusion
	Lead to a long-term decrease in the size of an important population of a species	Reduce the area of occupancy of an important population	Fragment an existing important population into two or more populations	Adversely affect habitat critical to the survival of a species	Disrupt the breeding cycle of an important population	Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduce disease that may cause the species to decline, or	Interfere substantially with the recovery of the species.	
Lepidium monoplocoides	Not known form the study area but suitable habitat present. The removal of vegetation may result in the direct mortality of a small number of individuals, however the works are unlikely to lead to a long-term decrease in the size of a population of this species.	Current area of occupancy will not be affected.	The patches of habitat in the study area are already somewhat fragmented and isolated by the existing Newell Highway. The proposal is unlikely to break the local occurrence into more fragments.	No habitat critical to this species will be affected	Unknown if breeding cycle would be interrupted as this species was not recorded in the study area.	Based on associated PCTs/habitat, the proposed works will remove about 19.02 ha of potential habitat. This impact is low in terms of the available habitat in the locality and not likely to result in the decline of this species.	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.	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.	Recovery of this species will not be affected by the proposal.	Not significant

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