

Singleton bypass

Technical working paper: Biodiversity Assessment

Roads and Maritime Services | November 2019

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Prepared by

Umwelt (Australia) Pty Limited for AECOM Australia Pty Ltd and Roads and Maritime Services

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Executive summary

Roads and Maritime Services (Roads and Maritime) is proposing to build a New England Highway bypass of Singleton, NSW (the proposal). The proposal is a two-lane highway located to the west of Singleton. The proposal connects to the New England Highway in Whittingham, to the south of Singleton, and to the north of Singleton near McDougalls Hill.

The proposal will include about eight kilometres of new highway with a single lane in each direction and seven bridges including one bridge over the Hunter River.

The proposal area is 257.7 hectares in size and would disturb up to approximately 31.9 hectares of remnant vegetation and disturbed land.

Threatened species, populations and threatened ecological communities

- Nine threatened fauna species as listed under the *Biodiversity Conservation Act* 2016 (BC Act) were confirmed present within the proposal area through targeted fauna surveys, being little eagle (*Hieraaetus morphnoides*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), eastern coastal free-tailed bat (*Micronomus norfolcensis*), little bent-winged bat (*Miniopterus australis*), large bent-winged bat (*Miniopterus orianae oceanensis*), southern myotis (*Myotis macropus*), squirrel glider (*Petaurus norfolcensis*), brush-tailed phascogale (*Phascogale tapoatafa*) and grey-headed flying-fox (*Pteropus poliocephalus*). An additional four species were recorded as potentially occurring, being masked owl (*Tyto novaehollandiae*), eastern false pipistrelle (*Falsistrellus tasmaniensis*), greater broad-nosed bat (*Scoteanax rueppellii*) and eastern cave bat (*Vespadelus troughtoni*).
- One endangered population is present in the proposal area, outside of the impact area, comprising river red gum (*Eucalyptus camaldulensis*) in the Hunter Catchment endangered population (BC Act)
- Two threatened ecological communities (TEC) as listed under the BC Act were recorded within the proposal area, comprising *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions* EEC (BC Act) and *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC (BC Act)
- One TEC as listed under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) was recorded in the proposal area, comprising *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act)
- Two TECs are predicted to occur in the proposal area based on regional vegetation mapping, comprising the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregion* EEC (BC Act) and *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions* EEC.

Summary of likely impacts on biodiversity values

- Potential impact to ecological values include removal of up to 1.22 hectares of *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregion* EEC (BC Act), 13.98 hectares of *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC (BC Act) and 16.89 hectares of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act)

Summary of significance assessments

- An Assessment of Significance under Section 7.3 of the BC Act was undertaken for 19 threatened fauna species, one endangered flora population, and two TECs recorded or with high potential to occur in the proposal area. It is unlikely that the proposed work would significantly impact these species, population or communities.
- An Assessment of Significance under the EPBC Act was undertaken for five threatened fauna species, one migratory species and one TEC recorded or with high potential to occur in the proposal area. It is likely that the proposed work would significantly impact the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act).
- An Assessment of Significance under Section 220ZZ of the *Fisheries Management Act* 1994 FM Act was conducted for one threatened species being the southern purple-spotted gudgeon (*Mogurnda adspersa*) which has potential to occur in the Hunter River. It is unlikely that the proposed work would significantly impact this species

Key mitigation measures to minimise impact to biodiversity

- Preparation of a Construction Environmental Management Plan
- Ground-truthing surveys to be undertaken between the Hunter River and the southern extent of the area surveyed by Umwelt (2019), north of the New England Highway near Gowrie Gates
- Minimisation of vegetation removal through further detailed design
- Pre-clearance surveys
- Preparation of a nest box strategy to account for the loss of hollow-bearing trees
- Preparation of a wildlife connectivity strategy
- Preparation of a specific microbat management plan (if required)
- Aquatic habitat protection
- Preparation of a Biodiversity Offset Strategy to compensate for residual impacts from the proposal.

Assumptions or limitations

Where vegetation within the proposal area was not surveyed and mapped by Umwelt or others, the Upper Hunter State Vegetation mapping (OEH 2019b) has been used. Ground-truthing of the vegetation in these areas would be required prior to the commencement of construction.

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Terms and acronyms used in this technical working paper

Terms and acronyms used in this report

Term / Acronym	Description
BAM	Biodiversity Assessment Methodology
BC Act	<i>Biodiversity Conservation Act 2016</i> (NSW)
BCD	Biodiversity Conservation Division (Department of Planning, Industry and Environment)
CEMP	Construction Environmental Management Plan
DoEE	Department of the Environment and Energy (Federal)
DPIE	Department of Planning, Industry and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Federal)
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
GDE	Groundwater dependent ecosystem
IBRA	Interim Biogeographically Regionalisation of Australia
MNES	Matter of National Environmental Significance
OEH	Office of Environment and Heritage (now BCD)
PCT	Plant Community Type
REF	Review of Environmental Factors
SEPP	State Environmental Planning Policy
TEC	Threatened Ecological Community
TSPD	Threatened Species Profile Database
VIS	Vegetation information system

1 Introduction

1.1 Proposal background

Roads and Maritime Services (Roads and Maritime) propose to build a New England Highway bypass of Singleton (the proposal). The proposal is a two-lane highway bypass located to the west of Singleton.

The proposal is located in the Singleton local government area (LGA) in the Hunter Valley, 75 kilometres inland from Newcastle, 47 kilometres south-east of Muswellbrook and 200 kilometres from Sydney (Figure 1.1).

The New England Highway currently passes through Singleton and forms the main road access through the town and to the town centre. More than 28,000 vehicles, including over 3700 heavy vehicles, use the highway through Singleton each day. In recent years, traffic growth has been high with the coal mining industry commuters and heavy vehicles identified as a major contributor. Traffic volumes are predicted to further increase as a result of population growth, future land developments in and around Singleton and general increase of freight movement across the region.

The New England Highway through Singleton is a two-lane road with the corridor restricted by numerous intersections and adjacent buildings with minimal setback from the road. The road performance of the highway through Singleton is expected to gradually worsen over time with increasing traffic volumes. Road users are already experiencing traffic congestion and increased travel times through this corridor, as well as safety issues on the highway through the town.

A bypass at Singleton would improve traffic flow, travel times and safety through Singleton by reduced traffic volumes and improve the movement of heavy freight vehicles.

1.2 The proposal

Proposal area

The proposal would depart the New England Highway near Newington Lane in Whittingham then head west over the Main North railway line across the Hunter River floodplain over Putty Road. It would continue over the Hunter River, west of Singleton, before crossing the New England Highway to the west of the Gowrie Gates and continue north before re-joining the highway north of McDougalls Hill (Figure 1.2). This covers a total of 257.73 hectares and is hereafter referred to as the proposal area.

Key features

The proposal, as assessed in this Biodiversity Assessment, would include the following key features:

- Approximately eight kilometres of the bypass of Singleton with a single lane in each direction
- Connection with the New England Highway at the southern end of the proposal, including a southbound entry ramp and northbound exit ramp only (the southern connection)
- A 55 metre long bridge over the bypass at the southern connection
- A 1.7 kilometre long bridge over the Main North railway line, Doughboy Hollow and Hunter River floodplain, Army Camp Road and Putty Road (bridge over the floodplain)

- Connection to Putty Road including a northbound entry ramp and southbound exit ramp (the Putty Road connection)
- A 40 metre bridge over the entry ramp at the Putty Road connection
- A 100 metre bridge over Rose Point floodway
- A 205 metre bridge over the Hunter River
- A 40 metre bridge over the New England Highway west of the existing Main North railway line overbridge (known as Gowrie Gates)
- Connection with the New England Highway at Gowrie Gates consisting of a southbound entry ramp and northbound exit ramp. The northbound exit ramp would connect to the New England Highway via a new roundabout intersection at Maison Dieu Road
- A 1.7 kilometre northbound climbing lane between Gowrie Gates and the northern connection
- Connection at Magpie Street providing access to the nearby industrial area (the northern connection), consisting of a southbound entry ramp, southbound exit ramp and northbound entry ramp
- A 60 metre long bridge over the bypass at the northern connection.

Additional features

The proposal would also include the following additional features:

- Demolition of buildings
- Vegetation clearing
- Tie-in work with the New England Highway at the northern and southern ends of the proposal
- Tie-in work with Putty Road and the New England Highway at Gowrie Gates
- Closure of Waterworks Lane intersection with Putty Road
- Utility adjustment or relocation, including electricity, water and sewerage, gas and telecommunications
- Operational spill containment basins
- Drainage infrastructure
- Boundary fencing
- Noise walls
- Headlight screen at the southern connection
- Provision of permanent access roads for maintenance activities
- A heavy vehicle stopping bay at the southern connection
- Diversion of an ephemeral creek line north of the Hunter River
- Creek bank stabilisation work near Hunter River bridge northern abutment
- Upgrade to access between Newington Lane and the New England Highway
- Property access adjustments
- Earthworks including construction of embankments
- Temporary ancillary facilities during construction including site offices, site compounds, laydown areas, and temporary access tracks
- An aerial crossing for fauna
- Finishing roadworks including pavement, road stabilisation, kerb and gutter, signage, lighting and line marking works
- Demobilisation of ancillary facilities following the completion of the construction of the proposal
- Landscaping works.

These features will cover an area of 109.69 hectares, hereafter referred to as the impact area (Figure 1.2).

Ancillary facilities

The following construction ancillary facilities sites have been identified for the proposal:

- Southern connection laydown area, located west of the New England Highway at the southern extent of the proposal
- Army Camp Road laydown area, located west of Army Camp Road
- Waterworks Lane construction compound, located on both sides of Waterworks Lane, between the Main North railway line to the east and the Putty Road connection to the west
- Gowrie Gates construction compound, located south of the existing Main North railway line bridge over the New England Highway
- Northern connection construction compound, located east of the existing New England Highway west of the Main North railway line.
- McDougalls Hill facility located in the McDougalls Hill industrial estate to the west of the New England Highway.

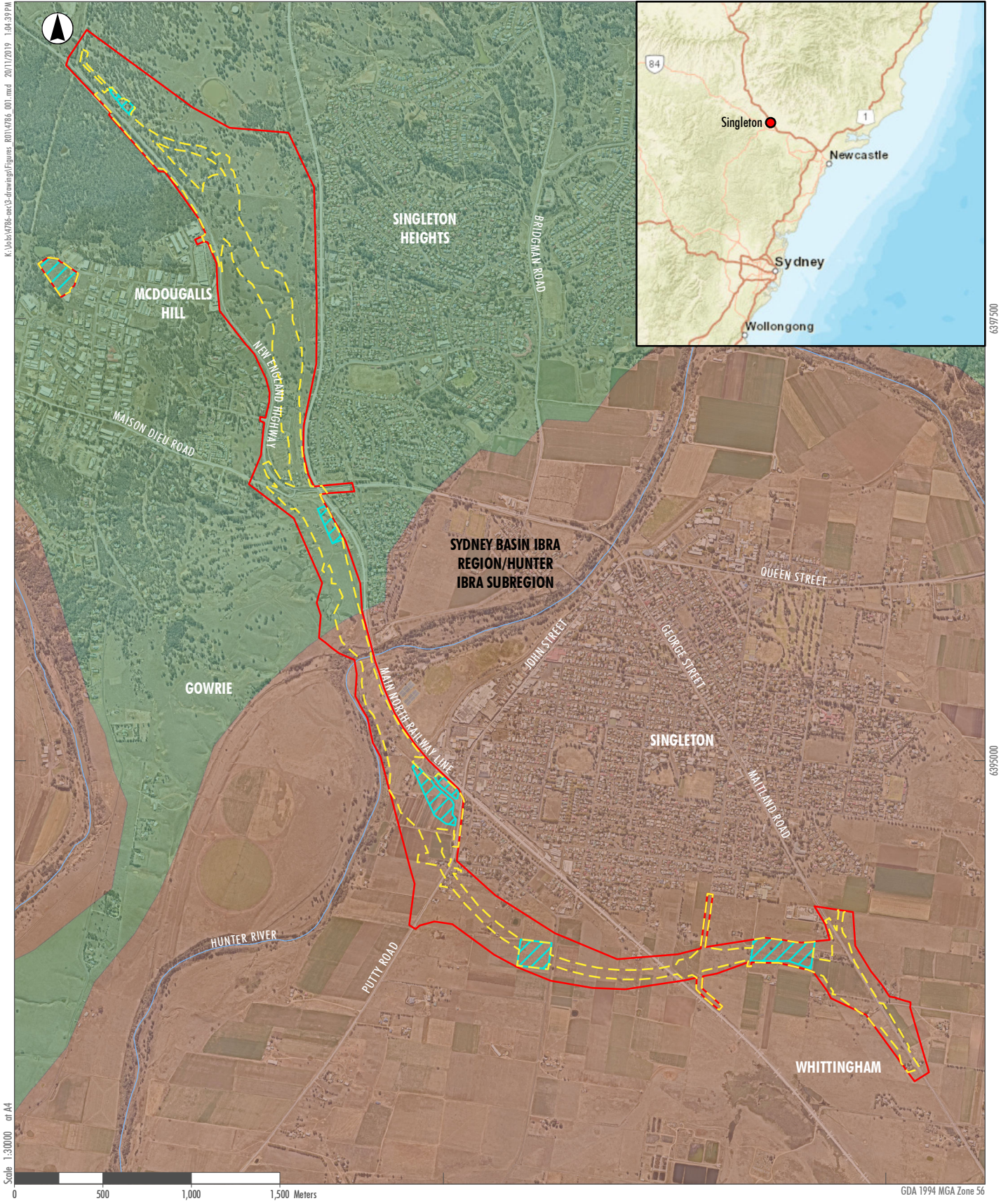
Vegetation clearing

Most of the clearance of native vegetation would occur in the northern end of the proposal to the north of the Gowrie Gates. Clearing trees along the Hunter River for the new bridge and some clearing of isolated paddock trees south of the Hunter River would also be required.

Vegetation clearing would include:

- Identification and marking out of clearing limits and hollow bearing trees
- Identification of suitable habitat features nearby for release of fauna that may be encountered during clearing
- Checking for the presence of fauna species onsite immediately prior to clearing and relocate if there is the potential for the animal to be disturbed or injured
- Clearing of non-hollow bearing trees including removal of stumps (trees in riparian zones would have their stumps retained wherever possible)
- Checking tree hollows for fauna and then removal of the habitat trees at least 24 hours after clearing non-hollow bearing trees
- Reuse of hollows and woody debris for habitat improvement or vegetation and mulch in rehabilitation.

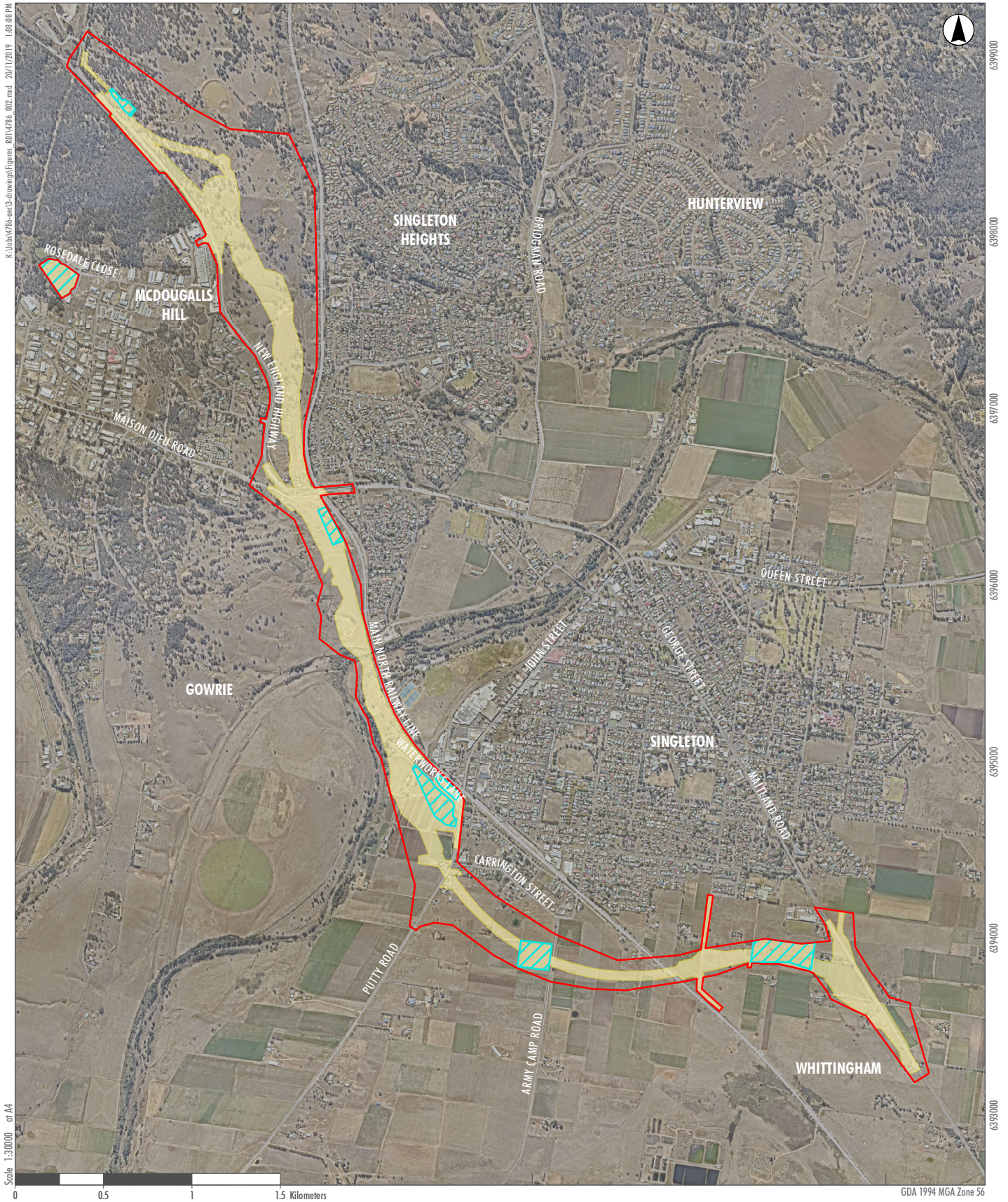
A total of approximately 31.93 hectares of native vegetation would be cleared.



- Scale 1:30,000 at A4
- 0 500 1,000 1,500 Meters
- Legend**
- Proposal Area
 - Impact Area
 - Ancillary Facilities
- Mitchell Landscapes**
- Central Hunter Foothills
 - Central Hunter Alluvial Plains

FIGURE 1.1

Location of the Proposal



- Legend**
- Proposal Area
 - Impact Area
 - Ancillary Facilities

FIGURE 1.2
The Proposal Area

Construction of the bridge over the Hunter River

The construction of a 205-metre-long bridge over the Hunter River is constrained by the river channel and the steep banks lining the river to the north. A detailed work methodology for the construction of the bridge would be determined during detailed design, however an indicative methodology is provided below:

- Diversion of the waterway in the impact area, to the north of the Hunter River to facilitate construction access. This third order waterway discharges into the Hunter River on the northern bank of the Hunter River in the impact area
- Construction of temporary access roads to access the northern and southern bridge abutments
- Construction of a temporary access ramp, from the temporary access track down to the southern river bank, to access the sand bed. The northern abutment would be accessed via the alignment of the bypass
- Establishment of a crane pad near the river bank to place pre-cast bridge structural components
- Construction of a temporary rock platform within the Hunter River to provide access for construction of the in-river pier. The rock platform would be constructed adjacent to the Hunter River bridge of the Main North railway line from the southern bank of the Hunter River. The banks would be protected by geotextile material with clean rock overlay, or similar to protect them from tracked equipment including cranes required to access the instream platform to lift the bridge bidders into place. The final dimensions of the platform would be confirmed during detailed design. A silt curtain would be installed around the rock platform. The platform would be constructed to minimise blocking the main river channel and to ensure that flow of the main river channel and fish passage is maintained even during low flow periods.
- Construction of pile casings in the river to prevent the riverbed from collapsing into the excavation
- Excavation of casing and construction of concrete pile
- Pier and superstructure construction through the use of cranes on either side of the Hunter River.

This work would result in alteration of fish passage, dredging and deposit of material in the river. The indicative methodology represents a worst-case approach to the construction of the bridge regarding potential disturbance area and overall impact.

Lighting

New roadway lighting or adjustments to existing lighting would be provided at the Putty Road connection, New England Highway connection at Gowrie Gates, and the northern connection adjacent to Magpie Street. Lighting would be designed in accordance with relevant guidelines and standards to minimise light spillage into residential properties and minimise glare that could impact on driver visibility. Lighting would be further refined during the detailed design phase.

1.3 Legislative context

A Review of Environmental Factors (REF) is prepared to satisfy Roads and Maritime's duties under section 5.5 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.5.5 of the EP&A Act in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared by AECOM for the New England Highway bypass of Singleton and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Section 1.7 of the EP&A Act require that the significance of the impact on threatened species and endangered ecological communities listed under the BC Act and/or *Fisheries Management Act 1974* (FM Act) is assessed using a five-part test (Section 7.3 of the BC Act) and seven-part test (Section 221ZV of the FM Act), respectively. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Director-General's requirements or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the EPBC Act. The approval applies to Roads and Maritime activities being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. As a result, Roads and Maritime proposals assessed via a 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 (DoEE) for these matters, even if the activity is likely to have a significant impact.

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).

2 Methods

2.1 Personnel

Eco Logical Australia (ELA) Ecologist Tom Schmidt and Principal Ecologist Martin Sullivan conducted flora and fauna surveys within the proposal area between February 2018 and May 2019.

Niche Senior Ecologist, Radika Michniewicz (Bachelor of Science (Hons), PhD) and Ecologist Rhidian Harrington (Bachelor of Science (Hons), MSc, PhD, accredited Biodiversity Assessment Method (BAM) Assessor) conducted habitat surveys and BAM surveys adjacent to the proposal area in August 2019.

Umwelt (Australia) Pty Ltd (Umwelt) Principal Ecologist Ryan Parsons (Bachelor of Environmental Science and Management (Hons), accredited BAM Assessor) and Senior Ecologist Trish Robinson (Bachelor of Science (Hons), accredited BAM Assessor) conducted vegetation surveys across the northern portion of the proposal area on 21, 24, 25 and 27 June 2019.

Technical direction and review was provided by Umwelt's National Ecology Leader Travis Peake (Bachelor of Natural Resources Hons, accredited BAM Assessor) and Umwelt's Principal Ecologist/Environmental Scientist, Naomi Buchhorn (Bachelor of Science Hons I).

2.2 Background research

The ecological desktop assessment included a review of relevant and publicly available literature and background information to identify threatened and migratory species, endangered populations and threatened ecological communities (TECs) (or their habitats) that had previously been recorded within, or near to, the proposal area. The following searches were completed by ELA:

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database (OEH 2019a) within a 10 kilometre radius of the proposal area (the locality), accessed by ELA in February 2018 and June 2019
- NSW Department of Primary Industries (DPI) Fisheries Fish Records Viewer, accessed by ELA in February 2018
- Department of the Environment and Energy (DoEE) Protected Matters Search Tool (PMST) for known/predicted EPBC Act listed TECs (DoEE 2019) within a 10 kilometre radius of the proposal area, accessed by ELA in February 2018
- Commonwealth critical habitat register, accessed by ELA in February 2018
- The federal Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE), accessed by ELA in February 2018
- DoEE directory of important wetlands, accessed by ELA in February 2018
- DPI database for aquatic TECs, accessed by ELA in February 2018
- DPI Key Fish Habitat mapping, accessed by ELA in February 2018.

The following additional resources were also reviewed by Umwelt in June and September 2019:

- OEH vegetation information system (VIS) database, accessed by Umwelt in June 2019
- The Vegetation of the Central Hunter Valley, NSW (Peake 2006)
- Greater Hunter Native Vegetation Mapping (Sivertsen et al. 2011)
- State Vegetation Type Map: Upper Hunter (OEH 2019b)
- Digital imagery (aerial photography) of the proposal area.
- Atlas of NSW Wildlife Database (OEH 2019a) within a 10 kilometre radius of the proposal area (the locality), accessed by Umwelt in September 2019
- DoEE PMST search accessed by Umwelt in September 2019 (Appendix A).

The PMST report generated in September 2019 listed a total of 20 threatened fauna species (including eight mammals, three frogs and nine birds), 11 threatened flora species, six TECs and 15 migratory species as being previously recorded or predicted to occur within a 10 kilometre radius of the proposal area. The Atlas of NSW Wildlife Database identified 30 threatened fauna species and five threatened flora species within a 10 kilometre radius of the proposal area.

DPI Key Fish Habitat identified the southern purple-spotted gudgeon (*Mogurnda adspersa*) Key Fish Habitat is mapped in the proposal area. The species is listed as endangered in NSW under the *Fisheries Management Act 1994* (FM Act). No critical habitat was identified within the proposal area (DoEE 2019). The Hunter River is mapped on the NSW Biodiversity Values Map (OEH 2019c). No declared areas of outstanding biodiversity value (BC Act) are located in, or near to, the proposal area.

2.3 Habitat assessment

A desktop habitat assessment of likelihood of occurrence of threatened species was undertaken by ELA using the results of the background research and field surveys. The likelihood of occurrence of these species and TECs within the proposal area was assessed based on the categories provided in Table 2.1.

Table 2.1 Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	Threatened species was observed in the proposal area during the current survey
High	It is highly likely that a threatened species inhabits the proposal area and is dependent on identified suitable habitat
Moderate	Potential habitat is present in the proposal area.
Low	It is unlikely that threatened species inhabits the proposal area and has not been recorded recently in the locality (10km).
None	Suitable habitat is absent from the proposal area.

The likelihood of occurrence table is located in Appendix C with updates made by Umwelt.

2.4 Field survey

Field surveys have been completed in the proposal area over multiple seasons by ELA, Niche and Umwelt. These surveys have considered the requirements of a number of survey guidelines where relevant, including:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)
- Biodiversity Assessment Method 2017 (OEH 2017a)

2.4.1 Vegetation surveys

Umwelt Vegetation Surveys

Umwelt conducted a total of 16 vegetation integrity plots and 21 rapid vegetation assessment points across the northern section of the proposal area (refer to Figure 2.1). Vegetation integrity plots and rapid vegetation assessment points were undertaken over four days on 21, 24, 25 and 27 June 2019. The location of each vegetation integrity plot was recorded using a hand-held GPS and the rapid vegetation assessment points were recorded using the Collector application for ArcGIS, with a general accuracy of ± 5 metres.

At each vegetation integrity plot, data was recorded according to Section 5 of the BAM (OEH 2017a). This involved setting out 20 by 50 metre, 20 by 20 metre and one by one metre plots.

At each vegetation integrity plot, approximately 45 to 60 minutes was spent searching for all vascular flora species present within the 20 by 20 metre plot. Searches of each 20 by 20 metre plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which usually supported well over half of the species present, however the composition of any shrub, mid-storey, canopy and emergent layers were also thoroughly examined.

For each flora species recorded in the vegetation integrity plot, the following data was collected in accordance with Table 2 of the BAM (OEH 2017a):

- Stratum/layer in which the species occurs
- Growth form
- Scientific name and common name
- Cover
- Abundance.

At each vegetation integrity plot the following attributes were also recorded in accordance with the BAM (OEH 2017a):

- **Composition** – native plant species richness by growth form (within the 20 by 20 metre plot)
- **Structure** – estimate foliage cover of native and exotic species by growth form (within the 20 by 20 metre plot)
- **Function** – (within the 20 by 50 metre plot) including number of large trees, presence or otherwise of tree stem size classes, presence or otherwise of canopy species regeneration, length of fallen logs, percentage cover for litter (recorded from five one by one metre plots), number of trees with hollows and high threat exotic plant cover.

Table 2.2 outlines the floristic survey effort in the proposal area.

Table 2.2 Adequacy of Vegetation Survey in the Proposal Area

Veg. Zone	Plant Community Type (PCT) ID and Common Name <i>Condition Class</i>	Proposal area (ha)	Impact area (ha)	Number of Vegetation Integrity Plots		Number of Rapids Completed
				Required	Completed	
1	1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter <i>Moderate to Good Condition</i>	0.47	Nil	1	1	0
2	1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter <i>Derived Native Grassland</i>	0.22	Nil	1	1	0
3	1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter <i>Moderate to Good Condition</i>	19.45	5.34	3	3	9
4	1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter <i>Thinned Canopy</i>	11.46	6.35	3	4	5
5	1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter <i>Derived Native Grassland</i>	50.16	14.21	5	5	3
6	1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter <i>African Olive Infestation</i>	1.14	Nil	1	1	1
n/a	Exotic Grassland	0.84	0.33	1	1	1
n/a	Cleared land, Dam and Swamp Oak Plantings	2.84	1.50	n/a	n/a	2
Total		86.57	27.73	16	16	21

Meandering transects were also conducted by Umwelt through vegetation zones across the proposal area (Figure 2.1). Meandering transects enable floristic sampling across a much larger area than plot-based survey. Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the proposal area.

All vascular plants recorded or collected within vegetation integrity plots and rapid vegetation assessment points were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002). Where known, changes to nomenclature and classification have been incorporated into the results. Updated taxonomy has been derived from PlantNET (Botanic Gardens Trust 2019). Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the proposal area. Vegetation mapping involved the following key steps:

- Review of existing regional vegetation mapping of the proposal area
- Review of digital airborne imagery to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- Preparation of a draft vegetation community map based on interpretation of digital airborne imagery
- Ground-truthing of the vegetation map as part of detailed flora surveys
- Revision of vegetation map based on vegetation integrity plots, rapid vegetation assessment points and meandering transects.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

ELA Vegetation Surveys

ELA conducted a total of 26 floristic plots and 15 rapid assessments in the proposal area north of the Hunter River on 20 and 21 February 2018, 28 May 2018, 2 June 2018, 2 July 2018, 16 October 2018 and 28 May 2019 (Figure 2.2).



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- Legend**
- Proposal Area
 - Impact Area
 - Ancillary Facilities
 - Umwelt Survey Coverage
 - Rapid Vegetation Assessment Points
 - BAM Floristic Plot
 - Meandering Tracks

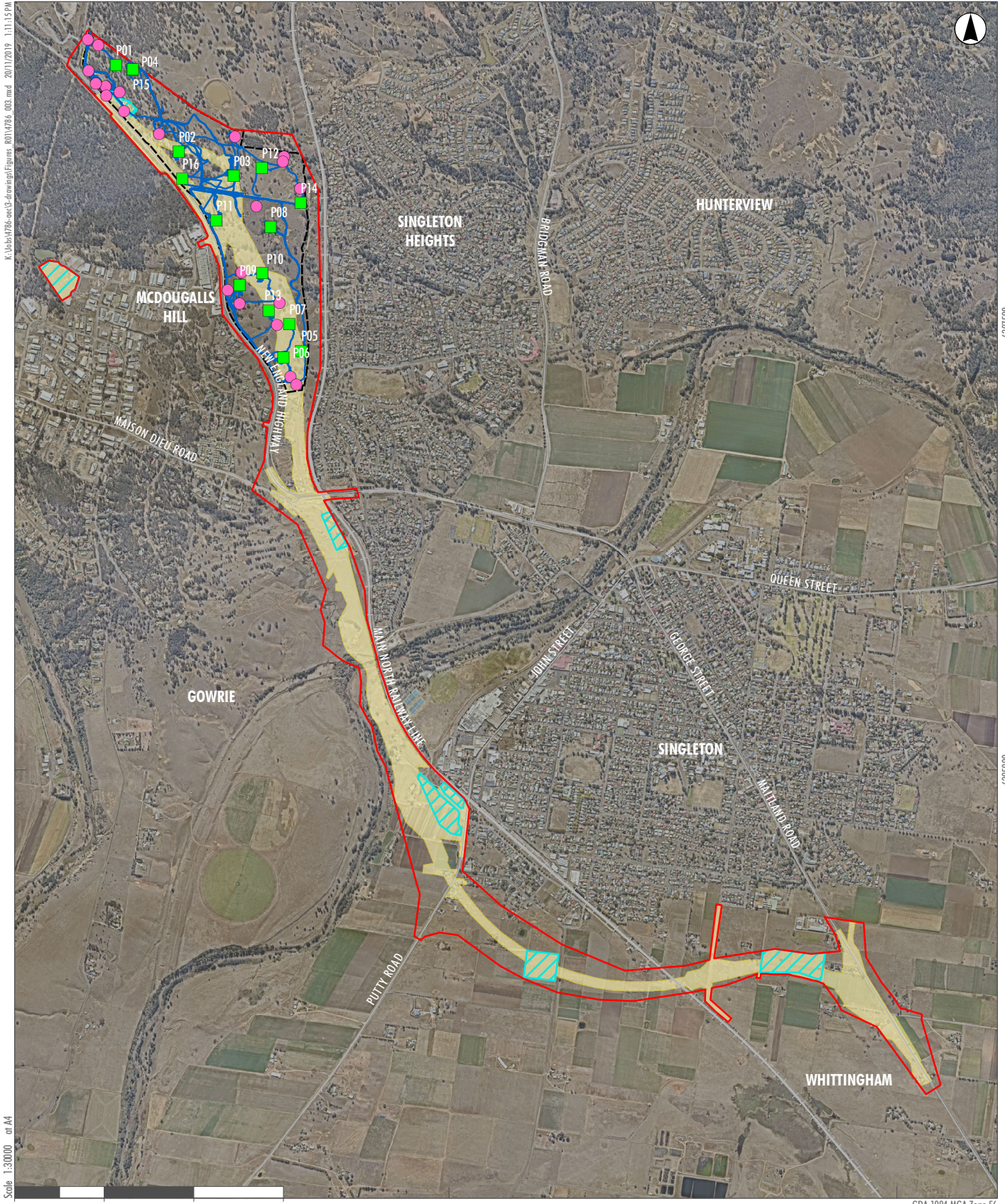
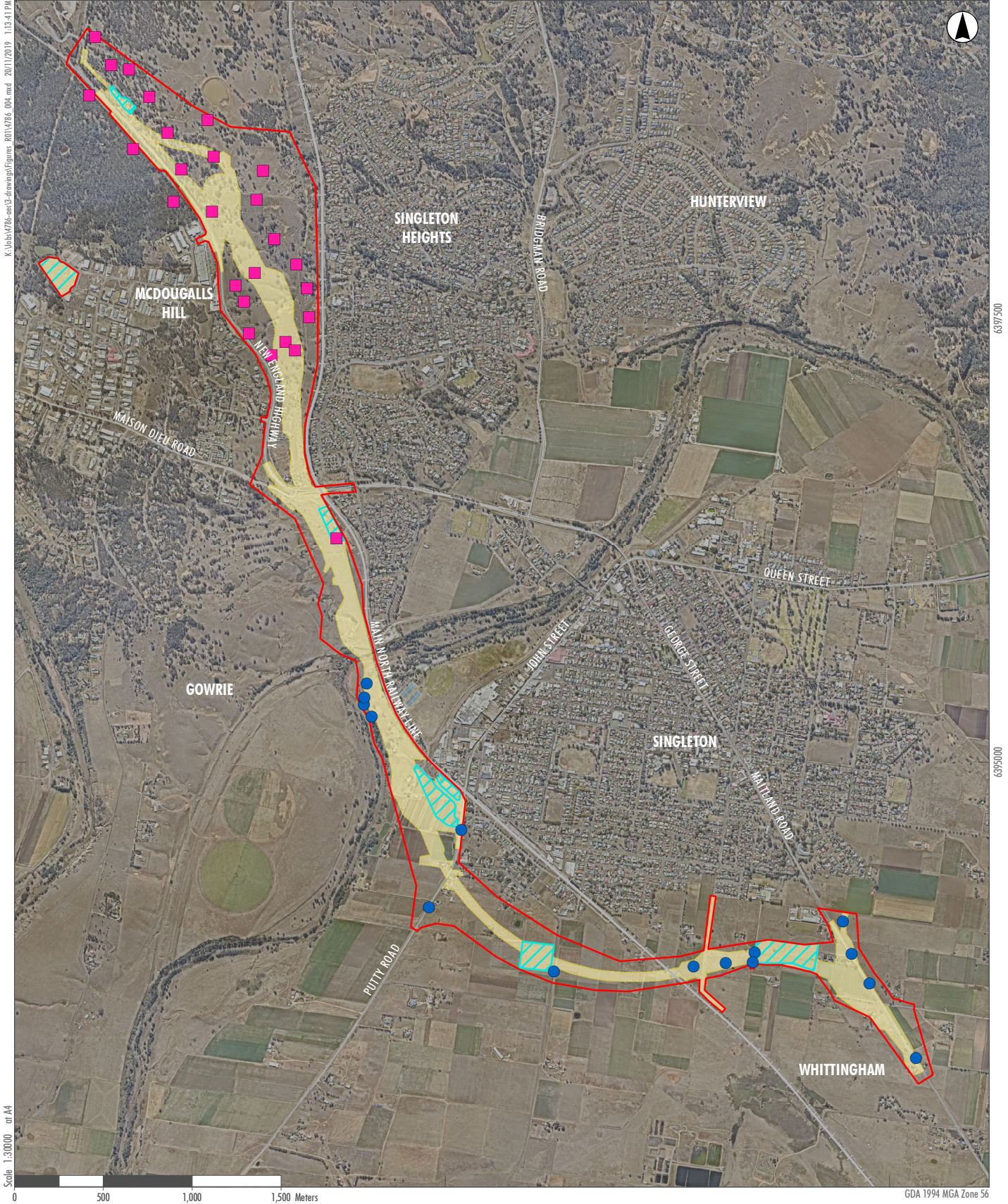


FIGURE 2.1

Umwelt Vegetation Survey Effort



- Legend
- Proposal Area
 - Impact Area
 - Ancillary Facilities
 - Rapid Vegetation Assessment Point
 - ELA BAM Floristic Plot

FIGURE 2.2

ELA Vegetation Survey

2.4.2 Targeted threatened flora surveys

Two threatened flora species were considered to have potential to occur in the proposal area, including *Cymbidium canaliculatum* and river red gum (*Eucalyptus camaldulensis*) which are both listed as endangered populations in the Hunter Catchment under the BC Act.

Cymbidium canaliculatum is an epiphytic orchid, which grows in the hollow and forks of eucalypts. All trees in the northern portion of the proposal area were inspected by ELA during hollow-bearing tree surveys (Section 2.3) on 16, 29 and 30 October 2018, and 6 and 7 December 2018. No individuals of *Cymbidium canaliculatum* were observed.

Opportunistic surveys for threatened flora species were undertaken by Umwelt in conjunction with the vegetation surveys completed on 21, 24, 25 and 27 June 2019.

2.4.3 Targeted Threatened Fauna Surveys

Habitat Assessments

Habitat surveys were carried out by ELA on 16, 29 and 30 October 2018, and 6 and 7 December 2018. All trees were visually inspected from the ground to identify possible hollows, and x10 binoculars were used to estimate the number of hollows in each tree. Each hollow was allocated to a size class: less than 5 centimetres, 5 to 10 centimetres, 10 to 20 centimetres, 20 to 30 centimetres, and greater than 30 centimetres. The location of each tree was recorded in the field using a GPS-enabled mobile device.

A search for evidence of owls, such as whitewash and pellets, was also undertaken during the hollow-bearing tree (HBT) survey. The ground under suitable trees and hollows was scanned for evidence of owls (Figure 2.3).

Niche carried out additional habitat surveys on 27, 28 and 29 August 2019 across 287.9 hectares of vegetated areas adjacent to the proposal area (Figure 2.4). Niche conducted 47 BAM plots on 27, 28 and 29 August 2019 using 50 by 20 metre plots to assess habitat values. Data was collected in accordance with the BAM (OEH 2017a) and included:

- Function attributes including number of large trees, stem class size, tree regeneration and length of logs
- Litter cover: assessment of average litter cover (and other groundcover components) within five one square metre sub-plots
- The number and size of hollows present.

PCTs containing hollow-bearing trees and considered to provide suitable foraging habitat for fauna species were mapped (Niche 2019).

2.4.3.1 Fauna Surveys

A range of fauna surveys were carried out across the proposal area by ELA between February and December 2018 (refer to Figure 2.3).

Diurnal bird survey

Diurnal bird surveys were carried out during morning and afternoon periods (peak times for bird activity) on 7 and 21 February, and 16 October 2018. A 20-minute survey with two observers using 10x binoculars was completed at each site. All bird species observed or heard were recorded, and any threatened species identified were also quantified (if possible). A total of seven diurnal bird surveys were completed.

Call-playback

Call playback surveys were carried out to target masked owl (*Tyto novaehollandiae*), powerful owl (*Ninox strenua*) and bush stone-curlew (*Burhinus grallarius*) in the proposal area. At each site, an initial listening period of 10 minutes preceded call-broadcast of each species for approximately five minutes, with a listening period of five minutes in between species. Following call-broadcasts, spotlighting and listening were conducted in the vicinity for up to

30 minutes. On each survey night call-playback was conducted at two sites at least 800 metres apart, with spotlighting conducted in between and afterwards. A total of 16 call-playback sessions were completed over eight separate nights.

Spotlighting

Spotlighting was completed to target nocturnal fauna on 21 February, 2 June, 12 June, 29 and 30 October, and 14, 19 and 20 November 2018. Surveys targeting suitable habitat were carried out by two observers on foot, as well as from a vehicle driven in first gear (5 to 10 kilometres per hour), with the passenger using a hand-held spotlight. Spotlighting was conducted in association with call-playback surveys over eight separate nights. Total spotlighting effort was approximately 16-person hours.

Motion-sensing cameras

Motion-sensing cameras (Reconyx HC550 and HC600) were used to target arboreal and ground-based fauna species in the proposal area. Arboreal cameras were attached to a tree trunk or branch and aimed at a bait (peanut butter/oats/honey bait mix) secured to a branch or adjacent tree. Arboreal cameras (eight sites) and baits were set approximately two metres above the ground and the bait tree was sprayed with a honey water solution. Ground cameras at four sites were aimed at a baitholder secured to the ground via a short metal stake. Ground cameras were baited with a combination of chicken, tuna and sardines. Cameras were left in-situ between 6 and 21 February 2018 (15 nights) and 21 February and 20 March 2018 (27 nights). Total survey effort was 156 trap nights for arboreal cameras, and 84 trap nights for ground cameras.

Ultrasonic recording

Song Meter (SM2+) ultrasonic call detectors were used to record call activity of bats in the proposal area. Each unit was set to record continuously from 10pm till 5am the following morning. A total of five Song Meters were set across the proposal area in February and March 2018 for two nights each, totalling 10 trap nights of survey effort. Calls were analysed by ELA Microbat specialist Alicia Scanlon using the program AnalookW (Version 4.2n 16 March 2017, written by Chris Corben, www.hoarybat.com). Call identifications were made using region-based guides to the echolocation calls of microbats in New South Wales (Pennay, Law and Reinhold 2004); and south-east Queensland and north-east New South Wales (Reinhold, Law, Ford and Pennay 2001) and the accompanying reference library of over 200 calls from Sydney Basin, NSW (which is available at <http://www.forest.nsw.gov.au/research/bats/default.asp>). Results of the call analysis were reviewed by bat specialist Greg Ford from Balance Environmental.

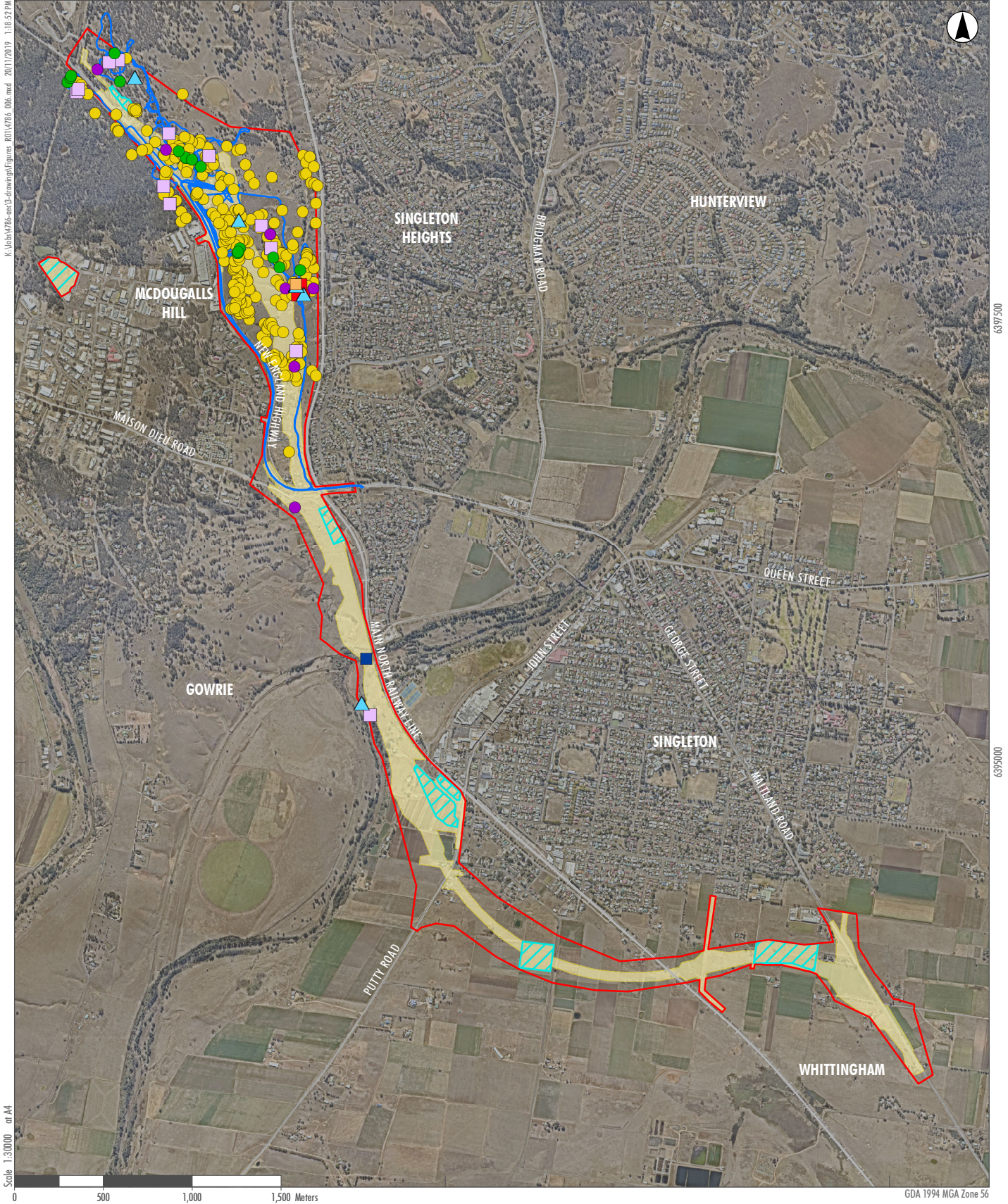
Dusk watch for bats

Two culverts in the proposal area contained potential roost sites for bats. One dusk watch was conducted at each culvert, on 29 and 30 October 2018. The dusk watch involved two observers, one stationed at each of the culvert entrances, who watched for exiting bats from 30 minutes before, until one hour after dusk. Each observer recorded the number and time of bats observed exiting the culvert while training a Song Meter (SM2+) at emerging bats to

record their calls. Call data was later analysed to identify species present correlating observations of emerging bats with the recorded calls to identify the species of bats using the roost.

Harp Trapping

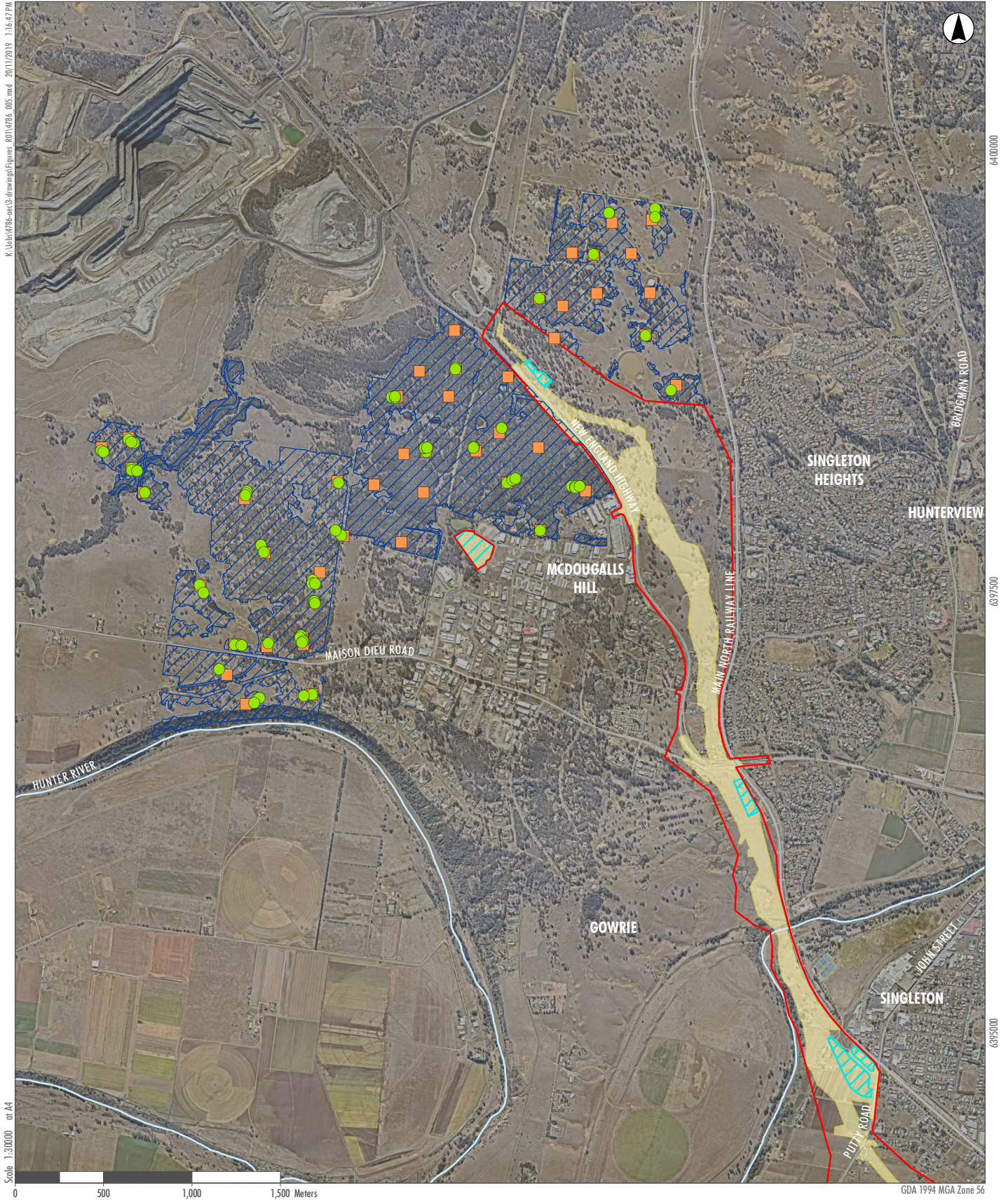
One harp trap was placed over one entrance of the occupied culvert before dusk on 6 December 2018. The trap was visually monitored, and once a bat was observed to be captured the trap was moved away from the culvert entrance. The captured bats were extracted for identification before being released.



- Scale 1:30,000 at A4
- 0 500 1,000 1,500 Meters
- Legend**
- Proposal Area
 - Impact Area
 - Ancillary Facilities
 - Spotlighting Track
 - Call Playback
 - Diurnal Bird Survey
 - Harp Trap
 - Motion-sensing Camera
 - ▲ Ultrasonic Recorder
 - Dusk Watch
 - Hollow-bearing Tree
 - Aquatic Habitat Assessment

FIGURE 2.3

ELA Fauna Survey Effort



Legend

- Proposal Area
- Impact Area
- Ancillary Facilities
- Targeted Local Habitat Assessment Area (Niche 2019)
- Niche Vegetation Integrity Plot
- Niche Hollow-bearing Tree

FIGURE 2.4

Niche Survey Effort

2.4.4 Aquatic Surveys

The habitat value of the Hunter River was assessed to inform characterisation of habitat sensitivity and waterway classification in accordance with NSW DPI (Fisheries) *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013).

An aquatic habitat assessment was undertaken by ELA at the proposed bridge crossing location of the Hunter River on 21 February 2018. The assessment included a visual inspection of the river at the crossing site and 100 metres upstream and downstream, to identify the aquatic habitat features present.

2.4.5 Summary of survey effort

Table 2.3 provides a summary of the targeted species surveys completed by ELA and Niche.

Table 2.3 Targeted species survey details

Method	Target species	Effort per site	Replication	Total survey effort
Diurnal bird survey	regent honeyeater, grey-crowned babbler, speckled warbler, little lorikeet, little eagle, scarlet robin, hooded robin, painted honeyeater, white-bellied sea-eagle, varied sittella, brown treecreeper, spotted harrier, flame robin, diamond firetail	20 minutes with two observers	7 sites	4.6 person-hours
Call-playback	masked owl, powerful owl, bush stone-curlew	30-minute listen/broadcast/search event per site with two observers in suitable habitat	Two sites per night on eight nights	16 call-playback sessions over 8 separate nights
Spotlighting	squirrel glider, brush-tailed phascogale, masked owl, powerful owl, bush stone-curlew, grey-headed flying-fox	At least one hour with two observers, combination of walking and driving	8 nights	16 person-hours
Motion-sensing cameras (arboreal)	squirrel glider, brush-tailed phascogale	15 nights at five sites; 27 nights at three sites	8 sites	156 trap nights
Motion-sensing cameras (ground)	spotted-tailed quoll	15 nights at two sites; 27 nights at two sites	4 sites	84 trap nights
Ultrasonic recording	eastern cave bat, yellow-bellied sheath-tail-bat, Corben's long-eared bat, southern myotis, eastern coastal freetail-bat, large bentwing-bat, little bentwing-bat, eastern false	Units were set to record from 2000 to 0500 hrs each night. For each site call data was analysed for two nights.	5 sites	10 trap nights

Method	Target species	Effort per site	Replication	Total survey effort
Dusk watch for bats	pipistrelle	1 observer at each entrance for 30 mins before, and 1 hour after dusk	2 sites	2 dusk watches
Harp trapping		1 trap over culvert during emergence	1 site	1 emergence survey
Meandering transects	Threatened flora, including <i>Cymbidium canaliculatum</i>	N/A	N/A	ELA: October (16, 29, 30) December (6, 7) 2018 Umwelt: June (21, 24, 25, 27) 2019

2.5 Limitations

Where vegetation within the proposal area was not surveyed and mapped by Umwelt or others, the Upper Hunter State Vegetation mapping (OEH 2019b) has been used (refer to Section 3 below). No vegetation integrity or floristic surveys were conducted in the portion of the proposal area south of the Hunter River, where agricultural land is present and the vegetation is mapped predominately as non-native (OEH 2019b). Additionally limited surveys have been completed to date in the vegetation along the Hunter River and between the Hunter River and the area known as Gowrie Gates. Ground-truthing of the vegetation in these areas would be required prior to the commencement of construction.

3 Existing environment

The proposal is located in the Singleton local government area (LGA) in the Hunter Valley, 75 kilometres inland from Newcastle, 47 kilometres south-east of Muswellbrook and 200 kilometres from Sydney (Figure 1.1). Wollemi National Park (NP) and Yengo NP occur approximately 20 kilometres west of the proposal area.

A review of the *Singleton Local Environmental Plan 2013* (LEP) identified the proposal area is mapped predominately as RU1 – Primary Production zoned land south of the Hunter River crossing and north of the New England Highway. A small area of SP2 – Infrastructure (Railway) zoned land occurs just south of the Hunter River crossing, and the proposal area occurring between the Hunter River and New England Highway contains both RE2 – Private Recreation and R1 – General Residential zoned land. Where the proposal area crosses the New England Highway it crosses SP2 – Infrastructure (Classified Road) zoned land.

The proposal area contains open forest and woodland in the north, with open forest and woodland located outside the proposal area to the west and north, along with residential area areas to the east as part of Singleton Heights. The Rixs Creek open cut coal mine is also located further to the north. A narrow band of riparian vegetation occurs along the Hunter River and south of the Hunter River crossing the proposal area contains cultivated pasture and cropping.

The distribution of PCTs is shown on Figure 3.1 and a description of the PCTs occurring within the proposal area is provided in Section 3.1.

The surrounding environment is characterised by alluvial plains that are utilised as agricultural land. The elevation of the proposal area ranges between 40 and 130 metres above sea level. The soil landscape in the proposal area south of the Hunter River is mapped as Hunter soil landscape, which is characterised by level plains and river terraces of the Hunter River with elevations of 20 to 60 metres above sea level. This landscape unit is typically cleared due to intensive agriculture practices, and the soils are all formed in alluvium (OEH 2019d). The soil landscape in the proposal area north of the Hunter River is mapped as Sedgefield soil landscape, which is characterised by undulating hills with elevations of 60 to 170 metres above sea level. This landscape unit typically supports woodland comprising ironbarks with some grey box and rough-barked apple. The soils of this landscape unit are typically yellow soloths and yellow solodic soils (OEH 2019d).

The proposal area occurs in the north-east of the Sydney Basin IBRA region as mapped in the Interim Biogeographic Regionalisation for Australia (IBRA), and the Hunter IBRA subregion (Figure 1.1). It occurs in the Central Hunter Alluvial Plains and Central Hunter Foothills Mitchell landscapes (Figure 1.1).

The Sydney Basin bioregion consists of a geological basin filled with near horizontal sandstones and shales of Permian to Triassic age that overlie older basement rocks of the Lachlan Fold Belt. Erosion by coastal streams has created a landscape of deep cliffed gorges and remnant plateaus across which an east-west rainfall gradient and differences in soil control the vegetation of eucalypt forests, woodlands and heaths. The Sydney Basin Bioregion includes coastal landscapes of cliffs, beaches and estuaries (OEH 2016).

The proposal area includes a small section of the Hunter River with remnant riparian vegetation, which provides a potential movement corridor for fauna.

A total of 73 fauna species were recorded in the proposal area during the site inspection including 40 bird species, 29 mammals, three amphibians and one reptile (Appendix B). Of these three threatened birds (including a potential sighting) and 10 threatened mammals (including three potential recordings) were recorded. Further consideration of threatened species is provided in Section 3.4. The eucalypt species present within the proposal area are likely to provide a nectar resource when flowering for nectarivorous birds, and the majority of the trees which occur within the proposal area north of the Hunter River area contain hollows (Figure 2.3 and Figure 2.4).

3.1 Plant community types

The northern portion of the proposal area where the majority of the native vegetation occurs was subject to detailed vegetation surveys (Umwelt 2019) (Figure 3.1). For the remainder of the proposal area regional mapping, State Vegetation Type Map: Upper Hunter (OEH 2019b), was used to inform this report (Figure 3.1).

The total extent of plant community types recorded in the proposal area based on verified and regional vegetation mapping is shown in Table 3.1 below:

Table 3.1 Extent of plant community types within the proposal area

Plant community type (PCT)	Condition	Area (ha) in proposal area	Area (ha) in impact area
Verified Vegetation Mapping (Umwelt 2019)			
1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	Moderate/Good	0.47	-
1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter	Derived Native Grassland (DNG)	0.22	-
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	Moderate/Good	19.45	5.34
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	Thinned Canopy	11.46	6.35
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	DNG	50.16	14.21
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter	African Olive Infestation	1.14	-
-	Exotic Grassland	0.84	0.33
-	Cleared Land, Dam and Swamp Oak Plantings	2.84	1.50
Total		86.57	27.73
Regional Vegetation Mapping (OEH 2019b)			
42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	-	3.83	1.22
1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	-	4.36	2.21
1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open	DNG	2.44	2.44

Plant community type (PCT)	Condition	Area (ha) in proposal area	Area (ha) in impact area
forest of the lower Hunter			
1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	-	4.15	0.08
1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	-	0.15	-
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	-	0.02	-
1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	-	-	0.08
Non-native	-	156.11	75.92
Total		171.14	81.95
Overall Total		257.73	109.69

Recommendations for ground truthing surveys are provided in Section 5. The following sections detail the plant community types recorded by Umwelt (2019) and regional mapping (OEH 2019b).

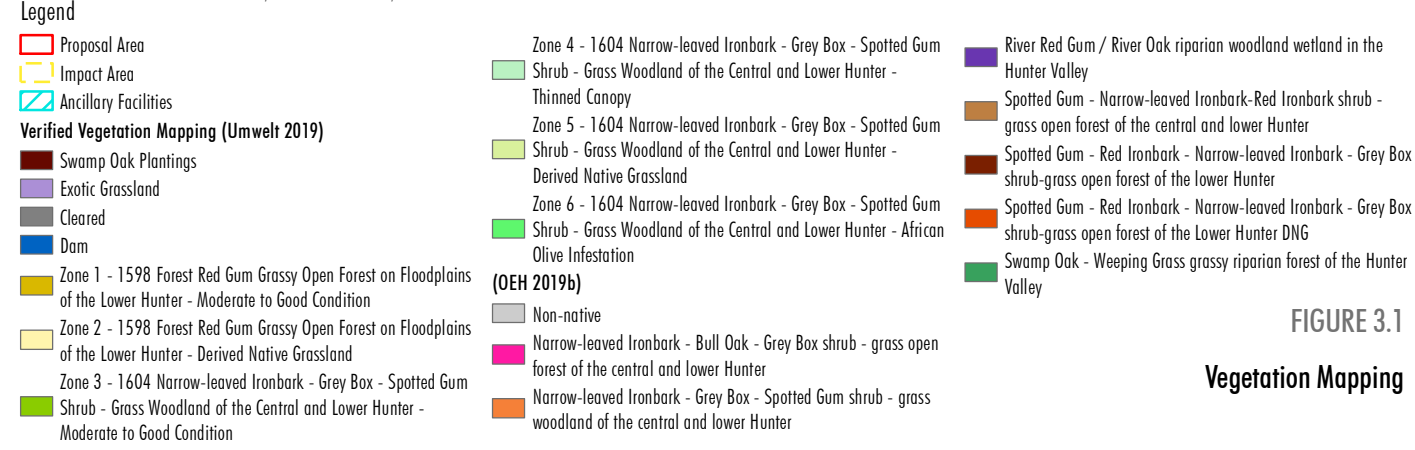
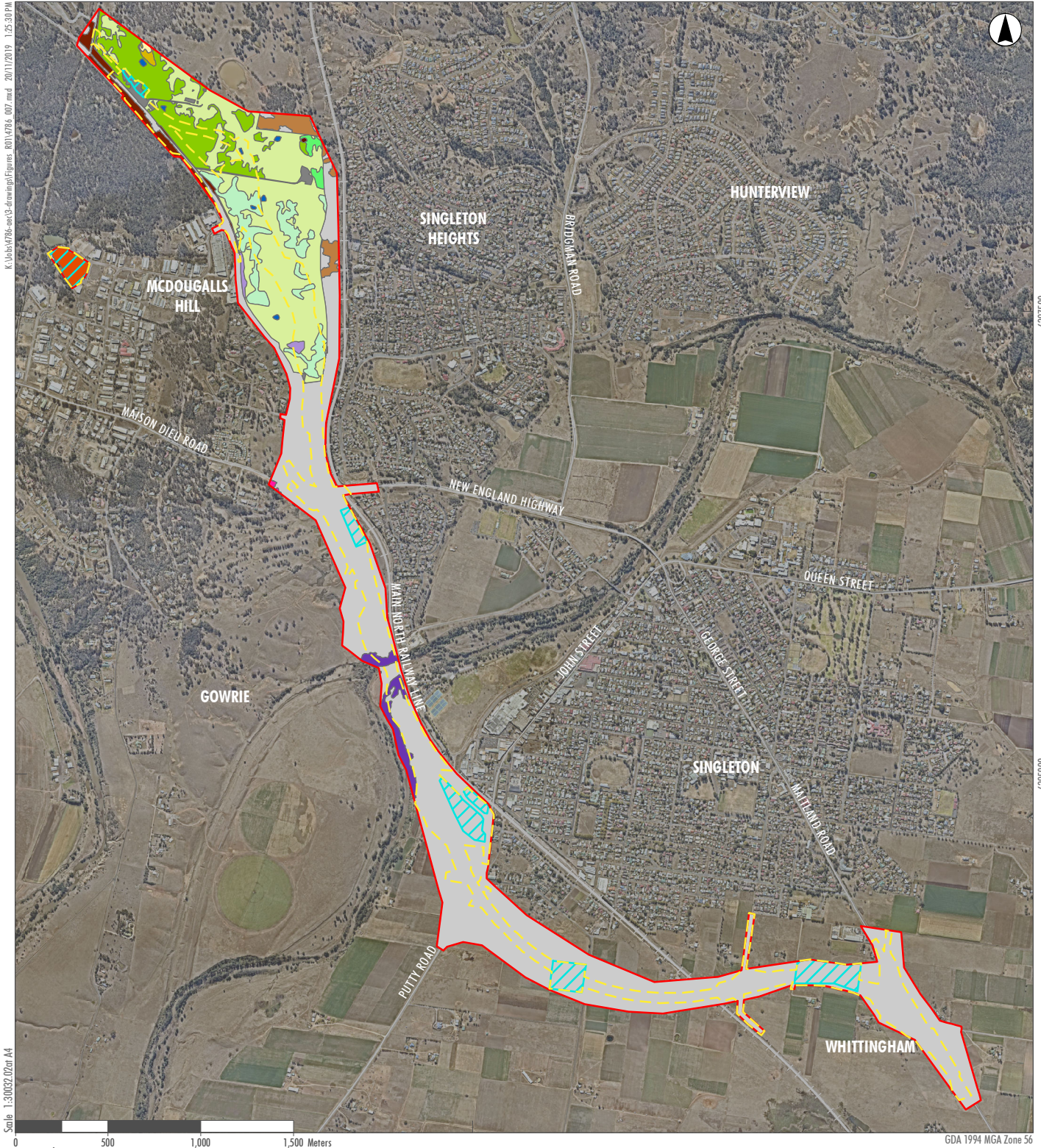


FIGURE 3.1
Vegetation Mapping

3.1.1 Verified Vegetation Mapping

Umwelt surveys of the proposal area identified two PCTs across six condition classes, shown in Figure 3.1 and Table 3.1. These are described in the following sections. PCT 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good

Veg Zone: 1

Vegetation formation: Forested Wetlands

Vegetation class: Coastal Floodplain Wetlands

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Consistent with the *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions* EEC listed under the BC Act

Estimate of percent cleared: NA

Condition: Moderate to Good

Extent in the proposal area: 0.47 hectares

Plots completed in vegetation zone: 1 vegetation integrity plot

Structure	Average height and height range (m)	Average cover (%)	Typical species
Trees	15-20	35	Dominated by forest red gum (<i>Eucalyptus tereticornis</i>), with occurrences of narrow-leaved ironbark (<i>Eucalyptus crebra</i>).
Small trees	0.5-1.0	2	Largely absent, with some regenerating forest red gum (<i>Eucalyptus tereticornis</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>).
Ground covers	<0.5	50	Dominant grasses comprise purple wiregrass (<i>Aristida ramosa</i>), red grass (<i>Bothriochloa decipiens</i> var. <i>decipiens</i>), variable glycine (<i>Glycine tabacina</i>) and common couch (<i>Cynodon dactylon</i>). Common forbs include forest nightshade (<i>Solanum prinophyllum</i>), blue trumpet (<i>Brunoniella australis</i>), many-flowered mat-rush (<i>Lomandra multiflora</i> subsp. <i>multiflora</i>), and wattle matt-rush (<i>Lomandra filiformis</i> subsp. <i>coriacea</i>). Introduced species generally occur at low abundance, and include lambs tongue (<i>Plantago lanceolata</i>), fireweed (<i>Senecio madagascariensis</i>), tiger pear (<i>Opuntia aurantiaca</i>), and African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>).

Description: This vegetation zone comprises a red gum dominated forest associated with the upper reaches of an unnamed drainage line that flows into Stonequarry Gully. This zone has been heavily grazed however there is active regeneration of the canopy species.

This vegetation zone is aligned with PCT 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter given the dominance of forest red gum (*Eucalyptus tereticornis*) in the canopy and presence of several characteristic understorey species. It is noted that this vegetation zone is associated with the upper reaches of an unnamed drainage line and is not associated with a floodplain. However, according to the VIS Classification Database (OEH 2019e) this PCT can also occur on the Central Hunter Foothills Mitchell landscape, which is the Mitchell landscape mapped across the proposal

area. This vegetation zone is considered to be at the upper limit in the landscape of PCT 1598 and as a result has influences from the surrounding PCT 1604.



Photograph 3.1 PCT 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good

3.1.2 PCT 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Derived Native Grassland

Veg Zone: 2

Vegetation formation: Forested Wetlands

Vegetation class: Coastal Floodplain Wetlands

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Not listed

Estimate of percent cleared: NA

Condition: Derived Native Grassland

Extent in the proposal area: 0.22 hectares

Plots completed in vegetation zone: 1 vegetation integrity plot

Structure	Average height and height range (m)	Average cover (%)	Typical species
Trees	10	1	Largely absent, with scattered occurrences of forest red gum (<i>Eucalyptus tereticornis</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>).
Small trees	0.5-1.0	1	Largely absent, with some regenerating forest red gum (<i>Eucalyptus tereticornis</i>).
Ground covers	<0.2	70	Purple wiregrass (<i>Aristida ramosa</i>), common couch (<i>Cynodon dactylon</i>), red grass (<i>Bothriochloa decipiens</i> var. <i>decipiens</i>), rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>) and variable glycine (<i>Glycine tabacina</i>). Introduced species generally occur at low abundance, including lambs tongue (<i>Plantago lanceolata</i>), scarlet pimpernel (<i>Lysimachia arvensis</i>) and <i>Richardia humistrata</i> .

Description: This vegetation zone comprises native grassland derived from the moderate to good condition zone of PCT 1598 and is also associated with the upper reaches of an unnamed drainage line that flows into Stonequarry Gully. This zone has been heavily grazed however there is active regeneration of the canopy species.

This vegetation zone has been aligned with PCT 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter given its position in the landscape and adjacent remnant vegetation.



Photograph 3.2 PCT 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Derived Native Grassland

3.1.3 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate to Good Condition

Veg Zone: 3

Vegetation formation: Grassy Woodland

Vegetation class: Coastal Valley Grassy Woodland

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Consistent with the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC listed under the BC Act and the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC listed under the EPBC Act.

Estimate of percent cleared: 71.00

Condition: Moderate to Good

Extent in the proposal area: 19.45 hectares

Plots completed in vegetation zone: 3 vegetation integrity plots

Structure	Average height and height range (m)	Average cover (%)	Typical species
Trees	15-20	25-40	The dominant canopy species is spotted gum (<i>Corymbia maculata</i>), along with narrow-leaved ironbark (<i>Eucalyptus crebra</i>) and grey box (<i>Eucalyptus moluccana</i>). There are also occurrences of red ironbark (<i>Eucalyptus fibrosa</i>) along the northern boundary of the proposal area.
Small trees	1-8	10	Regeneration of the canopy species is common.
Shrubs	1-1.5	2	Largely absent, with scattered occurrences of native blackthorn (<i>Bursaria spinosa</i>), coffee bush (<i>Breynia oblongifolia</i>), gorse bitter pea (<i>Daviesia ulicifolia</i>) and broad-leaf hopbush (<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>).
Ground covers	<0.5	30	Common species include purple wiregrass (<i>Aristida ramosa</i>), red grass (<i>Bothriochloa decipiens</i> var. <i>decipiens</i>), barbed wire grass (<i>Cymbopogon refractus</i>), three awn speargrass (<i>Aristida vagans</i>), wallaby grass (<i>Rytidosperma fulvum</i>), <i>Paspalidium distans</i> , tall chloris (<i>Chloris ventricosa</i>), curly windmill grass (<i>Enteropogon acicularis</i>), paddock lovegrass (<i>Eragrostis leptostachya</i>), weeping grass (<i>Microlaena stipoides</i>), hairy panic (<i>Panicum effusum</i>), common couch (<i>Cynodon dactylon</i>), blue trumpet (<i>Brunoniella australis</i>), kidney weed (<i>Dichondra repens</i>), common fringe-sedge (<i>Fimbristylis dichotoma</i>), variable glycine (<i>Glycine tabacina</i>), <i>Lomandra filiformis</i> subsp. <i>filiformis</i> , many-flowered mat-rush (<i>Lomandra multiflora</i> subsp. <i>multiflora</i>), <i>Arthropodium</i> sp., bristly cloak fern (<i>Cheilanthes distans</i>), rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), slender tick-trefoil (<i>Desmodium varians</i>), climbing saltbush (<i>Einadia nutans</i> subsp. <i>nutans</i>), amulla (<i>Eremophila debilis</i>), and slender wire lily (<i>Laxmannia gracilis</i>). Introduced species generally occur at low abundance, including fireweed (<i>Senecio madagascariensis</i>), tiger pear (<i>Opuntia aurantiaca</i>), creeping pear (<i>Opuntia humifusa</i>), common prickly pear (<i>Opuntia stricta</i>), Paddys lucerne (<i>Sida rhombifolia</i>) and African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>).

Description: This vegetation zone comprises a woodland to open forest with a history of grazing. Due to this grazing the understorey is structurally simplified. It occurs across the slopes within the proposal area.

This zone is aligned with PCT 1604 as it supports a high proportion of characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2019e). Of the 14 flora species listed on the VIS Classification Database as characteristic for PCT 1604, this vegetation zone supports 13 of these species (93 per cent). Whilst this vegetation zone also has similarity to several other closely related PCTs, it has the highest per cent floristic similarity to PCT 1604.



Photograph 3.3 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate to Good Condition

3.1.4 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy

Veg Zone: 4

Vegetation formation: Grassy Woodland

Vegetation class: Coastal Valley Grassy Woodland

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Consistent with the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC listed under the BC Act and the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC listed under the EPBC Act.

Estimate of percent cleared: 71.00

Condition: Thinned Canopy

Extent in the proposal area: 11.46 hectares

Plots completed in vegetation zone: 4 vegetation integrity plots

Structure	Average height and height range (m)	Average cover (%)	Typical species
Trees	12-18	25	The dominant canopy species comprise spotted gum (<i>Corymbia maculata</i>), grey box (<i>Eucalyptus moluccana</i>) and narrow-leaved ironbark (<i>Eucalyptus crebra</i>). It is noted that some of the grey box (<i>Eucalyptus moluccana</i>) trees have influence from white box (<i>Eucalyptus albens</i>) at the southern end of the proposal area, as indicated by fruit size, foliage colour and rough bark extent. Bulloak (<i>Allocasuarina luehmannii</i>) is also present in low abundance.
Small trees	1-6	15	Generally sparse, with patches of dense eucalypt regeneration
Shrubs	0.5-1	5	Common exotic shrubs include African boxthorn (<i>Lycium ferocissimum</i>) and African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>).
Ground covers	<0.5	60	<p>Common species include purple wiregrass (<i>Aristida ramosa</i>), barbed wire grass (<i>Cymbopogon refractus</i>), slender bamboo grass (<i>Austrostipa verticillata</i>), red grass (<i>Bothriochloa decipiens</i> var. <i>decipiens</i>), tall chloris (<i>Chloris ventricosa</i>), speargrass (<i>Austrostipa scabra</i>), common couch (<i>Cynodon dactylon</i>), blue trumpet (<i>Brunoniella australis</i>), kidney weed (<i>Dichondra repens</i>), variable glycine (<i>Glycine tabacina</i>), wattle matrush (<i>Lomandra filiformis</i> subsp. <i>coriacea</i>), many-flowered mat-rush (<i>Lomandra multiflora</i> subsp. <i>multiflora</i>), <i>Lomandra filiformis</i> subsp. <i>filiformis</i>, <i>Arthropodium</i> sp., bristly cloak fern (<i>Cheilanthes distans</i>), rock fern (<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>), slender tick-trefoil (<i>Desmodium varians</i>), ruby saltbush (<i>Enchylaena tomentosa</i>), climbing saltbush (<i>Einadia nutans</i> subsp. <i>linifolia</i>), berry saltbush (<i>Einadia hastata</i>), amulla (<i>Eremophila debilis</i>), corrugated sida (<i>Sida corrugata</i>), spiked sida (<i>Sida hackettiana</i>), common everlasting (<i>Chrysocephalum apiculatum</i>), knob sedge (<i>Carex inversa</i>), slender flat-sedge (<i>Cyperus gracilis</i>), slender stackhousia (<i>Stackhousia viminea</i>) and small-leaf bluebush (<i>Maireana microphylla</i>).</p> <p>Common introduced species include galenia (<i>Galenia pubescens</i>), Paddys lucerne (<i>Sida rhombifolia</i>), tiger pear (<i>Opuntia aurantiaca</i>), creeping pear (<i>Opuntia humifusa</i>), fireweed (<i>Senecio madagascariensis</i>), common prickly pear (<i>Opuntia stricta</i>), African lovegrass (<i>Eragrostis curvula</i>) and lambs tongue (<i>Plantago lanceolata</i>).</p>

Description: This vegetation zone comprises an open woodland to woodland with a history of grazing and vegetation clearing. Due to grazing practices and vegetation clearing, the understorey is structurally simplified, with patches of dense eucalypt regeneration. This vegetation zones occurs on the slopes in the southern half of the proposal area. galenia (*Galenia pubescens*), Paddys lucerne (*Sida rhombifolia*), tiger pear (*Opuntia aurantiaca*), creeping pear (*Opuntia humifusa*), fireweed (*Senecio madagascariensis*), common prickly pear (*Opuntia stricta*), African lovegrass (*Eragrostis curvula*) and lambs tongue (*Plantago lanceolata*).

This zone is aligned with PCT 1604 as it supports a reasonable proportion of characteristic species listed in the PCT description according to the VIS Classification Database (OEH 2019e). Of the 14 flora species listed on the VIS Classification Database as characteristic for PCT 1604, this vegetation zone supports 11 of these species (79 per cent). Whilst this vegetation zone also has similarity to several other closely related PCTs, it has the highest per cent floristic similarity to PCT 1604.



Photograph 3.4 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy

3.1.5 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Derived Native Grassland

Veg Zone: 5

Vegetation formation: Grassy Woodland

Vegetation class: Coastal Valley Grassy Woodland

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Portions are consistent with the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC listed under the EPBC Act.

Estimate of percent cleared: 71.00

Condition: Derived Native Grassland

Extent in the proposal area: 50.16 hectares

Plots completed in vegetation zone: 5 vegetation integrity plots

Structure	Average height and height range (m)	Average cover (%)	Typical species
Ground covers	<1.0	70	Common species include purple wiregrass (<i>Aristida ramosa</i>), cotton panic grass (<i>Digitaria brownii</i>), windmill grass (<i>Chloris truncata</i>), tall chloris (<i>Chloris ventricosa</i>), red grass (<i>Bothriochloa decipiens</i> var. <i>decipiens</i>), barbed wire grass (<i>Cymbopogon refractus</i>), Queensland bluegrass (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>), common couch (<i>Cynodon dactylon</i>), small-leaf bluebush (<i>Maireana microphylla</i>), corrugated sida (<i>Sida corrugata</i>), spiked sida (<i>Sida hackettiana</i>), violet nightshade (<i>Solanum cinereum</i>), <i>Lomandra filiformis</i> subsp. <i>filiformis</i> , common everlasting (<i>Chrysocephalum apiculatum</i>) and bristly cloak fern (<i>Cheilanthes distans</i>). Common introduced species include galenia (<i>Galenia pubescens</i>), stagger weed (<i>Stachys arvensis</i>), lambs tongue (<i>Plantago lanceolata</i>) and saffron thistle (<i>Carthamus lanatus</i>).

Description: This vegetation zone occurs across the slopes within the proposal area where the canopy has been removed and it surrounds the remnant patches of other condition zones. Scattered paddock trees occur sporadically.

This zone has been aligned with PCT 1604 based on its position in the landscape, surrounding woodland and forest vegetation that aligns with PCT 1604 and presence of characteristic groundcover species.



Photograph 3.5 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Derived Native Grassland

3.1.6 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – African Olive Infestation

Veg Zone: 6

Vegetation formation: Grassy Woodland

Vegetation class: Coastal Valley Grassy Woodland

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Not listed

Estimate of percent cleared: 71.00

Condition: African Olive Infestation

Extent in the proposal area: 1.14 hectares

Plots completed in vegetation zone: 1 vegetation integrity plot

Structure	Average height and height range (m)	Average cover (%)	Typical species
Small Trees	2-4	20	Dominated by African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)
Ground covers	<0.5	40	Common native species include barbed wire grass (<i>Cymbopogon refractus</i>), purple wiregrass (<i>Aristida ramosa</i>), Queensland bluegrass (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>), variable glycine (<i>Glycine tabacina</i>), common everlasting (<i>Chrysocephalum apiculatum</i>), and bristly cloak fern (<i>Cheilanthes distans</i>). Common introduced species include African olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>), galenia (<i>Galenia pubescens</i>), Paddys lucerne (<i>Sida rhombifolia</i>), lambs tongue (<i>Plantago lanceolata</i>) and purpletop (<i>Verbena bonariensis</i>).

Description: This vegetation zone comprises derived native grassland with an infestation of African olive (*Olea europaea* subsp. *cuspidata*). This vegetation zone occurs on the far eastern slopes of the proposal area. Scattered paddock trees occur sporadically.

This zone has been aligned with PCT 1604 based on its position in the landscape, surrounding woodland and forest vegetation that aligns with PCT 1604 and presence of some characteristic groundcover species.



Photograph 3.6 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – African Olive Infestation

3.1.7 Exotic Grassland

Vegetation formation: NA

Vegetation class: NA

Other mapping sources: The Vegetation of the Central Hunter Valley, NSW (Peake 2006)

Conservation status: Not listed

Estimate of percent cleared: NA

Condition: Exotic Grassland

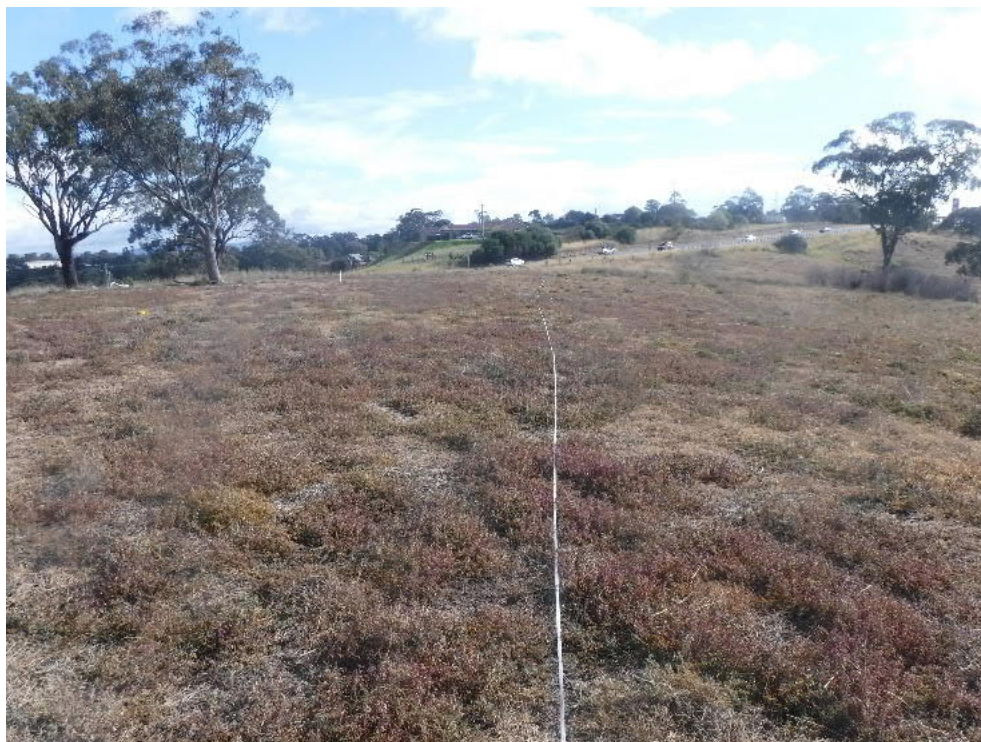
Extent in the proposal area: 0.84 hectares

Plots completed in vegetation zone: 1 vegetation integrity plot

Structure	Average height and height range (m)	Average cover (%)	Typical species
Ground covers	<0.5	90	<p>Dominant exotic species include galenia (<i>Galenia pubescens</i>), African lovegrass (<i>Eragrostis curvula</i>), Coolatai grass (<i>Hyparrhenia hirta</i>), Rhodes grass (<i>Chloris gayana</i>) and guinea grass (<i>Megathyrsus maximus</i>).</p> <p>Native species in the ground layer occur in low abundance and include purple wiregrass (<i>Aristida ramosa</i>), red grass (<i>Bothriochloa decipiens</i> var. <i>decipiens</i>) and common couch (<i>Cynodon dactylon</i>).</p>

Description: Discrete patches of grassland dominated by exotic species occurring in the southern portion of the proposal area. Introduced species dominate the ground layer of this community.

This zone is not attributable to any PCT based on the dominance of exotic species.



Photograph 3.7 Exotic Grassland

3.1.8 Regional Vegetation Mapping

Existing regional vegetation mapping (OEH 2019b) identified five Plant Community Types (PCTs) within the proposal area, shown in Table 3.1 and Figure 3.1. These were not verified by field surveys, and the following descriptions are based on information provided in the BioNet Vegetation Classification database (OEH 2019e). No areas of regional vegetation mapping have been modified by Umwelt except in the ancillary facility which occurs outside of the proposal area. Recent aerial photography shows that the majority of the ancillary compound to the west of McDougalls Hill has been cleared, and the extent of the PCTs present in this area have been calculated based on this updated aerial photography. As survey has not been undertaken and condition cannot be assessed, areas that appear cleared have been assumed consistent with PCT 1600 in a derived native grassland form.

3.1.9 PCT 42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley

Vegetation formation: Forested Wetlands

Vegetation class: Eastern Riverine Forests

Conservation status: Assumed consistent with the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC Listed under the BC Act.

Estimate of percent cleared: 95.00

Stratum	Typical species
Upper	River red gum (<i>Eucalyptus camaldulensis</i>) river oak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>), rough-barked apple (<i>Angophora floribunda</i>) and yellow box (<i>Eucalyptus melliodora</i>).
Middle	Typically absent.
Ground	Slender bamboo grass (<i>Austrostipa verticillata</i>), wallaby grass (<i>Austrodanthonia</i> sp.), common couch (<i>Cynodon dactylon</i>), <i>Einadia trigonos</i> subsp. <i>trigonos</i> , common wheatgrass (<i>Elymus scaber</i> var. <i>scaber</i>), <i>Alternanthera</i> sp. A, lesser joyweed (<i>Alternanthera denticulata</i>) and stinging nettle (<i>Urtica incisa</i>).

Description: Tall forest and woodland in the Hunter Valley with a grassy ground cover. Occurs on clayey and sandy soils on the banks and inner floodplains of the Hunter River and major tributaries grading upslope into woodland. Only about 100 hectares remains but before clearing, this community was probably extensive along the Hunter River upstream of Maitland, on the lower reaches of the Goulburn River, on Dart Brook and also Wollombi Brook. A highly threatened community due to clearing, weed invasion and altered river flows.

Rapid assessments were conducted by ELA in the area where PCT 42 is mapped, and the vegetation present is shown in Photograph 3.8, Photograph 3.9 and Photograph 3.10.



Photograph 3.8 Area mapped as PCT 42 along the Hunter River (Photo credit: ELA)



Photograph 3.9 Area mapped as PCT 42 along the Hunter River (Photo credit: ELA)



Photograph 3.10 Area mapped as PCT 42 along the Hunter River (Photo credit: ELA)

3.1.10 PCT 1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter

Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation class: Hunter-Macleay Dry Sclerophyll Forests

Conservation status: Assumed consistent with the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC listed under the BC Act and the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC listed under the EPBC Act.

Estimate of percent cleared: 71.00

Stratum	Typical species
Upper	Spotted gum (<i>Corymbia maculata</i>), red ironbark (<i>Eucalyptus fibrosa</i>), narrow-leaved ironbark (<i>Eucalyptus crebra</i>), grey box (<i>Eucalyptus moluccana</i>).
Middle	Native blackthorn (<i>Bursaria spinosa</i>), gorse bitter pea (<i>Daviesia ulicifolia</i>), silver-stemmed wattle (<i>Acacia parvipinnula</i>), coffee bush (<i>Breynia oblongifolia</i>), prickly beard-heath (<i>Leucopogon juniperinus</i>).
Ground	Threeawn speargrass (<i>Aristida vagans</i>), kangaroo grass (<i>Themeda australis</i>), matt-rush (<i>Lomandra confertifolia</i>), wattle mat-rush (<i>Lomandra filiformis</i>), <i>Vernonia cinerea</i> , blue trumpet (<i>Brunoniella australis</i>), whiteroot (<i>Pratia purpurascens</i>) and rock fern (<i>Cheilanthes sieberi</i>).

Description: Open forests restricted to the lower Hunter Valley with a canopy dominated by spotted gum. The mid-storey consists of an open shrub layer, and the ground layer is predominately grassy with various graminoids, forbs and small ferns.

3.1.11 PCT 1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter

Vegetation formation: Dry Sclerophyll Forests (Shrub/grass sub-formation)

Vegetation class: Hunter-Macleay Dry Sclerophyll Forests

Conservation status: Assumed consistent with the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC listed under the BC Act and the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC listed under the EPBC Act.

Estimate of percent cleared: 71.00

Stratum	Typical species
Upper	Spotted gum (<i>Corymbia maculata</i>), narrow-leaved ironbark (<i>Eucalyptus crebra</i>), red ironbark (<i>Eucalyptus fibrosa</i>).
Middle	Native blackthorn (<i>Bursaria spinosa</i>), gorse bitter pea (<i>Daviesia ulicifolia</i>), silver-stemmed wattle (<i>Acacia parvipinnula</i>) and peach heath (<i>Lissanthe strigosa</i>).
Ground	Threeawn speargrass (<i>Aristida vagans</i>), blue trumpet (<i>Brunoniella australis</i>), whiteroot (<i>Pratia purpurascens</i>), barbed wire grass (<i>Cymbopogon refractus</i>), purple wiregrass (<i>Aristida ramosa</i>), weeping grass (<i>Microlaena stipoides</i>), many-flowered mat-rush (<i>Lomandra multiflora</i>), blueberry lily (<i>Dianella revoluta</i>), slender wire lily (<i>Laxmannia gracilis</i>) and rock fern (<i>Cheilanthes sieberi</i>).

Description: Open forests in the central and lower Hunter Valley, with a canopy dominated by spotted gum and narrow-leaved ironbark. The mid-storey consists of a sparse shrub layer, and the ground layer is predominately grassy with various graminoids, forbs and small ferns.

3.1.12 PCT 1603 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Vegetation formation: Grassy Woodlands

Vegetation class: Coastal Valley Grassy Woodlands

Conservation status: Assumed consistent with the Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act.

Estimate of percent cleared: 77.00

Stratum	Typical species
Upper	Narrow-leaved ironbark (<i>Eucalyptus crebra</i>) and grey box (<i>Eucalyptus moluccana</i>).
Middle	Bulloak (<i>Allocasuarina luehmannii</i>), native blackthorn (<i>Bursaria spinosa</i>) and coffee bush (<i>Breynia oblongifolia</i>).
Ground	Barbed wire grass (<i>Cymbopogon refractus</i>), purple wiregrass (<i>Aristida ramosa</i>), kangaroo grass (<i>Themeda australis</i>), rock fern (<i>Cheilanthes sieberi</i>), bristly cloak fern (<i>Cheilanthes distans</i>), pomax (<i>Pomax umbellata</i>), <i>Dichondra</i> sp. A, many-flowered mat-rush (<i>Lomandra multiflora</i>) and amulla (<i>Eremophila debilis</i>).

Description: Open forests in the central and lower Hunter Valley, with a canopy dominated by narrow-leaved ironbark. The mid-storey consists of an open shrub layer, and the ground layer is predominately grassy with various graminoids, forbs and small ferns.

3.1.13 PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter

Vegetation formation: Grassy Woodlands

Vegetation class: Coastal Valley Grassy Woodlands

Conservation status: Assumed consistent with the Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC listed under the BC Act and the Central Hunter Valley Eucalypt Forest and Woodland CEEC listed under the EPBC Act.

Estimate of percent cleared: 71.00

Stratum	Typical species
Upper	Narrow-leaved ironbark (<i>Eucalyptus crebra</i>), spotted gum (<i>Corymbia maculata</i>) and grey box (<i>Eucalyptus moluccana</i>).
Middle	Native blackthorn (<i>Bursaria spinosa</i>) and sticky daisy-bush (<i>Olearia elliptica</i>).
Ground	Amulla (<i>Eremophila debilis</i>), barbed wire grass (<i>Cymbopogon refractus</i>), purple wiregrass (<i>Aristida ramosa</i>), weeping grass (<i>Microlaena stipoides</i>), threeawn speargrass (<i>Aristida vagans</i>), many-flowered mat-rush (<i>Lomandra multiflora</i>), rock fern (<i>Cheilanthes sieberi</i>) and blue trumpet (<i>Brunoniella australis</i>).

Description: Open forests with a sparse shrub layer in the central and lower Hunter Valley. The ground layer is predominately grassy with scattered graminoids; forbs and small ferns.

3.1.14 PCT 1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley

Vegetation formation: Forested Wetlands

Vegetation class: Coastal Swamp Forests

Conservation status: NA

Estimate of percent cleared: 62.00

Stratum	Typical species
Upper	Swamp oak (<i>Casuarina glauca</i>) and forest red gum (<i>Eucalyptus tereticornis</i>).
Middle	Forest nightshade (<i>Solanum prinophyllum</i>)
Ground	Weeping grass (<i>Microlaena stipoides</i>), kidney weed (<i>Dichondra repens</i>), common couch (<i>Cynodon dactylon</i>), slender bamboo grass (<i>Austrostipa verticillata</i>), <i>Opismenus aemulus</i> , whiteroot (<i>Pratia purpurascens</i>).

Description: Occurs on riparian and poorly drained floodplain sites; frequently associated with brackish water in the central an upper Hunter Valley. Substrates are sedimentary or unconsolidated alluvium and elevations range from 30 to 300 metres. No mid-stratum is present and shrubs occur as isolated individuals. The ground stratum is typically grassy with scattered forbs.

3.2 Threatened ecological communities

Four vegetation zones described above and mapped within the proposal area conform to State or Commonwealth listed TECs. Table 3.2 details the area of TECs listed under the BC Act within the proposal area and impact area. Table 3.3 details the area of TECs listed under the EPBC within the proposal area and impact area.

Table 3.2 Vegetation Zones Conforming to TECs Listed under the BC Act

TEC	Proposal area (ha)	Impact area (ha)
<i>Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC</i>	0.47	-
<i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i>	3.83	1.22
<i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC</i>	39.44	13.97
<i>Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC</i>	0.15	-
Total	43.88	15.19

A total of 1.22 hectares of Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) and 13.98 hectares of Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) will be cleared as a result of the proposed work.

Table 3.3 Vegetation Zones Conforming to TECs Listed under the EPBC Act

TEC	Proposal area (ha)	Impact area (ha)
<i>Central Hunter Valley Eucalypt Forest and Woodland</i> CEEC	47.77	16.89

A total of 16.89 hectares of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act) will be cleared as a result of proposed work.

TECs listed under the BC Act are shown on Figure 3.2 and TECs listed under the EPBC Act are shown on Figure 3.3.

Analysis of consistency with the Final Determinations/Approved Conservation Advice for each TEC was carried out, with consideration of the advice provided by the NSW Threatened Species Scientific Committee and/or the Commonwealth Threatened Species Scientific Committee Guidelines for interpreting listings for species, populations and ecological communities and policy statement under the BC Act and EPBC Act respectively. In particular, comparisons of floristic structure and composition, geographical location, biophysical attributes (soil type, location in the landscape, etc) and other specifically relevant attributes, such as key diagnostic features and condition thresholds (in the case of the EPBC Act CEEC) were made.

The following sections summarise the findings of these comparisons/analyses. A comparison with the *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions* EEC has not been conducted as the TEC is based on regional mapping, does not occur in the impact area and constitutes a small area (0.15 hectares) in the proposal area.

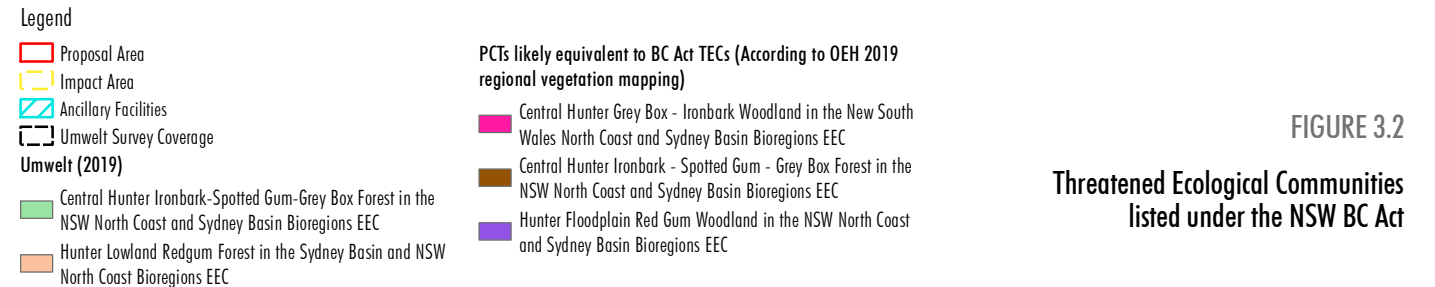
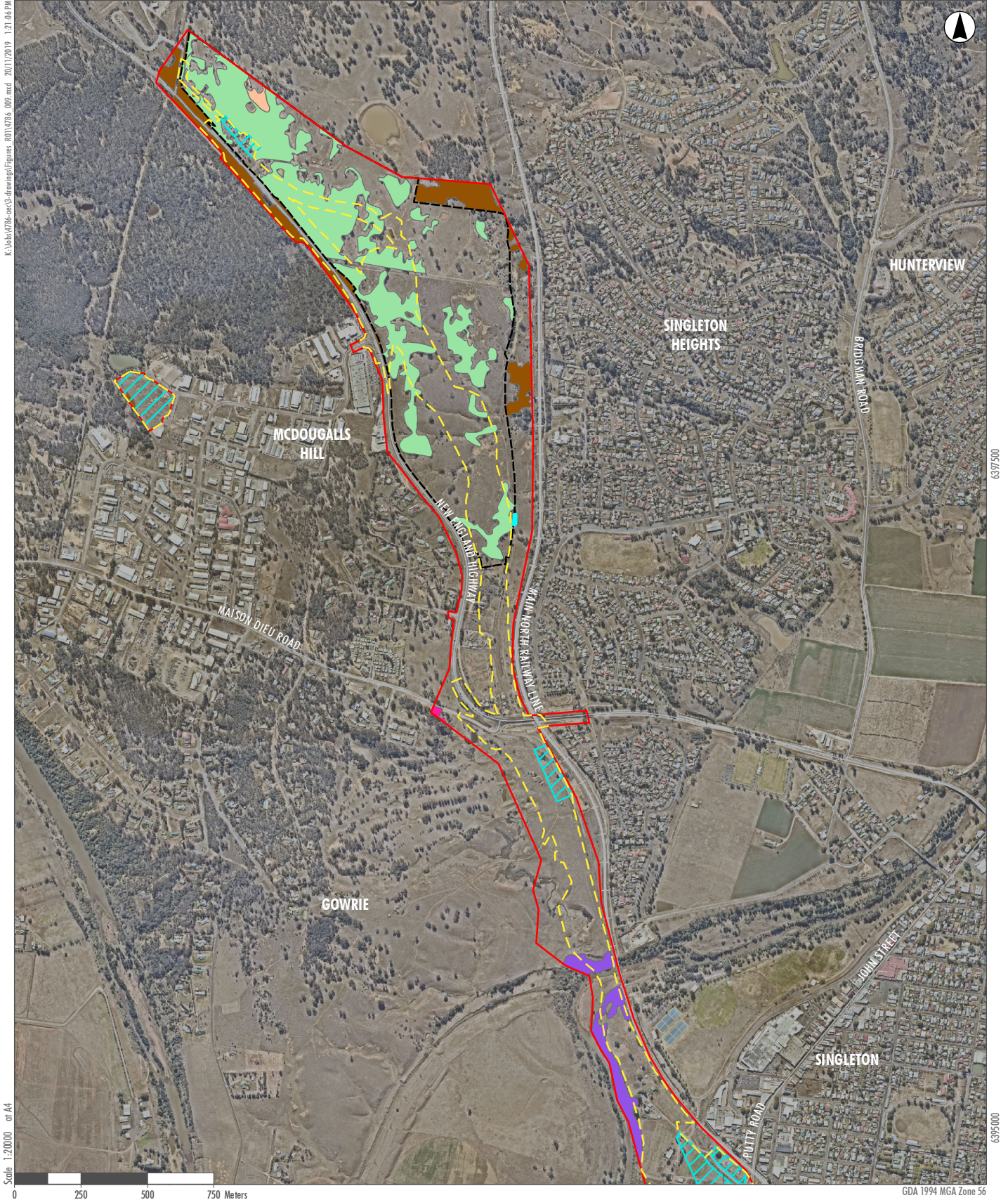
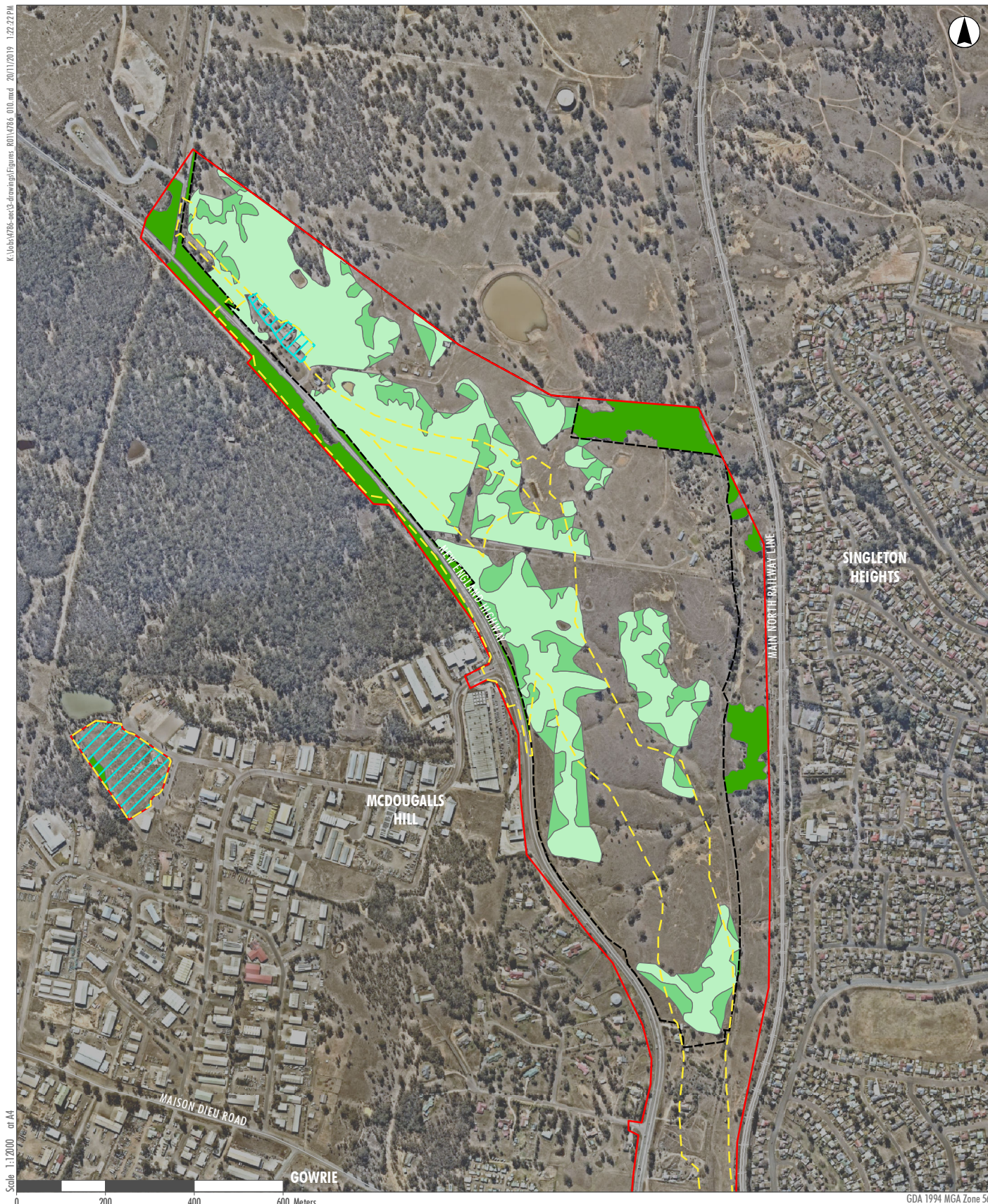


FIGURE 3.2

Threatened Ecological Communities listed under the NSW BC Act



Scale 1:12000 at A4

Legend

- Proposal Area
- Impact Area
- Ancillary Facilities
- Umwelt Survey Coverage

Umwelt (2019)

- Central Hunter Valley Eucalypt Forest and Woodland CEEC
- Central Hunter Valley Eucalypt Forest and Woodland CEEC - Derived Native Grassland Form

PCTs likely equivalent to the Central Hunter Valley Eucalypt Forest and Woodland CEEC (According to OEH 2019 regional vegetation mapping)

Central Hunter Valley Eucalypt Forest and Woodland CEEC

FIGURE 3.3

Central Hunter Valley Eucalypt Forest and Woodland CEEC Listed under the Commonwealth EPBC Act

3.2.1 Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC Listed under the BC Act

Zone 1 – 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good condition is consistent with the NSW Threatened Species Scientific Committee’s Final Determination for the *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC* (NSW Scientific Committee 2011). Table 3.4 summarises the findings of this comparison.

Zone 2 – 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Derived Native Grassland is not consistent with *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC* as the Final Determination does not include derived native grassland forms.

Table 3.4 Comparison of Final Determination for Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions EEC Listed under the BC Act to Vegetation Zone 1 – 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good condition

Final Determination	Vegetation Zone 1 within the proposal area
Location – in the NSW Sydney Basin and NSW North Coast Bioregion.	Occurs in Sydney Basin Bioregion.
Location – recorded in the LGAs Maitland, Cessnock, Port Stephens, Singleton and Muswellbrook.	Occurs in the Singleton LGA.
Found on gentle slopes arising from depressions and drainage flats on Permian sediments of the Hunter Valley floor.	Occurs on Permian sediments on gentle slopes in association with the upper reaches of a drainage line.
Community structure is typically an open forest.	Occurs as an open forest.
Characteristic flora assemblage.	25% of the species on the characteristic species list were recorded.
Common canopy species comprise <i>Eucalyptus tereticornis</i> and <i>Eucalyptus punctata</i> , although other frequently occurring canopy species include <i>Angophora costata</i> , <i>Corymbia maculata</i> , <i>Eucalyptus crebra</i> and <i>Eucalyptus moluccana</i>	Canopy is dominated by <i>Eucalyptus tereticornis</i> , with occurrences of <i>Eucalyptus crebra</i> .
Mid stratum is characterised as open with sparse shrubs of <i>Breynia oblongifolia</i> , <i>Leucopogon juniperinus</i> , <i>Daviesia ulicifolia</i> and <i>Jacksonia scoparia</i>	Shrubs are absent given the history of grazing.
Ground layer of grasses and herbs, characterised by <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Cymbopogon refractus</i> , <i>Echinopogon caespitosus</i> var. <i>caespitosus</i> , <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> and <i>Pratia purpurascens</i> .	Seven characteristic ground layer species recorded, including <i>Microlaena stipoides</i> var. <i>stipoides</i> and <i>Pratia purpurascens</i> .

This TEC does not occur in the impact area.

3.2.2 Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC Listed under the BC Act

Where PCT 42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley is mapped in the proposal area (OEH 2019b) it is assumed to be consistent with the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* listed under the BC Act. This is based on information provided through rapid assessments conducted by ELA. Recommendations are provided in Section 5.

Final Determination	Vegetation Zone 1 within the proposal area
Location – in the NSW North Coast and Sydney Basin Bioregion.	Occurs in Sydney Basin Bioregion.
Location – recorded in the LGAs Maitland, Mid-Western, Muswellbrook, Singleton, and Upper Hunter.	Occurs in the Singleton LGA.
Community structure is typically a tall woodland	Occurs as a tall woodland.
Occurs on floodplains and associated floodplain rises along the Hunter River and tributaries	Occurs on a floodplain along the Hunter River.
Common canopy species comprise <i>Eucalyptus camaldulensis</i> in combinations with <i>Eucalyptus tereticornis</i> , <i>Eucalyptus melliodora</i> and <i>Angophora floribunda</i> .	Canopy contains <i>Eucalyptus camaldulensis</i> .

1.22 hectares of this TEC occurs in the impact area.

3.2.3 Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC Listed under the BC Act

Zone 3 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate to Good Condition and Zone 4 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy are consistent with the NSW Threatened Species Scientific Committee's Final Determination for the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC* (NSW Scientific Committee 2010). Table 3.5 summarises the findings of this comparison.

Zone 5 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Derived Native Grassland is not consistent with *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC* as the final determination does not include derived native grassland forms.

Table 3.5 Comparison of Final Determination for Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC Listed under the BC Act to Vegetation Zones 3 and 4

Final Determination	Vegetation Zone 3 and 4 within the Proposal area
Location – on NSW North Coast and Sydney Basin Bioregion.	Occurs in Sydney Basin Bioregion.
Location – recorded in the LGAs of Cessnock, Singleton and Muswellbrook.	Occurs in the Singleton LGA.

Final Determination	Vegetation Zone 3 and 4 within the Proposal area
Generally occurs on Permian sediments.	Occurs on soils characterised by Permian sediments.
Community structure is typically Open Forest to Woodland.	Occurs as an Open Forest, Woodland and Open Woodland, depending on land use and disturbance history.
Characteristic flora species assemblage	68% of species on characteristic species list were recorded in the proposal area.
Canopy is dominated by <i>Eucalyptus crebra</i> , <i>Corymbia maculata</i> and <i>Eucalyptus moluccana</i> . Other tree species may be present and occasionally dominate or co-dominate, and include <i>Eucalyptus fibrosa</i> and <i>Eucalyptus tereticornis</i> .	The canopy is dominated by <i>Eucalyptus crebra</i> , <i>Corymbia maculata</i> and <i>Eucalyptus moluccana</i> . There are also occurrences of <i>Eucalyptus fibrosa</i> and <i>Eucalyptus tereticornis</i> .
A sparse layer of small trees may be present in some areas, typically including <i>Allocasuarina luehmannii</i> or <i>Acacia parvipinnula</i> .	<i>Allocasuarina luehmannii</i> was recorded in low abundance across the proposal area.
The shrub layer is typically sparse or absent in some cases, through to moderately dense. Common shrub species include <i>Daviesia ulicifolia</i> , <i>Pultenaea spinosa</i> , <i>Breynia oblongifolia</i> , <i>Hakea sericea</i> and <i>Bursaria spinosa</i> .	The shrub layer is typically sparse or absent, with occurrences in some areas of <i>Daviesia ulicifolia</i> , <i>Breynia oblongifolia</i> and <i>Bursaria spinosa</i> .
Ground cover can be sparse to moderately dense, and consists of numerous forbs, a few grass species, and a limited number of ferns, sedges or other herbs	The ground cover is typically mid-dense and contains many of the common species listed in the EEC final determination.

Where flora surveys have not been carried out in the proposal area, those areas mapped as PCT 1600, PCT 1601 and PCT 1604 by regional vegetation mapping (OEH 2019b) have also been considered consistent with this EEC.

A total of 13.98 hectares of this TEC occur within the impact area.

3.2.4 Central Hunter Valley Eucalypt Forest and Woodland CEEC Listed under the EPBC Act

Central Hunter Valley Eucalypt Forest and Woodland CEEC occurs in the Hunter Valley region on soils derived from Permian sedimentary bedrock (TSSC 2015). Typically, it is characterised as a eucalypt woodland and open forest, with a shrub layer of variable density and/or a grassy ground layer. Across its range, one or more of a complex of four eucalypt tree species, namely spotted gum (*Corymbia maculata*), narrow-leaved ironbark (*Eucalyptus crebra*), slaty gum (*Eucalyptus dawsonii*) or grey box (*Eucalyptus moluccana*) dominate the canopy (TSSC 2015).

Targeted surveys to map *Central Hunter Valley Eucalypt Forest and Woodland CEEC* were carried out in the northern portion of the proposal area (Umwelt 2019) in accordance with the sampling protocols and with consideration of the key diagnostic characteristics and condition thresholds provided within the Approved Conservation Advice (TSSC 2015). These 'key diagnostic characteristics' and 'condition thresholds' provided by the Approved Conservation Advice (TSSC 2015) and Identification Guide (DoEE 2016) formed the basis for delineating and identifying patches of native vegetation as being the threatened ecological community and distinguishing between patches of different quality. Additionally, Umwelt have considered previous advice provided to Umwelt by the Commonwealth Ecological Communities Section of DoEE for the *Central Hunter Valley Eucalypt Forest and Woodland CEEC*.

The following vegetation zones are considered, either entirely or in part, to conform to the *Central Hunter Valley Eucalypt Forest and Woodland CEEC*:

- Zone 3 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate to Good Condition
- Zone 4 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy
- Zone 5 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Derived Native Grassland

The results of the assessment for these vegetation zones within the northern portion of the proposal area against the key diagnostic characteristics according to the Approved Conservation Advice are detailed in Table 3.6 below.

Table 3.6 Assessment of Vegetation Patches within the Northern Portion of the Proposal Area Against the Key Diagnostic Features according to the Approved Conservation Advice (TSSC 2015)

Key Approved Conservation Advice (TSSC 2015)	Vegetation patches within the Proposal area
Key Diagnostic Characteristics	
It occurs in the Hunter River catchment (typically called the Hunter Valley region)	Yes – the northern portion of the proposal area occurs within the Hunter River catchment.
It typically occurs on lower hillslopes and low ridges, or valley floors in undulating country; on soils derived from Permian sedimentary rocks	Yes – the northern portion of the proposal area is underlain by Permian derived soils in undulating country on low hillslopes and ridges of the valley floor.
It does not occur on alluvial flats, river terraces, Aeolian sands, Triassic sediments or escarpments	Yes – the northern portion of the proposal area does not occur on alluvial flats, river terraces, Aeolian sands, Triassic sediments or escarpments.
It is woodland or forest, with a projected canopy cover of trees of 10 per cent or more; or with a native tree density of at least 10 native tree stems per 0.5 ha (at least 20 native tree stems/ha) that are at least one metre in height	Yes – patches associated with vegetation zones 3 and 4 within the proposal area comprise a projected canopy of cover at least 10 per cent with a native tree density of at least 10 native tree stems per 0.5 hectares that are at least one metre in height.
The canopy of the ecological community is dominated by one or more of the following four eucalypt species: <i>Eucalyptus crebra</i> (narrow-leaved ironbark), <i>Corymbia maculata</i> (syn. <i>E. maculata</i>) (spotted gum), <i>E. dawsonii</i> (slaty gum) and <i>E. moluccana</i> (grey box); OR a fifth species, <i>Allocasuarina luehmannii</i> (bullock, buloke) dominates in combination with one or more of the above four eucalypt species, in sites previously dominated by one or more of the above four eucalypt species	Yes – The canopy is dominated by <i>Eucalyptus crebra</i> , <i>Corymbia maculata</i> and <i>Eucalyptus moluccana</i> . <i>Allocasuarina luehmannii</i> only occurs in low abundance.
<i>Allocasuarina torulosa</i> (forest oak/ she-oak, rose she-oak/oak), <i>Eucalyptus acmenoides</i> (white mahogany) and <i>Eucalyptus fibrosa</i> (red/broad-leaved ironbark) are largely absent from the canopy of a patch. Largely absent: meaning no more than two trees per hectare on average across a patch.	The only contra-indicative species recorded was <i>Eucalyptus fibrosa</i> , which dominated a portion of the northern tip of the proposal area. This area was excluded based on there being more than two trees per hectare on average in this patch.

Key Approved Conservation Advice (TSSC 2015)	Vegetation patches within the Proposal area
A ground layer is present (although it may vary in development and composition), as a sparse to thick layer of native grasses and other native herbs and/or native shrubs	Yes – all vegetation patches within the northern portion of the proposal area have a mid-dense to dense ground layer dominated by native grasses and other native herbs and/or native shrubs.
Other Relevant Diagnostic Consideration	
Derived native grassland and shrublands are not included in this nationally protected ecological community. The exceptions are where there is a gap, in or at the edge of a patch; or connecting two patches across a short distance (i.e. 30 metres).	Portions of vegetation zone 5 (derived native grasslands) have been mapped within gaps or between patches of woodland and forest forms of the CEEC that are separated by less than 30 metres from the outer edge of the canopy. It is noted that the Approved Conservation Advice (TSSC 2015) and Identification Guide (DoEE 2016) provide details on the mapping of derived native grasslands, however the delineation of derived native grasslands is complex in heterogenous sites. The mapping of derived native grasslands by Umwelt have followed the rules as specified in the Approved Conservation Advice (TSSC 2015) and Identification Guide (DoEE 2016b), however in some cases there is opportunity for subjective interpretation and in such cases Umwelt has applied a line of best fit to represent the rules.

In addition to the key diagnostic attributes in Table 3.6, areas mapped as *Central Hunter Valley Eucalypt Forest and Woodland* CEEC meet the minimum condition thresholds for moderate quality to high quality condition, as defined in the Approved Conservation Advice (TSSC 2015) for this CEEC in the proposal area.

Where flora surveys have not been undertaken in the proposal area, those areas mapped as PCT 1600, PCT 1601, PCT 1603 and PCT 1604 by regional vegetation mapping (OEH 2019b) have also been considered consistent with this EEC.

A total of 16.89 hectares of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC occur in the impact area.

3.3 Groundwater dependent ecosystems

A review of the Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (BoM 2019) identified the Hunter River as a high potential aquatic Groundwater Dependent Ecosystem (GDE) with an inflow dependent ecosystems likelihood score of 10, that is the ecosystem is reliant on groundwater in addition to rainfall in the Hunter River channel (BOM 2019).

No terrestrial or subterranean GDE are mapped in the proposal area (BOM 2019). However, it is recognised that PCT 42 and the river red gums have some dependency on groundwater and are terrestrial GDEs.

3.4 Threatened species and populations

Nine threatened species were recorded as present, and four threatened species as potentially present, during fauna surveys conducted by ELA (refer to table 3.7 and Figure 3.4).

Table 3.7 Habitat assessment and surveys results

Scientific name	Common Name	Status		Comments
		BC Act	EPBC Act	
Birds				
<i>Hieraaetus morphnoides</i>	little eagle	V	-	
<i>Pomatostomus temporalis</i>	grey-crowned babbler	V	-	
<i>Tyto novaehollandiae</i>	masked owl	V	-	Potential sighting
Mammals				
<i>Falsistrellus tasmaniensis</i>	eastern false pipistrelle	V	-	Potential recording
<i>Micronomus norfolkensis</i>	eastern coastal free-tailed bat	V	-	
<i>Miniopterus australis</i>	little bent-winged bat	V	-	
<i>Miniopterus orianae oceanensis</i>	large bent-winged bat	V	-	
<i>Myotis macropus</i>	southern myotis	V	-	
<i>Petaurus norfolcensis</i>	squirrel glider	V	-	
<i>Phascogale tapoatafa</i>	brush-tailed phascogale	V	-	
<i>Pteropus poliocephalus</i>	grey-headed flying-fox	V	V	Flying over proposal area
<i>Scoteanax rueppellii</i>	greater broad-nosed bat	V	-	Potential recording
<i>Vespadelus troughtoni</i>	eastern cave bat	V	-	Potential recording

Habitat for threatened species which occur in the proposal area include:

- approximately 97.93 hectares of native vegetation, comprised of 52.82 hectares of grassland habitat and 45.1 hectares of woodland and forest vegetation that contains 239 hollow-bearing trees (refer to Figure 3.5)
- One known and five potential microbat roost sites in existing sandstone block culverts
- Key fish habitat in the Hunter River.

Based on rapid assessment points conducted by ELA, two river red gums (*Eucalyptus camaldulensis*) were recorded in the proposal area, outside of the impact area. These form part of the *Eucalyptus camaldulensis* – endangered population in the Hunter catchment was

Threatened species, populations, communities listed and migratory species under the BC Act and EPBC Act that have the potential to occur within the proposal area have been identified in the Habitat Assessment in Appendix C.



Legend

- Proposal Area
- Impact Area
- Ancillary Facilities
- Hollow-bearing Tree
- Brush-tailed Phascogale
- Eastern Bentwing Bat
- Eastern Coastal Free-tailed Bat
- *Eucalyptus camaldulensis* endangered population in the Hunter catchment
- Grey-crowned Babbler
- Little Bentwing Bat
- Little Eagle
- ▲ Microbat Roost
- Southern Myotis
- Squirrel Glider
- Masked Owl (potential record)

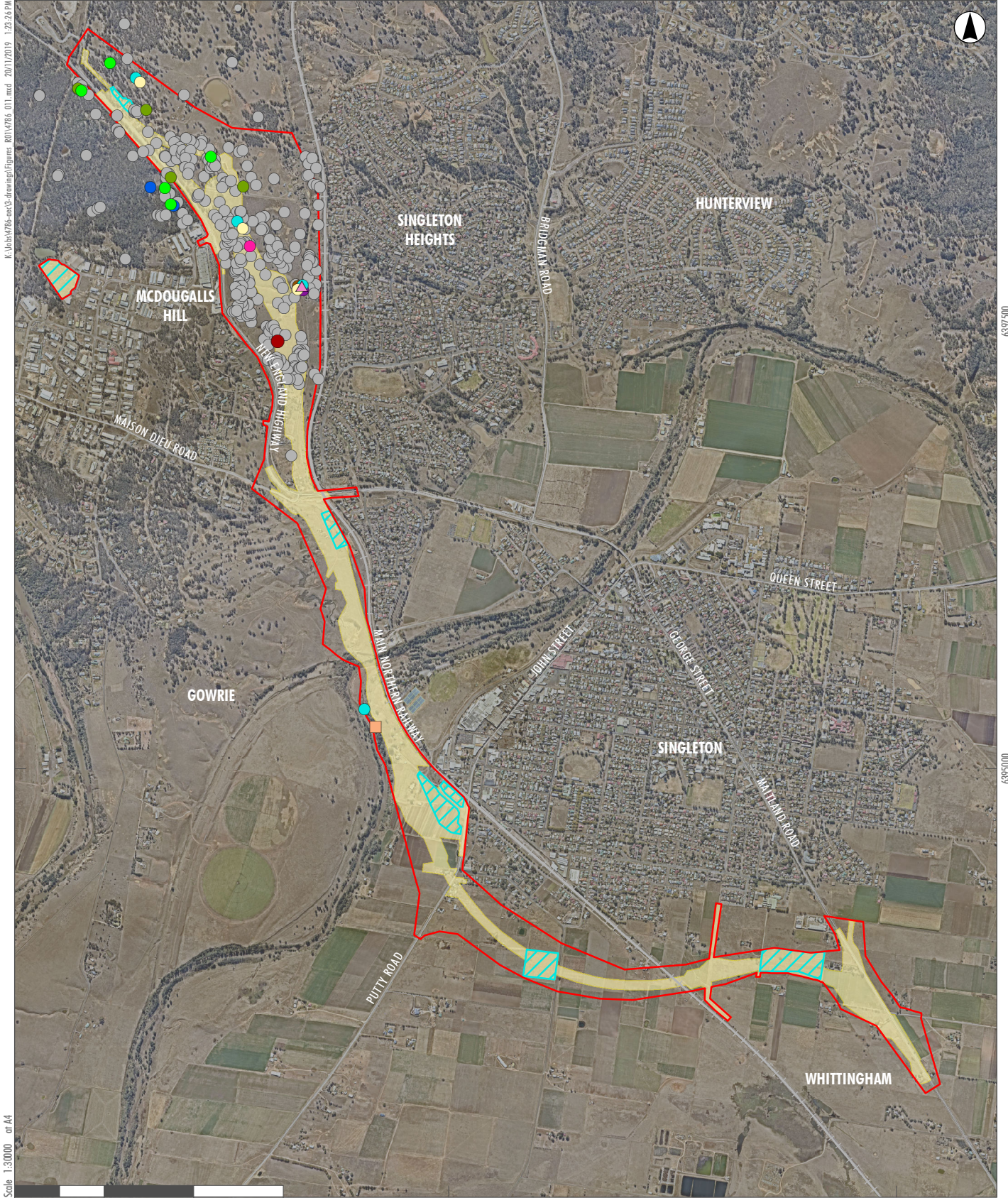


FIGURE 3.4

Threatened Species and Key Habitat Features

3.5 Aquatic results

The Hunter River is mapped as key fish habitat under the NSW DPI Key Fish Habitat mapping for the Singleton LGA (DPI 2018a), and forms part of the known distribution for the threatened southern purple-spotted gudgeon (*Mogurnda adspersa*). The species 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 riverbanks, leaf litter, rocks or snags are important for the species (DPI 2017).

The nearest known population of the southern purple-spotted gudgeon occurs in Goorangoola Creek approximately 20 kilometres north of Singleton in a tributary of Glennies Creek. This population occurs outside what was previously considered the natural range of the species, and it is unclear whether this population is natural or recently introduced to this location (DPI 2017).

The aquatic assessment was carried out by ELA at the Hunter River crossing location (defined as the area 100 metres upstream from the Main North railway line bridge) (Photographs 3.11, and 3.12) and for the adjoining sections of the Hunter River 100 metres upstream (Photographs 3.13 and 3.14) and downstream (Plate 3.15) of the bridge over the Hunter River. Result of the aquatic survey are summarised in Table 3.8. Due to property access restriction, an assessment of the aquatic habitat value of the ephemeral waterway to the north of the Hunter River has not been completed by ELA.

Table 3.8 Results of Aquatic Assessment of the Hunter River (ELA)

Feature Type	Description at crossing site	Description upstream	Description downstream
Turbidity	Moderate	Moderate	Moderate
Waterbody type	Large flowing pool	Large flowing pool	Large flowing pool
Aquatic vegetation	Nil	Emergent fringing sedges and rushes	Emergent fringing sedges and rushes
Overhanging vegetation	Nil	Some overhanging trees (<i>Salix</i> spp. and <i>Casuarina</i> spp.)	Some overhanging trees (<i>Salix</i> spp. and <i>Casuarina</i> spp.)
Riffles	Nil	Nil	Minor riffle just downstream of rail bridge
Snags	Nil	Occasional, some logs and branches	Occasional, some logs and branches
Bank nature	Sandy beach/rocky bank with few small trees	Sandy beach/vegetated bank	Sandy beach/vegetated bank

For the purposes of the application of the FM Act, NSW DPI has developed a classification scheme for the sensitivity of key fish habitat, to define the importance of habitat for the survival of fish and the ability of the habitat to withstand disturbance. In accordance with the Policy and guidelines for fish habitat conservation and management (DPI 2013), the Hunter River constitutes Type 1 highly sensitive key fish habitat including (but not limited to):

- Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 millimetres in two dimensions, snags greater than 300 millimetres in diameter or 3 metres in length, or native aquatic plants
- Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act.

The functionality of the Hunter River as fish habitat has been defined by NSW DPI (DPI 2013) to assess impact of activities on fish habitat, in conjunction with habitat sensitivity, and to make management recommendations to minimise the impact of developments. In keeping with the classification system of NSW DPI (DPI 2013), for fish passage the Hunter River provides

Class 1: Major key fish habitat, being permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.

A Seven Part Test of Significance has been conducted for the southern purple-spotted gudgeon (Appendix G). This species is considered unlikely to occur in the proposal area due to the habitat lacking characteristic features, and the location of the site outside of the species' normal range.



Photograph 3.11 Proposed location of the bridge over the Hunter River (foreground) and the Main North Railway Line bridge (background)



Photograph 3.12 View of the proposed location of the bridge over the Hunter River from the southern bank of the river.



Photograph 3.13 The Hunter River upstream of the proposed bridge location



Photograph 3.14 Upstream of crossing site



Photograph 3.15 Downstream of crossing site

3.6 Critical habitat and Areas of Outstanding Biodiversity Values

No critical habitat listed under the FM Act was identified within the proposal area.

No declared areas of outstanding biodiversity values listed under the BC Act occur within the proposal area.

3.7 Wildlife connectivity corridors

Wildlife corridors are largely limited to those occurring along the Hunter River and remnant vegetation north of the Hunter River between the New England Highway and the railway line.

A large area of remnant vegetation (approximately 250 hectares) occurs to the west of the New England Highway between Maison Dieu Road and Rixs Creek (Figure 1.2).

3.8 SEPPs

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) applies to development applications in the Singleton local government area. While a development application is not being lodged for the land in the proposal area, the habitat definitions and development controls identified in Part 3 of SEPP 44 have been used to define potential and core koala habitat.

Under SEPP 44 potential koala habitat is defined as areas of native vegetation where koala feed trees listed in Schedule 2, constitute at least 15 per cent of the total number of trees. Two PCTs in the proposal area meet this definition, comprising PCT 42 which contains a high proportion of river red gum (*Eucalyptus camaldulensis*) and PCT 1598 which contains a high proportion of forest red gum (*E. tereticornis*). However, no river red gums occur in the impact area where PCT 42 occurs, and PCT 1598 does not occur in the impact area.

Core koala habitat means that the land supports a resident population of koalas (breeding females and young). While potential koala habitat may occur around the proposal area there are only four records of the koala (*Phascolarctos cinereus*) in the locality and the likelihood of assessment table (Appendix C) determined that the koala has a low likelihood of occurrence in the proposal area.

No other SEPPs apply to the proposal.

3.9 Matters of National Environmental Significance

Threatened species, populations, communities listed and migratory species under the EPBC Act that have the potential to occur within the proposal area have been identified in the Habitat Assessment in Appendix C.

One wetland of international importance was identified in the vicinity of the proposal area being the Hunter estuary wetlands. This occurs 45 to 50 kilometres downstream of the proposal area.

No World Heritage or National Heritage places were identified within the proposal area. Assessments of Significance under the EPBC Act were conducted by Umwelt for the following threatened ecological communities and species (Appendix F):

- Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
- grey-headed flying-fox (Vulnerable under EPBC Act)
- koala (Vulnerable under the EPBC Act)

- regent honeyeater (Critically Endangered under the EPBC Act)
- swift parrot (Critically Endangered under the EPBC Act)
- spotted-tailed quoll (Endangered under the EPBC Act).

4 Impact assessment

A range of biodiversity impacts are likely to result from the proposal during the construction and operational phases. The removal of 31.93 hectares of native vegetation and threatened fauna habitat during proposed work has potential to result in disturbance, injury and mortality of fauna. Construction of the temporary instream structures in the Hunter River has the potential to result in alteration of fish passage during construction.

The long-term effects of these impacts during the operation phase include the fragmentation of fauna habitat and resulting loss of wildlife connectivity corridors in the locality. Invasion and spread of weeds, pests and pathogens, and changes to surface hydrology may occur as a result of the changed landscape.

The following sections discuss these impacts and identify relevant key threatening processes that may be exacerbated by the proposed work. Cumulative impacts from other projects in the region have been considered, and assessments of significance conducted for threatened entities based on the impacts identified.

4.1 Construction impacts

4.1.1 Removal of native vegetation

The impact area has an area of 109.69 hectares, which contains 31.93 hectares of native vegetation which would be cleared as a result of the proposal (Table 4.1). Vegetation consistent with an EEC which occurs within a compound will be avoided (Section 5).

Table 4.1 Impacts on native vegetation

Plant community type (PCT)	Estimate of % cleared (according to VIS)	Status		Area in impact area (ha)
		BC Act	EPBC Act	
Ground-truthed vegetation mapping (Umwelt 2019)				
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate/Good	71.00	Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC	Central Hunter Valley Eucalypt Forest and Woodland CEEC	5.34
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy	71.00	Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC	Central Hunter Valley Eucalypt Forest and Woodland CEEC	6.35
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – DNG	71.00	-	Portions consistent with Central Hunter Valley Eucalypt Forest and Woodland CEEC	14.21
Regional vegetation mapping (OEH 2019b)				
42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	95.00	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney	-	1.22

Plant community type (PCT)	Estimate of % cleared (according to VIS)	Status		Area in impact area (ha)
		BC Act	EPBC Act	
		<i>Basin Bioregions EEC</i>		
1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter	71.00	<i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC</i>	<i>Central Hunter Valley Eucalypt Forest and Woodland CEEC</i>	2.21
1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter DNG	71.00	-	-	2.44
1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter	71.00	<i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC</i>	<i>Central Hunter Valley Eucalypt Forest and Woodland CEEC</i>	0.08
1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley	62.00	-	-	0.08
Total				31.93

There are four known and two potential key threatening processes (KTPs) under the BC Act relevant to the removal of native vegetation (Table 4.2).

Table 4.2 KTPS relevant to native vegetation removal

Key threatening process	Type of Threat	Relevance to proposal
Known		
Clearing of native vegetation	Habitat loss/change	Proposal will result in the direct removal of 31.93 hectares of native vegetation.
Loss of hollow-bearing trees	Habitat loss/change	Proposal will result in the direct removal of 96 hollow-bearing trees.
Removal of dead wood and dead trees	Habitat loss/change	Proposal will result in the direct removal of dead wood and seven dead trees.
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Habitat loss/change	Proposal will result in operation of this KTP.
Potential		
Invasion of native plant communities by exotic perennial grasses	Weed	Exotic perennial grasses are present in the impact area, particularly along roadsides. Weed management required to avoid/reduce

Key threatening process	Type of Threat	Relevance to proposal
		impact of this KTP.
Invasion of native plant communities by African olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	Weed	African olive occurs in the northern section of the impact area, near McDougalls Hill. Weed management required to avoid/reduce impact of this KTP.

Based on the Assessments of Significance (Appendices D, E, and F) the implications of the known KTPs are not considered to be significant. Safeguards and mitigation measures for the potential KTPs are provided in Section 5.

4.1.2 Removal of threatened fauna habitat

The 31.93 hectares of native vegetation which occurs in the impact area and ancillary compounds provides potential foraging and/or breeding habitat for numerous threatened fauna species (Appendix C). The proposal would result in the removal of 96 hollow-bearing trees, many of which contain multiple hollows and seven of which are stags. Together, these HBTs constitute:

- 192 hollows less than 5 centimetres wide (84 trees)
- 150 hollows five to 10 centimetres wide (70 trees)
- 60 hollows 10 to 20 centimetres wide (45 trees)
- 13 hollows 20 to 30 centimetres wide (12 trees)
- Three hollows greater than 30 centimetres wide (three trees).

Six culverts which provide potential habitat for microbats, including the southern myotis (*Myotis macropus*) which was recorded during surveys, occur within the proposal area adjacent to the impact area. Four of these occur greater than 200 metres to the north, in a different catchment from the impact area and will not be disturbed by drainage or sedimentation impacts of the proposed work. Two culverts occur between approximately 20 to 50 metres of the impact area, in the receiving environment, and could be indirectly impacted by the work through increased noise, light and vibration impacts. Assessments of Significance (Appendices D and E) determined that no threatened microbat species were likely to be significantly impacted by the proposed work considering a range of mitigation measures recommended in Section 5 below.

There are three known and four low potential KTPs under the BC Act relevant to the removal of threatened fauna habitat (Table 4.3).

Table 4.3 KTPS relevant to removal of threatened fauna habitat

Key threatening process	Type of Threat	Relevance to proposal
Known		
Clearing of native vegetation	Habitat loss/change	Proposal will result in the direct removal of 31.93 hectares of native vegetation.

Key threatening process	Type of Threat	Relevance to proposal
Loss of hollow-bearing trees	Habitat loss/change	Proposal will result in the direct removal of 96 hollow-bearing trees.
Removal of dead wood and dead trees	Habitat loss/change	Proposal will result in the direct removal of dead wood and seven dead trees.
Low Potential		
Competition and grazing by the feral European rabbit	Pest animal	European rabbit is present in the impact area. Pest animal management may be required to avoid/reduce impact of this KTP.
Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	Pest animal	Feral dogs are potentially present in the impact area. Pest animal management may be required to avoid/reduce impact of this KTP.
Predation by feral cats	Pest animal	Feral cats are present in the impact area. Pest animal management may be required to avoid/reduce impact of this KTP.
Predation by the European red fox	Pest animal	European red foxes are present in the impact area. Pest animal management may be required to avoid/reduce impact of this KTP.

Based on the Assessments of Significance (Appendices D, E, and F) the implications of the known KTPs are not considered to be significant. Safeguards and mitigation measures for the potential KTPs are provided in Section 5.

4.1.3 Removal of threatened flora

Based on field survey results, three individuals of an endangered flora population have been recorded within the proposal area but outside of the impact area and ancillary compounds, being the *Eucalyptus camaldulensis* population in the Hunter catchment (BC Act). Based on rapid assessments conducted by ELA, it is not anticipated that any individuals from this population will be removed as a result of the proposal.

4.1.4 Aquatic impacts

The Hunter River is mapped as key fish habitat under the NSW DPI Key Fish Habitat Mapping for the Singleton LGA (DPI 2018b), and forms part of the mapped distribution for southern purple-spotted gudgeon (*Mogurnda adspersa*).

Within the impact area the Hunter River has been classified as Type 1 highly sensitive fish habitat and Class 1 major key fish habitat area as discussed in Section 3.5 (DPI 2013).

Features of the proposal that may impact the Hunter River where it occurs in the impact area are outlined in Section 1.2. The proposal includes construction of five piers and abutments, including four piers in the sandy beach on the southern bank of the river and one pier in the river channel. The new piers in the river would be constructed in the river approximately 40 metres upstream of the existing rail bridge.

Temporary access ramps, crane pads, sheet piling and a temporary rock platform in the river would impact on aquatic habitat values during construction. It is likely that dewatering would be required for sheet piling and pier construction where the work intersects groundwater.

A rock platform would be constructed adjacent to the Hunter River bridge on the southern bank of the river without blocking the main river channel. The banks would be protected by geotextile material with rock overlay, or similar, to protect them from tracked equipment including cranes required to access the instream platform to lift the bridge bidders into place. The final dimensions of the platform would be confirmed during detailed design. Clean rock would be placed on top of a geotextile liner. A silt curtain would be installed around the rock platform to protect water quality. The platform would be designed to ensure that flow of the main river channel and fish passage is maintained even during low flow periods.

Following the completion of bridge construction, the rock platform would be removed and the adjoining bank area returned to its original level and stabilised.

During the proposed work there would be the potential for impacts on the water quality through fuel spills and leaks from machinery, and from runoff of soils and materials into the waterway. If not controlled, this could lead to a degraded aquatic environment, increased turbidity and contamination of the waterway which could reduce the habitat quality for aquatic species. The implementation of the mitigation measures listed in Section 5 would reduce the likelihood for an incident to occur.

During construction one KTP as listed under the FM Act would operate, being the installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams. This would occur due to potential changes in natural flows associated with the temporary construction access structures, sheet piling and erosion control structures. However, the KTP would not operate in the long term as bridges have minimal impact on flow and are excluded.

It is unknown whether the proposal would increase operation of the KTP removal of large woody debris as it is unknown whether any large woody debris occur within the proposal area where it crosses the Hunter River.

The proposal would not degrade native riparian vegetation.

A seven-part test in accordance with Section 221ZV of the FM Act (Appendix G) determined that the southern purple spotted gudgeon was not likely to be significantly impacted by the proposed work.

4.1.5 Injury and mortality

During construction, 31.93 hectares of native vegetation including 96 hollow-bearing trees would require removal. This may result in injury or mortality to local native fauna during felling. Traffic flow would also increase in the area due to the presence of construction traffic during work hours (Section 1.2). The presence of construction traffic may cause injury or

mortality to fauna through vehicle strikes. Given the high number of existing vehicle movements around the impact area on the New England Highway, the likelihood of significantly increased fauna injury/mortality rates as a result of the proposal is considered low. Safeguards and mitigation measures for the prevention of fauna injury and mortality are provided in Section 5.

4.2 Indirect/operational impacts

4.2.1 Wildlife connectivity and habitat fragmentation

Vegetation occurring within the impact area is currently highly fragmented as a result of historic agricultural land practices. It contains areas of remnant native vegetation in the north, and part of the riparian corridor along the Hunter River. The proposal will increase the fragmentation of habitats through the removal of native vegetation including hollow-bearing trees, and pose a barrier (linear width ranging between approximately 30 and 250 metres) to terrestrial fauna.

While no mapped environmental corridors from existing datasets were identified, the forested area in the north portion of the proposal is considered to form part of a corridor for wildlife movements in the locality. Fauna may move through this area to access the substantial vegetated area to the west of the impact area and patchy vegetation to the east and north-east of McDougalls Hill. The current New England Highway bisects this corridor and creates an approximate 30 metre-wide linear barrier.

The proposal will widen the existing highway barrier up to widths of approximately 100 metres north of the McDougalls Hill Interchange. At the McDougalls Hill interchange the alignment deviates from the existing New England Highway and will not alter existing New England Highway conditions. The width of the new alignment will vary from approximately 40 metres to 250 metres. This will increase the existing barrier for fauna movement in the area, however it is not expected that the proposal would significantly increase the fragmentation of existing habitat so that it results in genetic isolation or prevents migration of species.

The proposal will result in edge effects to fauna including increased light, noise and vibration impacts during both the construction and operational phases. These will temporarily impact fauna species during construction by changes in foraging behaviours (i.e. avoidance of the impact area) and communication (i.e. potential reduced calling due to increased construction noise). The New England Highway currently has high traffic volumes, and fauna in the locality are currently not known to be substantially affected by these operational impacts. Fauna injury or mortality may occur where species attempt to cross the road. The implementation of the mitigation measures listed in Section 5 would reduce the likelihood of this occurring.

Pollinator and seed dispersal vectors for flora species are likely to include birds, mammals, insects and micro bats. The proposal is unlikely to result in a more substantial barrier for flora species pollinators than already is occurring.

Fish passage would be altered during construction however, upon completion, the bridge across the Hunter River is not expected to alter natural flows or block passage for any aquatic species or foraging micro-bats.

4.2.2 Edge effects on adjacent native vegetation and habitat

While the proposal will result in direct impacts to native vegetation through removal and modification within the impact area, native vegetation and habitat occurring adjacent to these areas will be subject to edge effects including:

- Modification of microclimate (i.e. increased light and wind penetration)
- Physical disturbance of vegetation through grading, weed control and vehicle use of the road
- Changes in surface drainage, particularly increased runoff.

Due to historical agricultural land practices, much of the vegetation within the proposal area has been subject to modified microclimates, physical disturbance and altered drainage. Areas of vegetation and habitat already occurring adjacent to the existing New England Highway, in particular, are already subject to these effects, and the proposal is not expected to exacerbate these effects to a substantial degree.

4.2.3 Invasion and spread of weeds

The proposal area is located in predominantly disturbed agricultural land. Areas containing native vegetation have been recorded with low to high abundances of exotic understorey species including seven priority weeds listed for the Singleton LGA as identified by the Department of Primary Industries and listed under the *Biosecurity Act 2015*. These include:

- African boxthorn (*Lycium ferocissimum*),
- African olive (*Olea europaea* subsp. *cuspidata*)
- Common prickly pear (*Opuntia stricta*)
- Creeping pear (*Opuntia humifusa*)
- Fireweed (*Senecio madagascariensis*)
- Lantana (*Lantana camara*)
- Tiger pear (*Opuntia aurantiaca*).

Safeguards and mitigation measures for the potential invasion and spread of weeds are provided in Section 5. It is not expected that the proposed work would exacerbate the invasion and spread of weeds within or outside of the proposal area.

4.2.4 Invasion and spread of pests

The proposal area is located in predominantly disturbed agricultural land, with fragmented patches of habitat within which European rabbits (*Oryctolagus cuniculus*), European red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) occur. Safeguards and mitigation measures for the potential invasion and spread of pests are provided in Section 5. It is not expected that the proposed work would exacerbate the invasion and spread of pests in the area.

4.2.5 Invasion and spread of pathogens and disease

The proposal will involve the movement of people, vehicles and organic material (e.g. soil) into and out of the impact area and ancillary compounds. While pathogens were not observed or tested for in the proposal area, the potential for pathogens to occur should be treated as a risk during construction. Safeguards and mitigation measures for the potential introduction and spread of pathogens are provided in Section 5.

It is not expected that the proposed work would exacerbate the invasion and spread of pathogens and disease in the area.

4.2.6 Changes to hydrology

The proposal crosses the Hunter River and its alluvial floodplain. There are a number of first order and second order watercourses north of the New England Highway that are tributaries of an unnamed modified watercourse that flows to the east through the residential areas of Singleton Heights to the Hunter River. The habitat value of these tributaries has not been assessed.

Near the northern connection with the New England Highway there is a first order tributary of Stonequarry Gully that flows to the north to Rixs Creek. The habitat value of this tributary has not been assessed.

A third order watercourse drains the golf course to the west of the proposal area between Maison Dieu Road and the Hunter River. This watercourse has a number of pools that may provide fauna habitat however, due to access limitation this has not been surveyed at this time.

The drainage design for the proposal considers:

- Transverse drainage (e.g. transverse culverts) to convey run-off from upslope catchments beneath the bypass
- Longitudinal drainage to convey flows either towards swales or transverse culverts
- Bridge drainage (except for the bridge over the floodplain) would be piped and provide adequate drainage of surface water. Runoff would be discharged via a spill containment basin or to existing drainage infrastructure depending on the location and subject to detailed design
- Drainage from the bridge over the floodplain would be via outlets onto the floodplain, for the bridge over the floodplain.

The proposed work will result in an overall change to a small percentage of each of the relevant catchments of the first and second order watercourses within the proposal area, north of the Gowrie Gates and is likely to have minor impacts.

The third order watercourse that flows into the Hunter River in the impact area would be diverted as part of the proposal.

4.2.7 Noise, light and vibration

The proposal will result in an increase of noise, light and vibration impacts within the impact area, ancillary facilities and adjacent areas during the construction and operation phases (Section 1.2). These impacts have the potential to adversely affect fauna species through disturbance of roosting and foraging behaviour and reducing the occupancy of areas of suitable habitat.

The impact area and ancillary facilities occur adjacent to the urban centres of Singleton and Singleton Heights, and these areas are already subject to light, noise and vibration impacts from the adjacent railway and the New England Highway. While the proposal will increase these impacts, it is not expected that the proposed work would significantly affect the behaviour of fauna in the surrounding locality.

4.2.8 Groundwater dependent ecosystems

The Hunter River and riparian vegetation are GDEs. The proposal may require temporary dewatering for piling of the piers for bridge structures over the Hunter River and for the floodplain bridges. Dewatering may have localised temporary drawdown of groundwater.

4.3 Cumulative impacts

The potential biodiversity impacts of a 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, as very large areas of vegetation within the locality have already been removed, predominately for mining and agriculture in the recent past. 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, mining, rural development and maintenance of infrastructure would likely include continued loss of biodiversity in the Hunter Catchment.

While data from all recent projects in the locality is not freely available, information for four known relevant projects is presented in Table 4.4 The total cumulative impact of the four projects listed and this proposal would result a reduction in the following TECs:

- 0.29 % *Central Hunter Ironbark Spotted Gum Grey Box Forest* EEC (BC Act)
- 0.001 % *Swamp Oak Floodplain Forest* EEC (BC Act)
- 0.002 % *Hunter Lowlands Redgum Forest* EEC (BC Act)
- 0.003 % *Hunter Floodplain Red Gum Woodland* EEC (BC Act)
- 0.008 % *Hunter Valley Footslopes Slaty Gum Woodland Vulnerable Ecological Community* (VEC) (BC Act)
- 0.08 % *Central Hunter Grey Box - Ironbark Woodland* EEC (BC Act)
- 0.75 % *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act)

Table 4.4 Past, present and future projects near the proposal

Project	Construction impacts	Operational impacts
<p>New England Highway Upgrade between Belford and the Golden Highway.</p> <p>The project occurs 8 kilometres to the south-east of the proposal and involves:</p> <ul style="list-style-type: none"> • Provision of dual carriage way in both directions • Replacement of the existing right turn movement from the Golden Highway to the New England Highway with a right turn flyover • The establishment of a road corridor for future development of the New England Highway towards Singleton. 	<p>Impacting a total of 11.23 ha of native vegetation including:</p> <ul style="list-style-type: none"> • 0.83 ha of <i>Swamp Oak Floodplain Forest</i> EEC (BC Act) • 10.40 ha <i>Central Hunter Ironbark Spotted Gum Grey Box Forest</i> EEC (BC Act) • 8.20 ha of <i>Central Hunter Valley Eucalypt Forest and Woodland</i> CEEC (EPBC Act) - considered a significant impact. <p>Impacting habitat features for 37 threatened and four migratory fauna species including:</p> <ul style="list-style-type: none"> • Removal of 18 hollow bearing trees • 0.3 hectares of cleared riparian areas • Aquatic habitat degradation • Noise, light and vibration impacts. 	<ul style="list-style-type: none"> • Fauna injury and mortality • Increase in the spread of weeds • Changed hydrology • Aquatic impacts.
<p>Muswellbrook Bypass – New England Highway.</p> <p>The project occurs 30 kilometres to the north-west of the proposal and proposes to construct a bypass off the New England Highway around the township of Muswellbrook. A preferred corridor has been preserved within the Muswellbrook LGA. A preferred route for the corridor has not yet been identified.</p>	<ul style="list-style-type: none"> • Preliminary mapping shows that the proposal area contains River Red Gum/River Oak grassy riparian woodland of the Hunter Valley and Narrow-leaved Ironbark/Grey Box/Spotted Gum shrub/ grass open forest of the central and lower Hunter. These may be consistent with threatened ecological communities under the BC Act and EPBC Act, though survey results and extent of clearance are not yet available. • Areas of vegetation to be cleared may contain fauna habitat features including hollow bearing trees and aquatic habitat where the Hunter River occurs. 	<ul style="list-style-type: none"> • Fauna injury and mortality • Increase in the spread of weeds • Changed hydrology • Aquatic impacts.

Project	Construction impacts	Operational impacts
<p>United Wambo Open Cut Coal Mine</p> <p>The project is located approximately 10 kilometres to the west of the proposal and involves:</p> <ul style="list-style-type: none"> • Merging the existing open cut operations at Wambo and establishing an open cut mine at United Collieries • Relocating a two kilometre stretch of the Golden Highway • Relocating a section of 330 kilovolt and 660 kilovolt transmissions lines to optimise coal recovery from the proposed open cut mine at United Collieries. 	<p>Impacting a total of 531 hectares of remnant and regenerated native vegetation communities including:</p> <ul style="list-style-type: none"> • 250.2 hectares <i>Central Hunter Valley Eucalypt Forest and Woodland</i> CEEC (EPBC Act) • 0.29 hectares <i>Hunter Floodplain Red Gum Woodland</i> EEC (BC Act) • 29.4 hectares <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest</i> EEC (BC Act) • 1.6 hectares <i>Hunter Valley Foothills Slaty Gum Woodland Vulnerable Ecological Community</i> (VEC) (BC Act) • 178.43 hectares <i>Central Hunter Grey Box – Ironbark Woodland</i> EEC (BC Act). <p>Likely to have a significant impact on three threatened fauna species:</p> <ul style="list-style-type: none"> • swift parrot (<i>Lathamus discolor</i>) • regent honeyeater (<i>Anthochaera phrygia</i>) • spotted-tailed quoll (<i>Dasyurus maculatus maculatus</i>) 	<ul style="list-style-type: none"> • Impacts form ongoing construction works specified
<p>Rix's Creek Continuation of Mining.</p> <p>The project occurs adjacent to the proposal area and involves:</p> <ul style="list-style-type: none"> • mining an additional 211 hectares of land immediately adjacent to the existing mining activities of Rix's Creek • Operation of the mine for 21 years from the date of approval • Increasing production limits to a maximum of 4.5 million tonnes of run-of-mine coal • Extension of open cut mining of Pit 3. and to extend the life of the current mine until approximately 2037. 	<p>Impacting a total of 72.4 hectares of vegetation including:</p> <ul style="list-style-type: none"> • 0.8 hectares of <i>Hunter Lowlands Redgum Forest</i> EEC (BC Act) • 0.62 hectares of <i>Central Hunter Grey Box-Ironbark Woodland</i> EEC (BC Act) • 5.8 hectares of <i>Central Hunter Valley Eucalypt Forest and Woodland</i> CEEC (EPBC Act) <p>Impacting habitat features for at least 16 threatened fauna species including:</p> <ul style="list-style-type: none"> • Removal of at least 10 hollow bearing trees • Noise, light and vibration impacts. 	<ul style="list-style-type: none"> • Impacts form ongoing construction works specified • Displacement of hollow-dependant fauna including the threatened squirrel glider.

Cumulative impacts have been considered by this proposal, and the impact area and ancillary facilities have been reduced to the smallest extent possible in TEC areas to limit unnecessary clearing. Features of the proposal (e.g. drainage basins) have been located outside of sensitive areas to avoid additional disturbance.

4.4 Assessments of significance

Assessments of Significance have been conducted by Niche (2019) and by Umwelt for threatened and migratory flora and fauna species, populations and ecological communities known or with potential to occur within the impact area and ancillary facilities (Table 4.5 for BC Act matters and Table 4.6 for EPBC matters) (Appendices D, E and F). A Seven-part Test under the FM Act was also conducted for the southern purple-spotted gudgeon (*Mogurnda adspersa*) (Appendix G).

Table 4.5 Summary and Outcomes of Assessments of Significance under the Five-part Test (BC Act)

Assessments of Significance							
Five- part Test under the BC Act							
Common name	Scientific name	Significance assessment questions ¹					Likely significant impact
		a	b	c	d	e	
Threatened Ecological Communities							
Central Hunter Ironbark - Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC		X	N	N	N	Y	N
Hunter Floodplain Red Gum Woodland EEC		X	N	N	N	Y	N
Endangered Populations							
Eucalyptus camaldulensis population in the Hunter catchment		N	X	N	N	Y	N
Threatened Birds							
grey-crowned babbler	Pomatostomus temporalis	N	X	N	N	Y	N
little eagle	Hieraaetus morphnoides	N	X	N	N	Y	N
little lorikeet	Glossopsitta pusilla	N	X	N	N	Y	N
masked owl	Tyto novaehollandiae	N	X	N	N	Y	N
speckled warbler	Chthonicola sagittata	N	X	N	N	Y	N
swift parrot	Lathamus discolor	N	X	N	N	Y	N

Assessments of Significance							
Five- part Test under the BC Act							
Common name	Scientific name	Significance assessment questions ¹					Likely significant impact
		a	b	c	d	e	
regent honeyeater	<i>Anthochaera phrygia</i>	N	X	N	N	Y	N
Threatened Mammals							
brush-tailed phascogale	<i>Phascogale tapoatafa</i>	N	X	N	N	Y	N
eastern cave bat	<i>Vespadelus trougtoni</i>	N	X	N	N	Y	N
eastern coastal free-tailed bat	<i>Mormopterus norfolkensis</i>	N	X	N	N	Y	N
eastern false pipistrelle	<i>Falsistrellus tasmaniensis</i>	N	X	N	N	Y	N
greater broad-nosed bat	<i>Scoteanax rueppellii</i>	N	X	N	N	Y	N
grey-headed flying fox	<i>Pteropus poliocephalus</i>	N	X	N	N	Y	N
koala	<i>Phascolarctos cinereus</i>	N	X	N	N	Y	N
large bent-winged bat	<i>Miniopterus orianae oceanensis</i>	N	X	N	N	Y	N
little bent-winged bat	<i>Miniopterus australis</i>	N	X	N	N	Y	N
southern myotis	<i>Myotis macropus</i>	N	X	N	N	Y	N
spotted-tailed quoll	<i>Dasyurus maculatus</i>	N	X	N	N	Y	N
squirrel glider	<i>Petaurus norfolcensis</i>	N	X	N	N	Y	N

Y= Yes (negative impact), N= No (no or positive impact), X= not applicable

Note: The five-part tests of significance for the squirrel glider, brush-tailed phascogale and eastern coastal free-tailed bat under the BC Act have been completed by Niche for the northern portion of the proposal area and impact area where the majority of the habitat for these species is present. The southern portion of the proposal area and impact area provides limited habitat for these species.

¹ Significance assessment questions as set out in section 7.3 of the *Biodiversity Conservation Act 2017*:

- 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. 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.

Table 4.6 Summary and Outcomes of Assessments of Significance under the EPBC Act

Assessment of Significance under the EPBC Act						
Common name	Scientific name	Status	Population ¹	Important population ²	TEC Impact criteria ²	Likely significant impact
Threatened ecological communities						
<i>Central Hunter Valley Eucalypt Forest and Woodland</i>		CE	-	-	Y	Y
Threatened birds						
swift parrot	<i>Lathamus discolor</i>	CE	N	-	-	N
regent honeyeater	<i>Anthochaera phrygia</i>	CE	N	-	-	N
Threatened Mammals						
grey-headed flying fox	<i>Pteropus poliocephalus</i>	V	-	N	-	N
koala	<i>Phascolarctos cinereus</i>	V	-	N	-	N
spotted-tailed quoll	<i>Dasyurus maculatus</i>	E	N	-	-	N

Y= Yes (negative impact), N= No (no or positive impact), X= not applicable

^{1.} A 'population of a species' as determined by the *Environment Protection and Biodiversity Conservation Act 1999* is 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) a geographically distinct regional population, or collection of local populations, or
- b) a regional population, or collection of local populations, that occurs within a particular bioregion.

An Important Population for a vulnerable species means:

- a) is likely to be key source populations either for breeding or dispersal, or
- b) is likely to be necessary for maintaining genetic diversity, or
- c) is at or near the limit of the species range.

^{2.} Significant Impact criteria for critically endangered and endangered ecological communities include actions likely to:

- reduce the extent of an ecological community
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- adversely affect habitat critical to the survival of an ecological 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
- 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
- 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
- interfere with the recovery of an ecological community.

The Assessments of Significance under the BC Act and EPBC Act found the proposal is likely to result in a significant impact to the *Central Hunter Valley Eucalypt Forest and Woodland CEEC*. No other significant impacts are likely for the other abovementioned threatened species, endangered population or TECs.

The Assessment of significance under the FM Act found no likely significant impacts will occur to the southern purple-spotted gudgeon (*Mogurnda adspersa*).

4.5 Impact summary

Table 4.7 provides details of the potential impacts to biodiversity values that have been considered in this assessment.

Table 4.7 Summary of impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Removal of native vegetation	Native vegetation	Direct	Site based	Long term	<ul style="list-style-type: none"> Clearing of native vegetation (31.93 hectares) would be exacerbated by the proposal. 	Known
	<i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> EEC (BC Act)	Direct	Site based	Long term	<ul style="list-style-type: none"> Clearing of this community (1.22 hectares) would be exacerbated by the proposal. 	Known
	<i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions</i> EEC (BC Act)	Direct	Site based	Long term	<ul style="list-style-type: none"> Clearing of this community (13.98 hectares) would be exacerbated by the proposal. 	Known
	<i>Central Hunter Valley Eucalypt Forest and Woodland</i> CEEC (EPBC Act)	Direct	Site based	Long term	<ul style="list-style-type: none"> Clearing of this community (16.89 hectares) would be exacerbated by the proposal. 	Known
Removal of threatened fauna habitat	Species as assessed in Appendices D, E, F and G	Direct	Site based	Long term	<ul style="list-style-type: none"> Clearing of native vegetation (31.93 hectares) Loss of hollow-bearing trees (96) Removal of dead wood and dead trees. These KTPs would be exacerbated by the proposal. 	Known
Removal of threatened flora	N/A	N/A	N/A	N/A	No threatened flora identified within the impact area or ancillary facilities.	N/A
Aquatic impacts	Threatened aquatic fauna	Direct	Site based	short term	Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and stream would occur during construction associated with temporary instream rock platforms and access ramps.	Known

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Aquatic impacts	Threatened aquatic fauna	Direct	Site based	Long term	Removal of large woody debris	Unknown
Aquatic impacts	Threatened aquatic fauna	Direct	Site based	Long term	NA - Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and stream is not applicable in the long term as bridges have minimal impact on flow and are excluded.	N/A
Injury and mortality of fauna	Threatened fauna	Direct	Site based	Short term Long term	The following KTPs would be exacerbated by the proposal: <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees. 	Unknown
Fragmentation of identified biodiversity links and habitat corridors	Threatened fauna	Direct/ indirect	Site-based	Short term Long Term	The following KTPs would be exacerbated by the proposal: <ul style="list-style-type: none"> • Clearing of native vegetation (31.93 ha) • Loss of hollow-bearing trees (96) • Removal of dead wood and dead trees. 	Known
Edge effects on adjacent native vegetation and habitat	Threatened flora Threatened fauna	Indirect	Site-based	Long term	N/A – edge effects are not expected to exacerbate KTPs.	Known
Invasion and spread of weeds	TECs	Indirect	Site based	Long term	The following KTPs have low potential to be exacerbated by the proposal: <ul style="list-style-type: none"> • Invasion of native plant communities by African Olive (<i>Olea europaea</i> L. subsp. <i>cuspidata</i>) • Invasion of native plant communities by exotic perennial grasses. 	Known
Invasion and spread of pests	Threatened fauna	Indirect	Site based	Long term	The following KTPs have low potential to be exacerbated by the proposal: <ul style="list-style-type: none"> • Competition and grazing by the feral European rabbit (<i>Oryctolagus cuniculus</i>) • Predation and hybridisation of feral dogs (<i>Canis lupus familiaris</i>) • Predation by the European red fox (<i>Vulpes vulpes</i>) • Predation by the feral cat (<i>Felis catus</i>). 	Unknown

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration	Does the proposal constitute or exacerbate a key threatening process?	Confidence in assessment
Invasion and spread of pathogens and disease	Threatened fauna and TECs	Indirect	Site based	Long term	N/A – the proposal is not expected to lead to the invasion and spread of pathogens and disease exacerbate KTPs.	N/A
Groundwater dependent ecosystems	Groundwater dependent ecosystems	Direct	Site based	Long term	NA	Known
Changes to hydrology	Threatened aquatic fauna	Direct	Site based	Short term	Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers	Known
Noise, light and vibration	Threatened fauna	Direct/indirect	Local	Short term Long term	N/A – noise, light and vibration are not expected to exacerbate KTPs.	NA

5 Avoid, minimise and mitigate impacts

5.1 Avoidance and minimisation

Impacts on biodiversity values were minimised as part of a preliminary feasibility assessment (AECOM2013) and route options identification report (Roads and Maritime 2015a). A key consideration of the option analysis was the presence of threatened species habitat and TECs. Figure 5.1 and Figure 5.2 detail the locations of TECs and threatened species records in relation to potential route corridors, reproduced from route options identification report (Roads and Maritime 2015). The route options report noted that the 'Central and southern options are closer to Singleton and are of potentially lower ecological effect when compared to the northern option' (Roads and Maritime 2015).

In addition to the route options identification, the impact area and ancillary compounds have been reduced as far as possible in areas of threatened ecological communities to minimise impacts. Items such as drainage basins and ancillary facilities have also been located outside of sensitive areas to avoid disturbance.

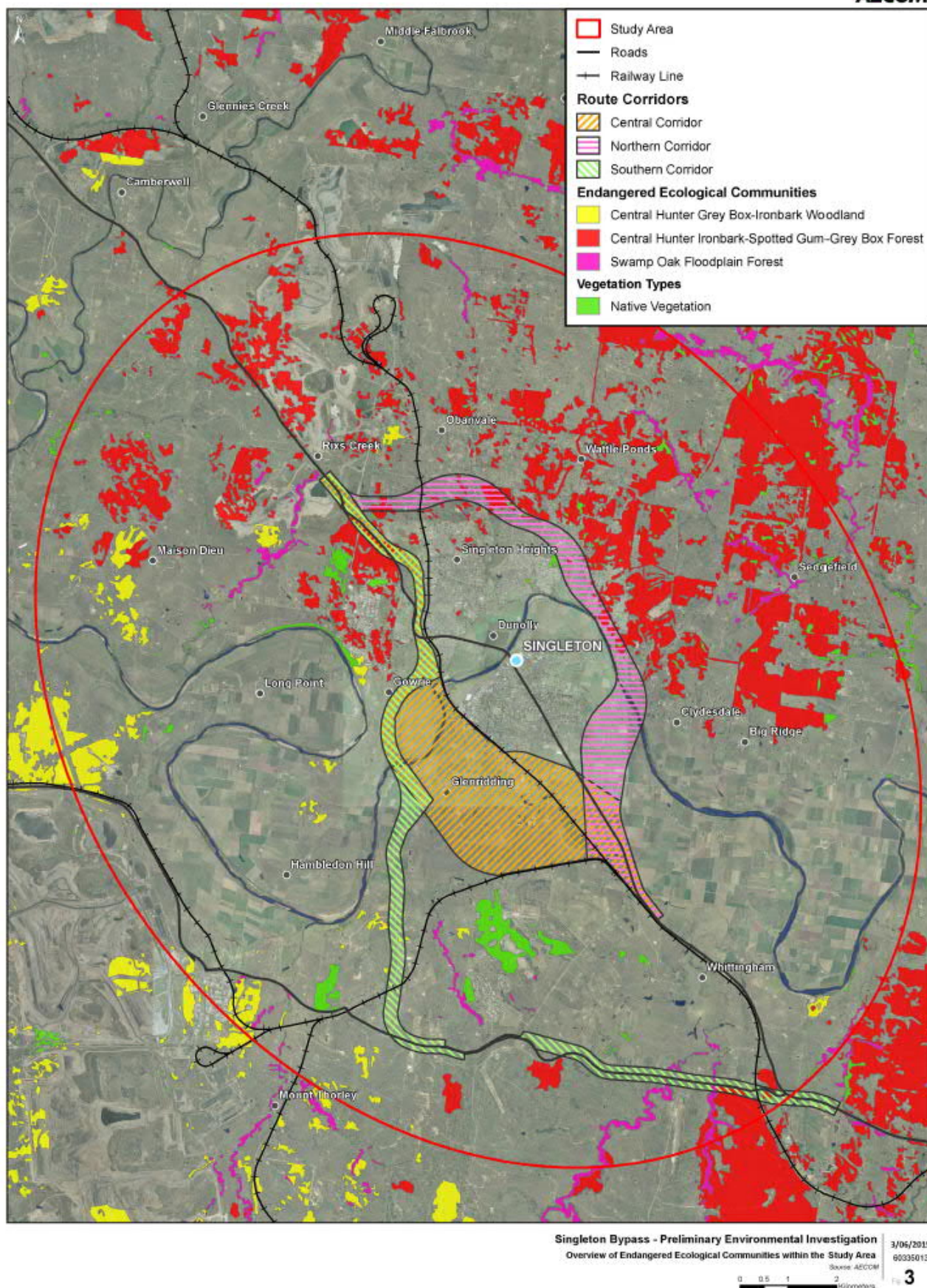


Figure 5.1 Threatened Ecological Communities within potential route corridors based on regional vegetation mapping and current as of the report publication date, reproduced from route options identification report (Roads and Maritime 2015a)

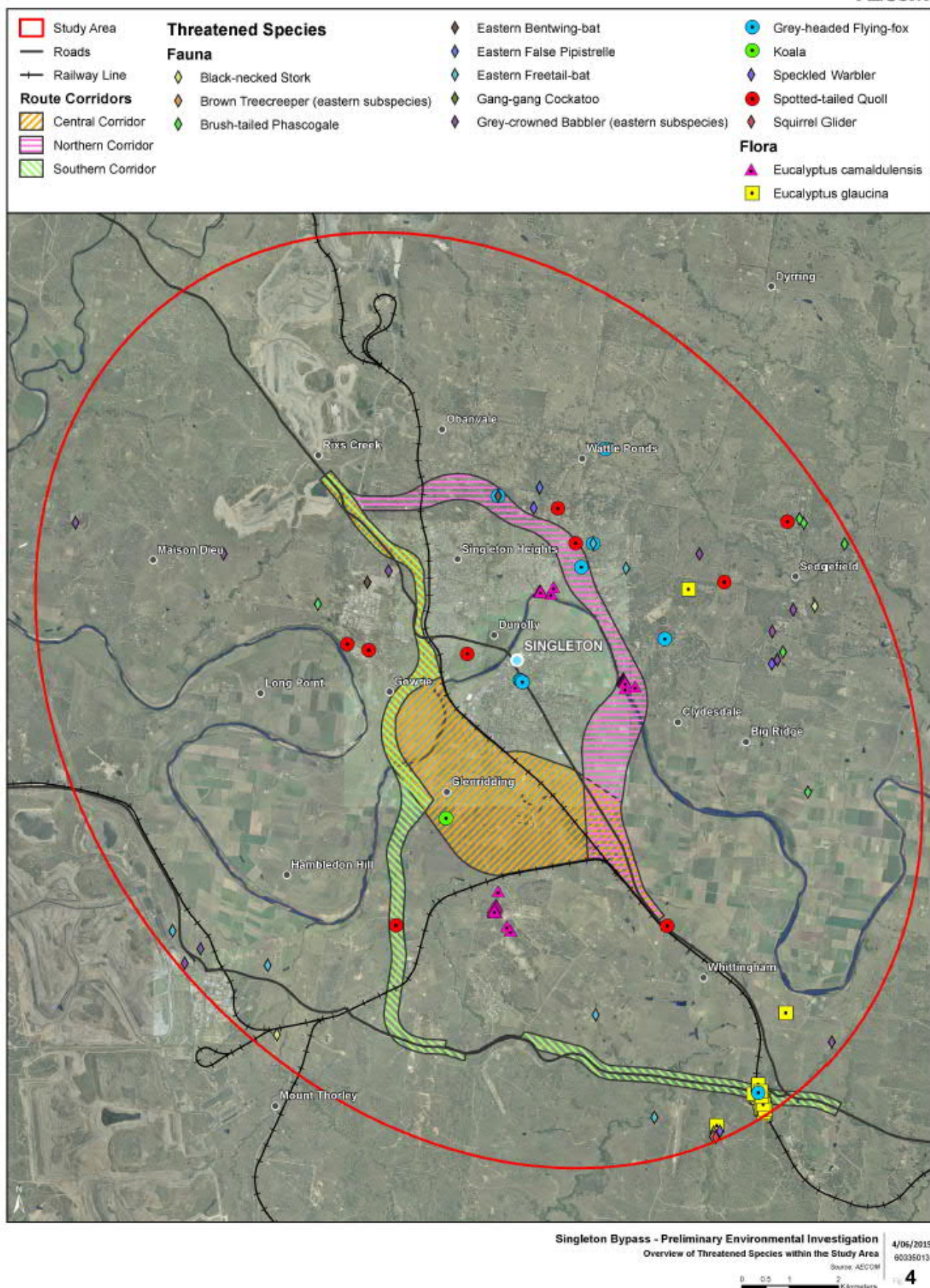


Figure 5.2 Threatened species within potential route corridors current as of the report publication, reproduced from route options identification report (Roads and Maritime 2015a)

5.2 Mitigation measures

A large range of mitigation measures are recommended to reduce the impacts to native biodiversity and are provided in Table 5.1 below.

Table 5.1 Mitigation measures

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation	<p>A Flora and Fauna Management Plan will be prepared and implemented as part of the CEMP. It will address terrestrial and aquatic matters and will include, but not necessarily be limited to:</p> <p>a) plans for the construction site and adjoining area showing native vegetation, flora and fauna habitat, threatened species and threatened ecological communities;</p> <p>b) plans showing areas to be cleared and areas to be protected, including exclusion zones and protected habitat features (e.g. hollow-bearing trees), and areas for rehabilitation or re-establishment of native vegetation. The limits of clearing within the construction site and protected habitat features will be clearly delineated using appropriate signage, barriers, fencing or markings;</p> <p>c) requirements set out in the Landscape Design Guideline (RMS 2018);</p> <p>d) procedures addressing relevant matters specified in the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (RTA 2011) including but not limited to:</p> <ul style="list-style-type: none"> - pre-clearing, including the outcomes of final flora and fauna species checks, establishment of exclusion zones and on-ground identification of specific habitat features to be retained (such as hollow-bearing trees) - vegetation clearing and bushrock removal, including staged habitat removal and any specified seasonal limits on clearing activities - fauna handling and unexpected threatened species finds - rehabilitation, revegetation, re-use of soils, woody debris and bushrock, 	Prior to and during construction	Effective	Residual impacts to threatened species and ecological communities would be offset in accordance with the offset strategy detailed in Section 6.
Removal of threatened species habitat and habitat features				
Aquatic impacts				

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	<p>and other habitat management actions</p> <ul style="list-style-type: none"> - weed, pathogen and pest management <p>e) procedures addressing relevant matters specified in the NSW DPI (Fisheries) Policy and guidelines for fish habitat conservation and management.</p> <p>f) monitoring during construction and post-construction</p> <p>g) adaptive management measures to be applied if monitoring indicates unexpected adverse impacts</p>			
<p>Removal of native vegetation</p> <p>Removal of threatened species habitat and habitat features</p> <p>Aquatic impacts</p>	<p>Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be considered during the detailed design stage and implemented where practicable and feasible. Measures to avoid and minimise impacts should be prioritised in the following order:</p> <ul style="list-style-type: none"> a) critical habitat b) threatened species, endangered ecological communities, groundwater dependent ecosystems or their habitat c) native vegetation and habitat supporting flora and fauna connectivity and/or that supports other environmental objectives such as protecting water quality, hydrology or erosion and sediment controls d) native vegetation of higher quality condition e) other native vegetation 	Detailed design	Effective	Residual impacts to threatened species and ecological communities would be offset in accordance with the offset strategy detailed in Section 6.

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
Removal of native vegetation Removal of threatened species habitat and habitat features Aquatic impacts	<p>Consistent with the Biodiversity Guidelines - Protecting and managing biodiversity on RTA projects (RTA 2011), and any specific requirements of the approved Flora and Fauna Management Plan, management arrangements will be implemented to ensure unavoidable vegetation and bushrock removal minimises biodiversity impacts as far as practicable. As a minimum that will include:</p> <ol style="list-style-type: none"> no vegetation clearing or bushrock removal beyond limits identified in this REF avoiding identified exclusion zones and protected habitat features. avoiding mixing of topsoil with woody debris materials separation of woody vegetation suitable for re-use during construction and rehabilitation or revegetation works implementation of staged clearing trimming and pruning to be undertaken in accordance with relevant Australian Standards in riparian zones: avoiding clearing during likely flood periods; ensuring cleared vegetation does not enter the waterway; installation of suitable sedimentation and erosion control; retaining roots and stumps to maintain bank stability; applying the hierarchy for snag management set out in the Guidelines. 	Detailed design	Effective	Residual impacts to threatened ecological communities would be offset in accordance with the offset strategy detailed in Section 6.
	<p>Prior to the commencement of construction, carry out:</p> <ol style="list-style-type: none"> Targeted surveys to confirm the presence of the following along the Hunter River and unnamed tributary to the north of the Hunter River within the area to be impacted by the proposal <ul style="list-style-type: none"> River red gum (<i>Eucalyptus camaldulensis</i>) (endangered population - BC Act) <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> (EEC – BC Act) Threatened flora survey, fauna habitat assessments and ground-truthing of vegetation mapping, between the Hunter River and the southern extent of the area surveyed by Umwelt (2019), north of the New 	Prior to construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	<p>England Highway near Gowrie Gates, within the area to be impacted by the proposal</p> <p>c) Ground truthing surveys of the regional vegetation mapping within the McDougalls Hill ancillary facility to confirm presence of:</p> <ul style="list-style-type: none"> - <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act)</i> - <i>Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)</i> - No clearing of threatened native vegetation is to be carried out within the McDougalls Hill ancillary facility. <p>Subject to the outcomes of the above, a consistency review or environmental assessment may be required.</p>			
	The unexpected species find procedure is to be followed under <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011) if threatened ecological communities, not assessed in the biodiversity assessment, are identified in the proposal site.	During construction	Proven	
	<p>A nest box strategy would be developed and implemented during the detailed design stage in accordance with <i>Guide 5: Re-use of woody debris and bushrock</i> and <i>Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (RTA 2011). The strategy is to include:</p> <ul style="list-style-type: none"> a) a trial of artificial hollow creations. b) reinstallation of suitable hollows removed by the proposal. c) installation of nest boxes in the event that there are not sufficient trees for artificial hollow creation and hollows for reinstallation. 	During construction	Proven	
	Prior to the commencement of construction, carry out monitoring to determine the presence of threatened microbats in the culverts that are part of the former Great Northern Railway.	Prior to construction	Effective	

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	<p>If threatened microbats are identified, collect the following information:</p> <ul style="list-style-type: none"> a) Species present. b) Total number of individuals and groups per occupied roost site. c) Description of occupied roost sites. d) Breeding status of colony, including approximate adult to juvenile ratios. 			
	<p>If roosting threatened microbats are found during pre-construction monitoring, a Bat Management Plan is to be developed and implemented. The Bat Management Plan is to be prepared by a microbat specialist and include the following:</p> <ul style="list-style-type: none"> a. A monitoring program for both during and outside of breeding periods. <p>Details of construction activities to be monitored that may affect microbat habitat, particularly light, noise, vibration, alteration of drainage into culverts.</p> <p>Mitigation measures to be implemented during construction, including regular inspections of impacts from sedimentation and weed encroachment to culvert entrances, consider timing and nature of immediately adjacent works in relation to known breeding period of relevant threatened microbats.</p> <p>Adaptive management measures to be implemented if monitoring indicates a decline in bat numbers or if bats are observed leaving the roost during construction activities.</p> <p>A process for evaluating the effectiveness of management measures.</p>	Prior, during and post construction	Effective	
Removal of threatened species habitat and habitat features	In accordance with Section 199 of the FM Act, Roads and Maritime would notify DPI Fisheries in writing of any proposed dredging or reclamation in the Hunter River and its tributary. Roads and Maritime would consider any matters raised by the Minister.	Prior to construction	Proven	Residual impacts to threatened species habitat would be offset in accordance

Impact	Mitigation measures	Timing and duration	Likely efficacy of mitigation	Residual impacts anticipated
	In accordance with Section 219 of the FM Act, Roads and Maritime would seek a permit from DPI Fisheries for any temporary blockage of fish passage. Roads and Maritime would consider any matters raised by the Minister.	Prior to construction	Proven	with the offset strategy detailed in Section 6 .
	Instream silt curtains would be implemented and maintained for construction in the Hunter River. Silt curtains would be installed such that they do not block fish passage.	Prior to and during construction	Effective	
	Changes to existing surface water flows would be minimised through detailed design. Any rock platform required to be constructed within the Hunter River bridge would be designed and constructed to prevent blocking the main river channel. The platform would be designed to ensure that flow of the main river channel and fish passage is maintained even during low flow periods. The DPI would be consulted on the final design.	Detailed design	Effective	
	A wildlife connectivity strategy would be finalised and implemented during the detailed design stage in accordance with the draft Roads and Maritime Wildlife Connectivity Guidelines (RMS 2011). The strategy is to focus on maintaining connectivity in the northern extent of the proposal and is to include, but not be limited to: a) provision for a rope crossing with an indicative location between chainages 8450 and 8725 b) identification of trees suitable for retention in the northern connection and tie in to facilitate glider crossings c) consideration of additional gliding crossing structures where the width of disturbance is greater than 50 metres d) type and extent of any associated landscaping or structures such as fencing or fauna infrastructure	Detailed design, during construction and post construction	Effective	

6 Offset strategy

The Guideline for Biodiversity Offsets (Roads and Maritime 2016) requires consideration of biodiversity offsets when threatened ecological communities or threatened species habitat is impacted above specified thresholds, as detailed in Table 6.1 below.

Table 6.1 Offsetting Thresholds for REFs (Roads and Maritime 2016)

Description of Activity or Impact	Consider Offsets or Supplementary Measures
Works involving clearing of national or NSW listed critically endangered ecological communities (CEECs)	Where there is any clearing of an CEEC in moderate to good condition
Works involving clearing of nationally listed TEC or nationally listed threatened species habitat	Where clearing >1 ha of a TEC or habitat in moderate to good condition
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing > 5 ha or where the ecological community is subject to an SIS
Works involving clearing of NSW listed threatened species habitat where the species is a species credit species as defined in the OEH Threatened Species Profile Database (TSPD)	Where clearing > 1ha or where the species is the subject of an SIS
Works involving clearing of NSW listed threatened species habitat and the species is an ecosystem credit species as defined in OEH's Threatened Species Profile Database (TSPD)	Where clearing > 5ha or where the species is the subject of an SIS
Type 1 or Type 2 key fish habitats (as defined by NSW Fisheries)	Where there is any net loss of habitat

The proposal triggers the offsetting thresholds for the following matters:

- Clearing of 16.89 hectares of EPBC Act listed *Central Hunter Valley Eucalypt Forest and Woodland* CEEC
- Clearing of 13.98 hectares of BC Act listed *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC
- Clearing of greater than one hectare of BC Act listed threatened species credit species habitat.
 - Southern myotis 11.96 hectares (includes all woodland and forest habitat within 200 metres of dams, sandstone culverts and hunter river)
 - Squirrel glider 13.98 hectares (includes all woodland and forest habitat, excluding the riparian vegetation along the Hunter River)
 - Brush-tailed phascogale 13.98 hectares (includes all woodland and forest habitat, excluding the riparian vegetation along the Hunter River)

All other threatened species recorded are classified as ecosystem credit species under the Biodiversity Assessment Methodology (BAM) (OEH 2017a) and are covered by the ecosystem credits required for the impacted TECs. Additionally, impacts to the *Hunter Floodplain Red Gum*

Woodland in the NSW North Coast and Sydney Basin Bioregions EEC are below the five hectare threshold for NSW listed EEC.

A preliminary BAM credit calculator assessment determined the following credit requirements for TECs and species credit species. Table 6.2 below details the biodiversity credits required for each of the identified TECs and relevant threatened species.

Table 6.2 Preliminary Biodiversity Credit Requirements according to the BAM (Roads and Maritime 2016)

Threatened Ecological Community/Threatened Species	Biodiversity Credits Required
<i>Central Hunter Valley Eucalypt Forest and Woodland</i> CEEC (EPBC Act)*	Overall Ecosystem credits = 493 CEEC component = 479
<i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions</i> EEC (BC Act)*	Overall Ecosystem credits = 493 EEC component = 443
Southern myotis	402
Squirrel glider	443
Brush-tailed phascogale	443

*note that the ecosystem credits requirements for the Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act) and Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC (BC Act) largely overlap.

Roads and Maritime has entered into an agreement under part 10 of the EPBC ACT with the Australian Government Department of the Environment and Energy (DoEE) which provides for the undertaking of a Strategic Assessment of the impacts on 'Specified Protected Matters'. Appendix F of the Strategic Assessment – under Part 10, Environment Protection and Biodiversity Conservation Act 1999 – Supplementary Report (Roads and Maritime 2015b) lists the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC as a 'Specified Protected Matter'.

The proposal is likely to have a significant impact on the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC. In keeping with the strategic assessment agreement, Roads and Maritime would, as part of detailed design, reduce impacts where possible to this Specified Protected Matter and consult with DoEE regarding the activity.

Residual impacts to the CEEC would be offset through the retirement of biodiversity credits.

Fulfilling offset requirements under the BC Act 2016 would be achieved by Roads and Maritime using one or a combination of the following offset strategies:

- In-perpetuity conservation through the establishment of a Stewardship site and the retirement of credits.
- Securing required credits through the open credit market and/or
- Payments to the Biodiversity Conservation Fund.

7 Conclusion

The proposal area contains four threatened ecological communities listed under the BC Act, two recorded comprising the *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions* EEC (BC Act), *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC (BC Act) and two predicted to occur based on regional mapping comprising the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregion* EEC (BC Act) and *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions* EEC. Nine threatened fauna species as listed under the BC Act were confirmed present within the proposal area through targeted fauna surveys, and one endangered population is present in the proposal area, outside of the impact area, comprising river red gum (*Eucalyptus camaldulensis*) in the Hunter Catchment endangered population (BC Act). The vegetation and habitats of some of the proposal area also conforms with the EPBC Act listed *Central Hunter Valley Eucalypt Forest and Woodland* CEEC.

Potential impact to ecological values as a result of the proposed work include removal of 96 hollow-bearing trees and approximately 31.93 hectares of native vegetation. This includes approximately 1.22 hectares of *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregion* (BC Act), 13.98 hectares of *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC (BC Act) and 16.89 hectares of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act).

Assessments of Significance were undertaken for 19 threatened fauna species, one endangered flora population, and two TECs listed under the BC Act, and five threatened fauna species and one TEC and migratory species under the EPBC Act. An Assessment of Significance under Section 220ZZ of the FM Act was also undertaken for one threatened aquatic species being the southern purple-spotted gudgeon (*Mogurnda adspersa*). These assessments found that the proposal would likely significantly impact the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC (EPBC Act). No other threatened species, populations or ecological communities known or predicted to occur are likely to be significantly impacted by the proposal.

Key mitigation measures to minimise impact to biodiversity

- Preparation of a Construction Environmental Management Plan
- Ground-truthing surveys to be undertaken between the Hunter River and the southern extent of the area surveyed by Umwelt (2019), north of the New England Highway near Gowrie Gates

Minimisation of vegetation removal through further detailed design

- Pre-clearance surveys
- Preparation of a nest box strategy to account for the loss of hollow-bearing trees
- Preparation of a wildlife connectivity strategy
- Preparation of a specific microbat management plan (if required)
- Aquatic habitat protection
- Preparation of a Biodiversity Offset Strategy to compensate for residual impacts from the proposal.

8 References

- AECOM 2013, HW (New England Highway) – Singleton Bypass: Preliminary Feasibility Assessment Report. Report prepared for Roads and Maritime Service, June 2013.
- Barclay, RMR, Chruszcz, BJ and Rhodes, M. 2000, Foraging behaviour of the large-footed myotis, *Myotis moluccarum* (Chiroptera: Vespertilionidae) in south-eastern Queensland. Australian Journal of Zoology 48: 385-92.
- Bureau of Meteorology (BOM) 2019, *Atlas of Groundwater Dependent Ecosystems*. Available at: <http://www.bom.gov.au/water/groundwater/gde/map.shtml>, accessed October 2019.
- Campbell, S. 2009, So long as it's near water: variable roosting behaviour of the large-footed myotis (*Myotis macropus*). Australian Journal of Zoology, 57, 89–98.
- Churchill, S. 2008, Australian bats. Allen & Unwin, Crows Nest, N.S.W.
- Commonwealth of Australia (CoA) 2016, National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*). Department of Environment and Energy.
- Cronquist, A. 1981, An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- Department of Environment, Land, Water and Planning (DELWP) 2016, National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus*. Australian government, Canberra.
- Department of the Environment (DoE) 2013, Commonwealth Matters of National Environmental Significance: Significant Impact Guidelines 1.1 EPBC Act.
- Department of the Environment (DoE) 2014, EPBC Act referral guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory).
- Department of Environment (DoE) 2015, Referral guidelines for management actions in grey-headed flying-fox and spectacled flying-fox camp. EPBC Act policy statement. Commonwealth of Australia.
- Department of Environment and Conservation (DEC) 2004, *Threatened Species Survey and Assessment: Guidelines for Developments and Activities (working draft)*. Sydney South, NSW.
- Department of Environment and Energy (DoEE) 2017, Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*, Commonwealth of Australia 2017.
- Department of the Environment and Energy (DoEE) 2019, Protected Matters Search Tool <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf>, accessed September 2019.
- Department of Primary Industries (DPI) 2013, *Policy and Guidelines for Fish Habitat Conservation and Management*. Fisheries NSW, Wollongbar.
- Department of Primary Industries (DPI) 2017, Primefact 1275, Southern Purple Spotted Gudgeon – *Mogurnda adspersa*.
- Department of Primary Industries (DPI) 2018a. Register of Critical Habitat. <https://www.dpi.nsw.gov.au/fishing/species-protection/conservation/what/register>. Accessed September 2018.
- Department of Primary Industries (DPI) 2018b, Freshwater Threatened Species Distributions Maps. Available at: <http://www.dpi.nsw.gov.au/fishing/species-protection/threatened-species-distributions-in-nsw/freshwater-threatened-species-distribution-maps>, accessed February 2018.
- Department of the Environment (DoE) 2013, *Matters of National Environmental Significance, Significant Impact Guidelines 1.1*. Canberra, ACT.
- Forest Fauna Surveys Pty Ltd (2017) Mount Owen Complex Fauna Monitoring 2016 Annual Report. Report prepared for Mount Owen Complex.
- Harden, G, J, editor, 1992, *Flora of New South Wales. Volume 3*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Harden, G, J, editor, 1993, *Flora of New South Wales. Volume 4*. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Harden, G, J, editor, 2000, *Flora of New South Wales. Volume 1*. 2nd edition. New South Wales University Press and Royal Botanic Gardens, Sydney.

Harden, G, J, editor, 2002, *Flora of New South Wales. Volume 2*. Revised edition. Royal Botanic Gardens Sydney & New South Wales University Press, Sydney.

Niche Environment and Heritage (Niche) 2019, Singleton Bypass Independent Assessments of Significance - Prepared for Roads and Maritime Services.

NSW Scientific Committee 2010, Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions – Endangered Ecological Community Listing. Electronic resource.

NSW Scientific Committee 2011, Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions – Final Determination.

Office of Environment and Heritage (OEH) 2016, Sydney Basin Bioregion. Available at <https://www.environment.nsw.gov.au/bioregions/SydneyBasinBioregion.htm>, accessed October 2019.

Office of Environment and Heritage (OEH) 2017a, Biodiversity Assessment Method, August 2017.

Office of Environment and Heritage (OEH) 2017b, *Eucalyptus camaldulensis* population in the Hunter catchment – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017c, Grey-crowned babbler – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017d, Little eagle – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017e, Little lorikeet – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017f, Masked owl – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017g, Speckled warbler – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017h, Spotted-tailed quoll – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017i, Greater broad-nosed bat – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017j, Southern myotis – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017k, Grey-headed flying-fox – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017l, Eastern false pipistrelle – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2017m, Eastern cave bat – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2019a, BioNet Atlas of NSW Wildlife, accessed September 2019.

Office of Environment and Heritage (OEH) 2019b, State Vegetation Type Map: Upper Hunter.

Office of Environment and Heritage (OEH) 2019c, Biodiversity Values Map and Threshold Tool , available at <https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap>, accessed October 2019.

Office of Environment and Heritage (OEH) 2019d, eSPADE v2.0 Soil Mapping. Available at <https://www.environment.nsw.gov.au/eSpade2Webapp>, accessed October 2019.

Office of Environment and Heritage (OEH) 2019e, BioNet Vegetation Classification Database, accessed October 2019.

Office of Environment and Heritage (OEH) 2019f, Koala – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2019g, Swift parrot – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2019h, Regent honeyeater – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2019i, Large bent-winged bat – Profile, accessed October 2019.

Office of Environment and Heritage (OEH) 2019j, Little bent-winged bat – Profile, accessed October 2019.

Peake T.C. 2006, *The Vegetation of the Central Hunter Valley, New South Wales. A report on the findings of the Hunter Remnant Vegetation Project*. Hunter- Central Rivers Catchment Authority, Paterson.

Pennay, M., Law, B., Reinhold, L. 2004, *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*. NSW Department of Environment and Conservation, Hurstville.

Reinhold, L., Law, B., Ford, G. and Pennay, M. 2001, *Key to the bat calls of southeast Queensland and north-east New South Wales*. Forest Ecosystem Research and Assessment Technical paper 2001-07, Department of Natural Resources and Mines, Queensland.

Roads and Maritime Service (Roads and Maritime) 2011, Wildlife Connectivity Guidelines: Managing Wildlife Connectivity on Road Projects. Draft guidelines, November 2011

Roads and Maritime Service (Roads and Maritime) 2015a, New England Highway Singleton Bypass Options Assessment: Route Options Identification Report. September 2015

Roads and Maritime Services (Roads and Maritime) 2015b, Strategic Assessment – under Part 10, Environment Protection and Biodiversity Conservation Act 1999 – Supplementary Report. May 2015.

Roads and Maritime Services (Roads and Maritime) 2016, Guidelines for Biodiversity Offsets.

Roads and Transport Authority (RTA) 2011, Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. Revision 0/September 2011. RTA Environment Branch.

Saunders, D. L. and Tzaros, C. L. 2011, National Recovery Plan for the Swift Parrot *Lathamus discolor*, Birds Australia, Melbourne.

Sivertsen, D., Roff, A., Somerville, M., Thonell, J., and Denholm, B. 2011, *Hunter Native Vegetation Mapping. Geodatabase Guide (Version 4.0)*. Published by Office of Environment and Heritage, Department of Premier and Cabinet, Sydney, Australia.

Threatened Species Scientific Committee (TSSC) 2015, *Approved Conservation Advice (including listing advice) for the Central Hunter Valley eucalypt forest and woodland ecological community*. <http://www.environment.gov.au/biodiversity/threatened/communities/pubs/130-conservation-advice.pdf>.

Umwelt (Australia) Pty Limited (Umwelt) 2019, *Singleton Bypass – Biodiversity Assessment: Targeted Vegetation Assessment*, August 2019.

Wheeler D, J, B, Jacobs S, W, L, and Whalley R, D, B, (2002) *Grasses of New South Wales*, 3rd Edition. The University of New England, Armidale.

**Appendix A – Department of the Environment and Energy
Protected Matters Search Tool Results**



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 23/09/19 14:38:17

[Summary](#)

[Details](#)

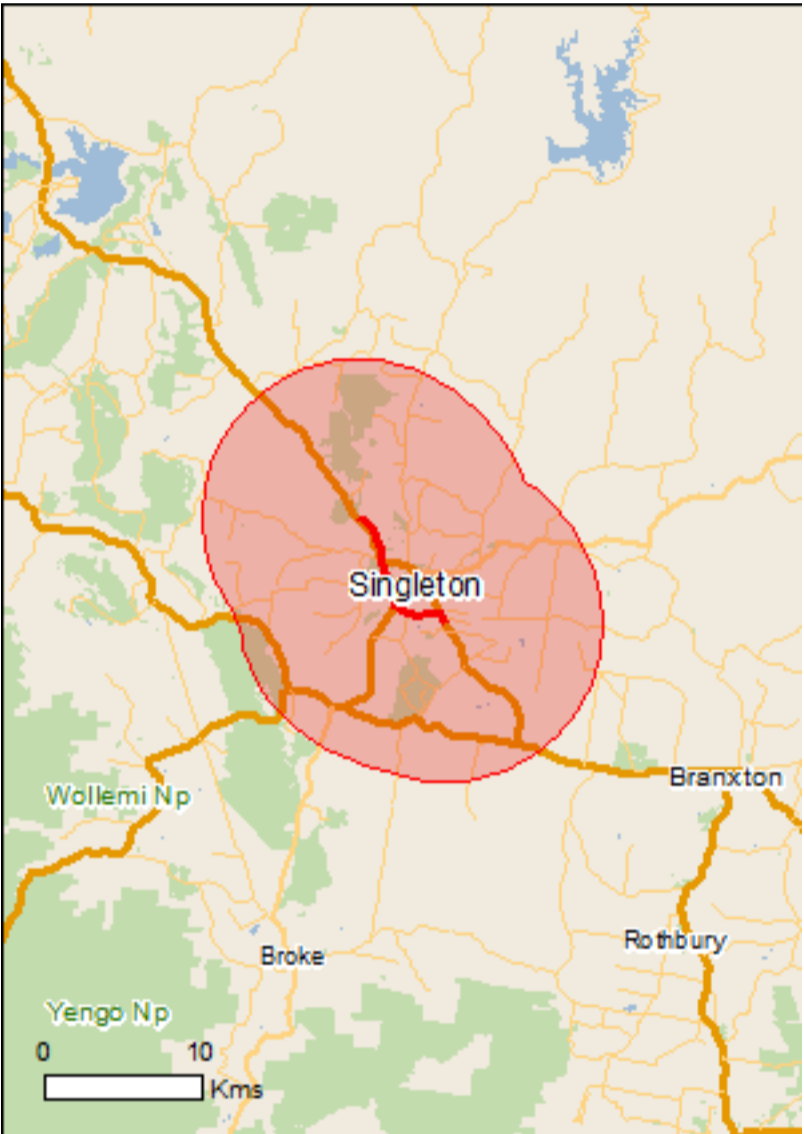
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

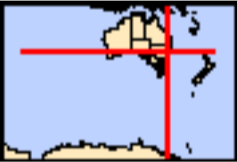
[Acknowledgements](#)



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[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	31
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	4
Commonwealth Heritage Places:	None
Listed Marine Species:	21
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	1
Invasive Species:	40
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Hunter estuary wetlands	40 - 50km upstream	

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Central Hunter Valley eucalypt forest and woodland	Critically Endangered	Community likely to occur within area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community may occur within area
Hunter Valley Weeping Myall (Acacia pendula) Woodland	Critically Endangered	Community may occur within area
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community may occur within area
Warkworth Sands Woodland of the Hunter Valley	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species

[Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species

Name	Status	Type of Presence
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	habitat may occur within area Species or species habitat likely to occur within area
Frogs		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Plants		
Asperula asthenes Trailing Woodruff [14004]	Vulnerable	Species or species habitat known to occur within area
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus glaucina Slaty Red Gum [5670]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Prostanthera cineolifera [11233]	Vulnerable	Species or species habitat may occur within area
Pterostylis gibbosa Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562]	Endangered	Species or species habitat may occur within area
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat may occur within area
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species

[[Resource Information](#)]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land	[Resource Information]
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The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Commonwealth Land - Australian Telecommunications Commission Commonwealth Land - Australian Telecommunications Corporation Commonwealth Land - Defence Housing Authority

Listed Marine Species	[Resource Information]
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* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		within area Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

Regional Forest Agreements	[Resource Information]
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Note that all areas with completed RFAs have been included.

Name	State
North East NSW RFA	New South Wales

Invasive Species	[Resource Information]
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Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Pycnonotus jocosus Red-whiskered Bulbul [631]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Alternanthera philoxeroides Alligator Weed [11620]		Species or species habitat likely to occur within area
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643] Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Senecio madagascariensis		
Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.533048 151.141276,-32.538909 151.149301,-32.546217 151.152305,-32.54884 151.153206,-32.555007 151.154322,-32.564719 151.158421,-32.575504 151.161365,-32.57818 151.165571,-32.580639 151.173382,-32.580133 151.181707,-32.579518 151.186728,-32.584887 151.19044,-32.584887 151.19044,-32.584887 151.19044

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

Appendix B – Recorded Species and Vegetation Integrity Data

Umwelt Flora Species List

The following list includes the results of the vegetation integrity plots surveys. It is acknowledged that the list is not comprehensive, as not all species are readily detected at any one time of the year. Many species flower only during restricted periods of the year, and some flower only once in several years. In the absence of flowering material, many of these species cannot be identified, or even detected.

Names of classes and families follow a modified Cronquist (1981) System.

Any species that could not be identified to the lowest taxonomic level are denoted in the following manner:

sp.	specimens that are identified to genus level only.
The following abbreviations or symbols are used in the list:	
AA	abundance estimate in accordance with BAM (OEH 2017a)
PC	per cent cover in accordance with BAM (OEH 2017a)
asterisk (*)	denotes species non-native species
subsp.	subspecies
var.	variety
x	denotes species recorded outside, but in proximity to, sampling location and within the same vegetation zone

All vascular plants recorded or collected were identified using keys and nomenclature in Harden (1992, 1993, 2000 and 2002) and Wheeler *et al.* (2002). Where known, changes to nomenclature and classification have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2019), the on-line plant name database maintained by the National Herbarium of New South Wales.

Common names used follow Harden (1992, 1993, 2000 and 2002) where available, and draw on other sources such as local names where these references do not provide a common name.

Table B1 Flora Species List (Umwelt)

Family	Scientific Name	Common Name	p01	p01	p02	p02	p03	p03	p04	p04	p05	p05	p06	p06	p07	p07	p08	p08	p09	p09	p10	p10	p11	p11	p12	p12	p13	p13	p14	p14	p15	p15	p16	p16
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Filicopsida (Ferns)																																		
Adiantaceae	Cheilanthes distans	bristly cloak fern			50	0.5					50	0.2			500	1	500	5	10	0.1			500	10	10	0.1	1000	10	50	0.2			20	0.2
Adiantaceae	Cheilanthes sieberi subsp. sieberi	rock fern	50	1													1	0.1					10	0.2	10	0.1	20	0.2			10	0.1	10	0.2
Magnoliopsida – Liliidae (monocots)																																		
Anthericaceae	Arthropodium sp.				5	0.1													1	0.1												5	0.1	
Anthericaceae	Laxmannia gracilis	slender wire lily			1	0.1																										x	x	
Anthericaceae	Tricoryne elatior	yellow autumn-lily													1	0.1							1	0.1										
Cyperaceae	Carex inversa	knob sedge							5	0.1							20	0.1	50	0.5					1	0.1	5	0.1	10	0.1				
Cyperaceae	Cyperus gracilis	slender flat-sedge	1	0.1					100	0.5							50	0.2	20	0.2			10	0.1										
Cyperaceae	Fimbristylis dichotoma	common fringe-sedge	10	0.2	2	0.1																1	0.1							2	0.1	2	0.1	
Juncaceae	*Juncus cognatus								2	0.1																								
Juncaceae	Juncus subsecundus	finger rush			2	0.1																												
Juncaceae	Luzula sp.								1	0.1																								
Lomandraceae	Lomandra filiformis subsp. coriacea	wattle matt-rush							1	0.1					20	0.2	10	0.2	1	0.1			20	0.2			10	0.2						
Lomandraceae	Lomandra filiformis subsp. filiformis	wattle matt-rush	50	1	100	1	50	1									50	0.5	20	0.2			50	0.5					10	0.2			20	0.2
Lomandraceae	Lomandra multiflora subsp. multiflora	many-flowered mat-rush	10	0.2	5	0.2			1	0.1					3	0.1	20	0.5					20	0.3			1	0.1	1	0.1			1	0.1
Phormiaceae	Dianella revoluta	blueberry lily																					10	0.2									10	0.1
Phormiaceae	Dianella sp.																5	0.1																
Poaceae	Aristida ramosa	purple wiregrass	100	10	200	10	1000	20	500	15	50	10	50	5	500	40	100	5	500	20	50	15	500	20	500	15	500	20	500	10	100	5	100	10
Poaceae	Aristida vagans	threeawn speargrass	5	0.2	100	5																											100	10
Poaceae	Austrostipa scabra	speargrass									50	1			3	0.1	10	0.2	50	5							2	0.1	2	0.1				
Poaceae	Austrostipa verticillata	slender bamboo grass									100	30					1	0.1			2	0.5												
Poaceae	Bothriochloa decipiens var. decipiens	red grass	100	10			1000	30	500	20	50	1	50	5	100	10	100	5	50	2	100	5	100	5	100	5	20	0.5			100	20	1	0.1
Poaceae	Bothriochloa macra	red grass																											20	0.5				
Poaceae	Capillipedium parviflorum	scented-top grass																											20	0.5				
Poaceae	*Chloris gayana	Rhodes grass																									x	x	1	0.1				
Poaceae	Chloris truncata	windmill grass					100	5																							50	1		
Poaceae	Chloris ventricosa	tall chloris	10	0.5	10	0.5			10	0.2	50	1			100	10	10	0.2	500	10	50	5	50	5			1	0.1						

Family	Scientific Name	Common Name	P01	P01	P02	P02	P03	P03	P04	P04	P05	P05	P06	P06	P07	P07	P08	P08	P09	P09	P10	P10	P11	P11	P12	P12	P13	P13	P14	P14	P15	P15	P16	P16
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Poaceae	Cymbopogon refractus	barbed wire grass	20	1	100	10	1	0.1			50	1	1	0.1	20	0.5	500	15	100	5	500	10	500	20			500	20	500	20			20	0.5
Poaceae	Cynodon dactylon	common couch	1	0.5			100		500	15	100	20	100	10	50	5	20	5	20	5	50	1			500	15	50	5			500	40	100	5
Poaceae	Dichanthium sericeum subsp. sericeum	Queensland bluegrass					500	10																		x	x	100	10					
Poaceae	Digitaria brownii	cotton panic grass									100	5			100	10					1000	20					500	20						
Poaceae	Digitaria diffusa	open summer-grass			20	0.5																												
Poaceae	Digitaria divaricatissima	umbrella grass													100	10					10	0.2					50	2						
Poaceae	Enteropogon acicularis	curly windmill grass	20	1	1	0.1			1	0.1															10	0.1								
Poaceae	Eragrostis brownii	Browns lovegrass					2	0.1																										
Poaceae	*Eragrostis cilianensis	stinkgrass			1	0.1																												
Poaceae	*Eragrostis curvula	African lovegrass															2	0.1	1	0.1			1	0.1										
Poaceae	Eragrostis leptostachya	paddock lovegrass	1	0.1	1	0.1																				1	0.1							
Poaceae	Eriochloa pseudoacrotricha	early spring grass					1	0.1	1	0.1			20	0.5	10	0.2					20	0.5				20	0.2							
Poaceae	*Melinis repens	red Natal grass																								x	x							
Poaceae	Microlaena stipoides	weeping grass	20	2					50	1											x	x										50	0.5	
Poaceae	Panicum effusum	hairy panic	1	0.1	20	1	20	1							50	1					2	0.1	20	0.2		10	0.2	5	0.1	1	0.1			
Poaceae	Panicum queenslandicum	Yadbila grass																								10	0.2							
Poaceae	Paspalidium distans		5	0.1	2	0.2			5	0.1							1	0.1							1	0.1					1	0.1	2	0.1
Poaceae	*Paspalum dilatatum	paspalum																										1	0.1					
Poaceae	Rytidosperma fulvum	wallaby grass	50	5							10	0.1													1	0.1	x	x					100	10
Poaceae	Rytidosperma sp.				50	1			1	0.1																								
Poaceae	*Setaria parviflora																				x	x					1	0.1						
Poaceae	Sporobolus creber	slender rats tail grass			1	0.1	1	0.1							1	0.1	1	0.1							20	0.2	1	0.1			20	0.5		
Magnoliopsida – Magnoliidae (dicots)																																		
Acanthaceae	Brunoniella australis	blue trumpet	20	0.2	20	0.1	10	0.1	50	0.2							50	0.2	20	0.2			50	0.2	10	0.1							10	0.1
Aizoaceae	*Galenia pubescens	galenia					2	0.1	1	0.1	100	30	1000	70	100	20	20	0.5	100	20	20	10	5	0.2	20	5	50	10	10	5				
Amaranthaceae	*Gomphrena celosioides	gomphrena weed																							2	0.1								
Apocynaceae	*Gomphocarpus fruticosus	narrow-leaved cotton bush							2	0.1					5	0.1						1	0.1	10	0.2			2	0.1	2	0.1			
Asteraceae	*Bidens pilosa	cobblers pegs																			5	0.2					2	0.1						

Family	Scientific Name	Common Name	p01	p01	p02	p02	p03	p03	p04	p04	p05	p05	p06	p06	p07	p07	p08	p08	p09	p09	p10	p10	p11	p11	p12	p12	p13	p13	p14	p14	p15	p15	p16	p16
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Asteraceae	Calocephalus citreus	lemon beauty-heads																					1	0.1										
Asteraceae	Calotis cuneifolia	purple burr-daisy	20	0.2													3	0.1																
Asteraceae	Calotis lappulacea	yellow burr-daisy					1	0.1							1	0.1	20	0.2																
Asteraceae	*Carthamus lanatus	saffron thistle													100	2			x	x	1000	5					500	5						
Asteraceae	Chrysocephalum apiculatum	common everlasting	20	0.2			50	0.2							10	0.1	20	0.1					5	0.1					20	0.2				
Asteraceae	*Cirsium vulgare	spear thistle																						1	0.1									
Asteraceae	Eclipta platyglossa	yellow twin-heads							1	0.1																								
Asteraceae	*Facelis retusa																							1	0.1					2	0.1			
Asteraceae	*Hypochaeris radicata	catsear																												10	0.1			
Asteraceae	Lagenophora stipitata	common lagenophora																					10	0.1					10	0.1				
Asteraceae	Ozothamnus diosmifolius	white dogwood	2	0.1																														
Asteraceae	*Senecio madagascariensis	fireweed	2	0.1	2	0.1	10	0.1	20	0.2	1	0.1					10	0.1	x	x			1	0.1	10	0.2					5	0.1		
Asteraceae	*Soliva sessilis	bindyi																												20	0.1			
Asteraceae	*Sonchus oleraceus	common sowthistle							2	0.1					2	0.1			x	x	50	0.2			10	0.1	2	0.1	10	0.1	10	0.1		
Asteraceae	*Vernonia cinerea	little ironweed	1	0.5	20	0.2											10	0.1	2	0.1												10	0.1	
Asteraceae	Vittadinia cuneata	a fuzzweed																	x	x			1	0.1					3	0.1				
Asteraceae	Vittadinia sp.	fuzzweed					1	0.1															10	0.1										
Brassicaceae	*Lepidium africanum	common peppergrass																	1	0.1														
Cactaceae	*Opuntia aurantiaca	tiger pear			2	0.1	1	0.1	20	0.2	10	0.2	2	0.1	10	0.1			10	0.1			1	0.1	2	0.1	3	0.1	1	0.1			1	0.1
Cactaceae	*Opuntia humifusa	creeping pear																			1	0.2	1	0.1	2	0.2	2	0.2	1	0.1			2	0.1
Cactaceae	*Opuntia stricta	common prickly pear	1	0.1	1	0.1					10	0.1	1	0.1	5	0.2	1	0.1	10	0.2														
Campanulaceae	Wahlenbergia gracilis	sprawling bluebell	1	0.1															x	x														
Campanulaceae	Wahlenbergia sp.	bluebell																					1	0.1										
Caryophyllaceae	*Paronychia brasiliana	Chilean whitlow wort					10	0.1	2	0.1							1	0.1													10	0.1		
Casuarinaceae	Allocasuarina luehmannii	bulloak	2	0.1													1	0.2																
Chenopodiaceae	Chenopodium pumilio	small crumbweed																													5	0.1		
Chenopodiaceae	Einadia hastata	berry saltbush			1	0.1					1	0.1					1	0.1					1	0.1										
Chenopodiaceae	Einadia nutans subsp. linifolia	climbing saltbush							2	0.1									20	0.5			20	0.2	10	0.2			5	0.1				

Family	Scientific Name	Common Name	p01	p01	p02	p02	p03	p03	p04	p04	p05	p05	p06	p06	p07	p07	p08	p08	p09	p09	p10	p10	p11	p11	p12	p12	p13	p13	p14	p14	p15	p15	p16	p16
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Chenopodiaceae	Einadia nutans subsp. nutans	climbing saltbush			1	0.1			1	0.1							10	0.2												3	0.1	3	0.1	
Chenopodiaceae	Enchylaena tomentosa	ruby saltbush							1	0.1	100	10					5	0.1	100	20			50	5					10	0.2				
Chenopodiaceae	Maireana microphylla	small-leaf bluebush					1	0.1			1	0.1	1	0.1			2	0.1	5	0.2	1	0.1			2	0.1	1	0.1	1	0.1				
Convolvulaceae	*Calystegia sp.																				x	x												
Convolvulaceae	Convolvulus erubescens	pink bindweed																					1	0.1			1	0.1	2	0.1				
Convolvulaceae	Dichondra repens	kidney weed							20	0.2							1	0.1	1	0.1			1	0.1								20	0.2	
Crassulaceae	Crassula sieberiana	Australian stonecrop																												20	0.1			
Dilleniaceae	Hibbertia obtusifolia	hoary guinea flower																														20	0.2	
Euphorbiaceae	Chamaesyce drummondii	caustic weed					5	0.1																						1	0.1			
Fabaceae (Faboideae)	Desmodium brachypodum	large tick-trefoil															1	0.1					x	x								1	0.1	
Fabaceae (Faboideae)	Desmodium varians	slender tick-trefoil	1	0.1													10	0.1					2	0.1								2	0.1	
Fabaceae (Faboideae)	Glycine clandestina	twining glycine			2	0.1											1	0.1																
Fabaceae (Faboideae)	Glycine tabacina	variable glycine	50	2	50	0.2	20	0.2	100	0.5					1	0.1	20	0.2	20	0.1	5	0.1	50	0.1	10	0.1	1	0.1	20	0.2	10	0.2	5	0.1
Fabaceae (Faboideae)	Hardenbergia violacea	false sarsaparilla																														1	0.1	
Fabaceae (Faboideae)	Indigofera australis	Australian indigo																														5	0.2	
Fabaceae (Faboideae)	*Medicago sp.	a medic													10	0.1			x	x					2	0.1	20	0.2	50	0.5				
Fabaceae (Faboideae)	Templetonia stenophylla	leafy templetonia																					2	0.1										
Fabaceae (Faboideae)	*Trifolium sp.	a clover																								1	0.1							
Fabaceae (Faboideae)	Zornia dyctiocarpa var. dyctiocarpa				2	0.1																												
Geraniaceae	Erodium crinitum	blue crowfoot													3	0.1											20	0.2						
Geraniaceae	Geranium solanderi	native geranium																					x	x	1	0.1								
Goodeniaceae	Goodenia rotundifolia																															2	0.1	
Haloragaceae	Haloragis heterophylla	variable raspwort					1	0.1																										
Lamiaceae	Ajuga australis	austral bugle																														1	0.1	
Lamiaceae	Mentha satureioides	native pennyroyal							1	0.1					20	0.2			1	0.1						20	0.2							
Lamiaceae	*Stachys arvensis	stagger weed											10	0.1	100	0.5			x	x	1000	15			50	0.5	1000	10						

Family	Scientific Name	Common Name	P01	P01	P02	P02	P03	P03	P04	P04	P05	P05	P06	P06	P07	P07	P08	P08	P09	P09	P10	P10	P11	P11	P12	P12	P13	P13	P14	P14	P15	P15	P16	P16
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Lobeliaceae	Pratia purpurascens	whiteroot							5	0.1															10	0.1								
Malvaceae	*Malva sp.	mallow																												1	0.1			
Malvaceae	*Modiola caroliniana	red-flowered mallow							1	0.1																				1	0.1			
Malvaceae	Sida corrugata	corrugated sida					3	0.1			1	0.1					1	0.1	5	0.1			2	0.1					1	0.1				
Malvaceae	*Sida rhombifolia	Paddys lucerne			20	0.5			2	0.1	10	0.2	10	0.2	20	0.2	20	0.2	20	0.2	50	0.5			20	0.2	20	0.2	50	0.5				
Malvaceae	Sida hackettiana	golden rod			2	0.1					20	0.2	10	0.2	10	0.2	10	0.2	10	0.2	2	0.1					100	5						
Myoporaceae	Eremophila debilis	amulla	2	0.2					10	0.2	10	0.1			3	0.1	10	0.2	20	1	3	0.2	10	0.2			2	0.2	2	0.1			1	0.1
Myrsinaceae	*Lysimachia arvensis	scarlet pimpernel					10	0.1						50	0.1										50	0.2	100	1			20	0.1		
Myrtaceae	Corymbia maculata	spotted gum	x	x	10	15											2	10					x	x	x	x							20	45
Myrtaceae	Eucalyptus crebra	narrow-leaved ironbark	3	20	11	5			3	5	x	x					17	15					50	20	x	x			1	1	1	1	3	0.2
Myrtaceae	Eucalyptus moluccana	grey box	1	5	3	10					4	20					x	x	7	15			1	0.2	x	x								
Myrtaceae	Eucalyptus punctata	grey gum																							x	x								
Myrtaceae	Eucalyptus tereticornis	forest red gum							15	30							x	x													6	1		
Oleaceae	*Olea europaea subsp. cuspidata	African olive							1	0.1	20	5					1	0.1	2	0.5									500	20			2	0.2
Oxalidaceae	Oxalis perennans								10	0.1									1	0.1					1	0.1					20	0.1	2	0.1
Phyllanthaceae	Breynia oblongifolia	coffee bush			1	0.1																												
Phyllanthaceae	Phyllanthus virgatus	wiry spurge													2	0.1	2	0.1	x	x					10	0.1					2	0.1		
Pittosporaceae	Bursaria spinosa	native blackthorn			x	x																												
Plantaginaceae	Plantago debilis	shade plantain																	1	0.1														
Plantaginaceae	*Plantago lanceolata	lamb's tongues					1	0.1	20	0.2					100	0.2			1	0.1	100	0.5	20	0.2	500	10			100	0.5	100	1		
Plantaginaceae	Veronica plebeia	trailing speedwell			2	0.1																												
Polygonaceae	Rumex brownii	swamp dock																											2	0.1				
Rubiaceae	Asperula conferta	common woodruff							20	0.1															1	0.1			20	0.1				
Rubiaceae	Opercularia diphylla	stinkweed																															2	0.1
Rubiaceae	*Richardia humistrata								20	0.1																					20	0.1		
Sapindaceae	Dodonaea viscosa subsp. spatulata	broad-leaf hopbush	12	2																														
Solanaceae	*Lycium ferocissimum	African boxthorn									1	0.1							2	0.5							x	x						
Solanaceae	Solanum cinereum	Narrawa burr													1	0.1			3	0.1	1	0.1			5	0.1	10	0.2	1	0.1	2	0.1	2	0.1
Solanaceae	Solanum esuriale	quena																	20	0.2														
Solanaceae	*Solanum nigrum	black-berry nightshade							1	0.1					2	0.1							1	0.1							2	0.1		
Solanaceae	Solanum prinophyllum	forest nightshade							20	0.3							1	0.1																
Stackhousiaceae	Stackhousia sp.																																1	0.1

Family	Scientific Name	Common Name	p01	p01	p02	p02	p03	p03	p04	p04	p05	p05	p06	p06	p07	p07	p08	p08	p09	p09	p10	p10	p11	p11	p12	p12	p13	p13	p14	p14	p15	p15	p16	p16
			AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC	AA	PC
Stackhousiaceae	Stackhousia viminea	slender stackhousia	3	0.1													20	0.1					2	0.1										
Verbenaceae	*Verbena bonariensis	purpletop															1	0.1											10	0.2				
Verbenaceae	*Verbena rigida var. rigida	veined verbena																	x	x	x	x	10	0.1					2	0.1				

Table B2 Flora Species List (ELA) Plots 1 to 13

Scientific Name	Plot																											
	1		2		3		4		5		6		7		8		9		10		11		12		13			
	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia amblygona	0.1	20	0.1	5																								
Allocasuarina luehmannii	0.1	5																										
Alternanthera sp.					0.1	1																						
Aristida vagans			1	50			0.2	50			2	500	2	500	1	50					0.1	20						
Asperula conferta																							0.1	20				
Austrostipa ramosissima													2	500	5	100												
Austrostipa sp.																	10	100	1	100	0.1	10						
Axonopus fissifolius																										5	500	
Breynia oblongifolia			0.1	1							0.1	1																
Brunoniella australis									0.1	5													0.1	50				
Carthamus lanatus															5	500			30	2000	0.1	20						
Centaurium tenuiflorum																										2	500	
Cheilanthes sieberi	0.1	100	0.1	50	0.1	20					1	100											0.1	10	0.1	5		
Chloris gayana													0.1	5	2	100												
Chloris truncata							0.1	5															0.1	20	0.1	10		
Chrysocephalum apiculatum	0.1	50			0.1	1																			0.1	20		
Cirsium vulgare					0.1	1					0.1	10			0.1	20												
Commelina cyanea			0.1	10	0.1	5	0.1	20			0.1	50	0.2	100														
Convolvulus erubescens															0.1	10												
Corymbia maculata	0.1	1					11	20	5	20	10	4																
Cymbopogon refractus			0.5	30							1	100			20	1000			0.1	10			0.1	20				
Cynodon dactylon	15	1000	0.1	50	5	1000	1	500					0.1	50	10	500	1	500	1	100			5	500	10	1000		
Cyperus gracilis									1	500	0.5	100									0.1	100	0.1	5p				
Cyperus sp.																							0.1	5				
Daviesia ulicifolia					0.1	5																						
Desmodium varians			0.1	20	0.1	10					0.1	20											0.1	10	0.1	50		
Dianella caerulea					0.1	10																	0.1	1				
Dichondra repens									0.1	5	0.5	100	0.5	50									0.1	100				
Einadia polygonoides							0.1	20	0.1	20			0.1	10									0.2	100				
Enchylaena tomentosa															1	50	1	50			0.1	20						
Eragrostis brownii	0.1	10	0.1	5																								
Eragrostis curvula							0.1	20																				
Eremophila debilis			0.1	5			0.1	1	0.1	10	2	200	1	100			0.1	20			0.1	20	0.1	5				

Scientific Name	Plot																									
	1		2		3		4		5		6		7		8		9		10		11		12		13	
	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Eucalyptus crebra	0.1	1	10	6	15	17	3	5			5	7									25	1	5	3		
Eucalyptus fibrosa																							0.2	20		
Eucalyptus moluccana									1	5	5	2	3	20			20	3								
Eucalyptus tereticornis																							20	12		
Fimbristylis dichotoma																									0.1	1
Galenia pubescens									0.1	20	0.2	50	1	100			30	1000	5	500	0.5	100	0.1	5		
Glycine clandestina	0.1	5	0.1	5	0.1	5	0.1	5	0.1	20	0.1	20											0.1	20	0.1	1
Glycine tabacina																										
Gomphrena celosioides																									0.1	5
Gomphocarpus fruticosus									0.1	1					0.1	20			0.1	1						
Grevillea robusta																										
Hardenbergia violacea																										
Hypochaeris radicata	0.1	5																								
Juncus sp.																					0.1	10				
Laxmannia gracilis	0.1	20					0.1	20																	0.1	10
Linum trigynum																									0.1	20
Lomandra filiformis subsp. filiformis			0.1	20									0.1	50												
Lomandra multiflora subsp. multiflora			0.2	100			0.1	1			0.1	20									0.2	100	0.1	50		
Lomandra sp.					3	500	0.5	100	1	100													0.1	1		
Lycium ferocissimum													0.1	10												
Maireana microphylla									0.1	5			1	20	0.2	20	0.2	10	0.1	5						
Olea europaea											0.2	20									0.2	10	0.1	2		
Opuntia aurantiaca							0.2	100	1	50	0.1	20	0.1	20			0.2	50	0.2	50	0.1	10	0.1	5	0.1	1
Opuntia stricta	0.1	1	0.1	20			0.2	50	0.1	10	0.1	20	0.1	20	0.5	50	0.1	20	0.1	10	0.1	5				
Ozothamnus diosmifolius			0.2	30																						
Panicum sp.													0.1	5												
Petrorhagia dubia											1	500														
Plantago gaudichaudii									0.1	10															1	500
Plantago lanceolata	0.1	5	0.1	50							5	500	0.5	100	1	100	0.1	50	5	1000	0.5	100	0.2	100		
Richardia humistrata																									3	500
Rytidosperma sp.	2	100	0.1	20	0.1	20	0.1	20	1	100																
Senecio madagascariensis	0.1	50	0.1	20	0.1	20			0.1	30	0.2	50					0.1	20			0.1	10	0.2	100	2	500
Sida corrugata													0.2	50												
Sida rhombifolia									0.1	20			0.1	50	1	100	0.1	20	0.1	50					0.1	1
Solanum prinophyllum					0.2	20			0.2	20	0.1	20									0.1	10	0.1	20		
Sporobolus elongatus																									0.1	20
Sporobolus sp.															0.1	5										
Themeda triandra			1	50	0.5	50																				
Verbena bonariensis											1	100			2	100										
Verbena rigida											0.5	50	0.2	50	1	500			0.2	100	0.2	20				
Vittadinia sp.			0.1	100	0.1	20					0.1	20														
Zornia dyctiocarpa			0.1	5																						

Table B3 Flora Species List (ELA) Plots 14 to 26

Scientific Name	Plot																									
	14		15		16		17		18		19		20		21		22		23		24		25		26	
	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Acacia amblygona													5	100	0.1	10										
Acacia falcata													1	20			0.1	5								
Acacia saligna							0.1	1													1	2				
Anagallis arvensis																					0.1	20	0.5	50		
Aristida ramosa																					2	50			0.2	50
Aristida vagans	2	50			15	1000	2	100	5	100	1	100	2	500	0.1	10	2	100					2	100		
Arthropodium sp.			0.1	1									0.1	5			0.1	5								
Asperula conferta	0.1	1																								
Austrostipa sp.			0.1	10																					0.1	10
Austrostipa verticillata																									20	500
Axonopus fissifolius																		5	100							
Bidens pilosa																					0.1	20				
Bothriochloa macra																									0.5	100
Breynia oblongifolia													8	50	0.2	10	10	100								
Brunoniella australis			0.1	20									0.1	5											0.1	5
Carthamus lanatus							0.2	100	3	100	8	500									0.1	20	2	500	0.1	10
Centaurium tenuiflorum					0.2	100																				
Cheilanthes sieberi	0.1	20	0.1	50	0.2	100			2	500			0.5	100	0.5	100	0.1	10								
Chloris gayana							5	100											2	50						
Chloris truncata															0.1	5							0.5	20		
Chloris ventricosa																								0.2	20	
Chrysocephalum apiculatum					0.2	100																	1	100		
Cirsium vulgare																										
Commelina cyanea			0.1	5			0.1	10			1	50	0.5	100			0.1	5							0.1	5
Corymbia maculata			20	42									10	23	15	22	15	8								
Cyclospermum leptophyllum																					0.1	5				
Cymbopogon refractus			0.1	5	3	100	2	100			1	20	0.1	5	1	20									0.2	20
Cynodon dactylon	5	1000	1	100	5	500					0.2	100	0.2	20					5	100	5	1000	2	500	20	500
Cyperus gracilis																					1	100			..1	100
Cyperus sp.																					2	500	1	100		
Daviesia ulicifolia													5	100	0.2	10	0.1	5								
Desmodium brachypodum																					0.1	1				
Desmodium varians			0.1	20	0.1	20							0.1	20			0.1	1								
Dianella caerulea													0.5	100	3	100	0.5	50								
Dianella prunina															0.1	10										
Dichelachne sp.					0.1	5																				
Dichondra repens			1	100			0.1	20					0.2	50	0.2	100					5	1000			0.1	1
Digitaria sp.																									1	50
Ehrharta erecta																					1	100				
Einadia hastata																									1	50
Einadia polygonoides							0.1	5															0.1	5	0.1	10
Enchylaena tomentosa							0.3	50													0.2	20			5	100
Enteropogon acicularis																									0.1	10
Entolasia stricta															0.5	20										

Scientific Name	Plot																									
	14		15		16		17		18		19		20		21		22		23		24		25		26	
	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Eragrostis curvula																			1	20						
Eragrostis sp.					0.5	50																				
Eremophila debilis			0.1	5			1	50					0.1	10	0.1	5					0.1	5			2	100
Erodium crinitum																							2	500	0.1	1
Eucalyptus crebra			1	5											2	4	2	12								
Eucalyptus fibrosa													15	2												
Eucalyptus moluccana							20	1																	25	5
Eucalyptus tereticornis																					25	2				
Galenia pubescens	0.1	5			0.1	5	0.5	100	20	1000	15	1000									15	100	15	500	7	50
Glycine clandestina			0.1	10	0.1	10							0.1	10	0.1	10	0.1	5								
Glycine tabacina													0.1	10	0.1	5										
Gomphocarpus fruticosus	0.1	1					0.1	3	0.1	5					0.1	5					0.1	5				
Goodenia rotundifolia			0.1	50									0.2	50	0.1	20										
Grevillea robusta																	2	1								
Hardenbergia violacea													0.1	1												
Juncus sp.																			0.2	100						
Lantana camara																	2	1								
Laxmannia gracilis					0.1	10							0.2	50	0.2	20	0.1	10	0.1	5						
Linum trigynum	0.1	5	0.1	1															0.1	10						
Lomandra multiflora subsp. multiflora			0.1	20									1	50	0.5	50	1	50								
Lomandra sp.			0.1	20									0.5	20	0.5	100	0.1	10						0.1	5	
Lycium ferocissimum			0.1	1																	10	20			1	5
Maireana microphylla	0.1	1							0.1	1	0.1	1													0.2	10
Medicago sp.																							1	100		
Myoporum montanum															2	5										
Olearia elliptica															5	20										
Olea europaea							0.1	5					0.1	10	1	20	2	5			15	20			2	7
Oplismenus sp.													0.1	10												
Opuntia aurantiaca	0.1	20	0.1	20					0.1	10	0.1	10			0.1	10					0.1	20	0.5	50	0.1	10
Opuntia stricta	0.1	5	0.1	10	0.1	10	0.1	10	0.1	10	0.1	10	0.1	10	0.1	5	0.1	2	0.1	5	0.1	10	1	50	0.1	10
Oxalis sp.																					0.1	10	0.1	50	0.1	5
Panicum sp.					0.5	100											0.1	10								
Pennisetum clandestinum			0.1	5																	2	100				
Petrorhagia dubia					0.5	100																				
Phyllanthus virgatus																									0.1	5
Plantago lanceolata	3	500			0.5	100	0.1	50	0.2	100	1	100							1	500	0.5	50	10	1000		
Pomax umbellata													0.1	1												
Portulaca oleracea																									0.1	1
Rumex brownii	0.1	1																								
Rumex sp.									0.1	1																
Rumex sp.																					0.1	5				
Rytidosperma sp.	0.1	10	0.1	20									1	20	1	20	0.2	20							0.5	100
Senecio madagascariensis	2	100			0.1	50	0.1	20	0.1	5									0.5	100	0.1	5			0.1	5
Senna sp.													3	20												

Scientific Name	Plot																									
	14		15		16		17		18		19		20		21		22		23		24		25		26	
	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Setaria sp.			0.1	5																						
Sida sp.							0.1	10	5	1000	0.5	100									1	50				
Sida corrugata																								0.1	10	
Sida rhombifolia	0.1	5			0.1	10	0.1	20	0.1	5	0.1	20									0.5	20	0.2	100	0.1	20
Solanum prinophyllum	0.1	5	0.1	10			0.2	50			0.1	5					0.1	3					0.1	1		
Sonchus sp.																					0.1	10	0.1	10	0.1	10
Spartothamnella juncea															0.5	5										
Sporobolus creber																								0.1	5	
Sporobolus sp.	0.1	20															0.1	1	0.1	20						
Stachys arvensis																					0.1	20	1	100		
Stackhousia viminea													0.1	20	0.1	5										
Verbena bonariensis					0.1	20													0.1	50						
Verbena rigida	0.1	10			0.5	100	0.2	100			0.1	50														
Vittadinia sp.			0.1	5											0.1	10									0.1	1
Wahlenbergia sp.																									0.1	5

Table B4 Vegetation Integrity Data (Umwelt)

Plot	COMPOSITION						STRUCTURE						FUNCTION										
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
													<5	5-10	10-20	20-30	30-50	50-80					
PCT 1598 – Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – Moderate to Good																							
P04	2	2	14	10	0	1	35.0	0.3	52.5	1.4	0.0	0.5	1	1	1	1	1	1	1	0	41.0	29.0	0.6
PCT 1598 – Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter – DNG																							
P15	2	1	8	6	1	1	2.0	0.1	66.8	0.6	0.1	0.2	1	0	0	1	0	0	0	0	35.0	0.0	0.1
PCT 1604 – Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate to Good																							
P01	3	3	16	6	1	2	25.1	2.3	32.0	1.3	1.0	2.1	1	1	1	1	1	0	0	0	82.8	21.0	0.2
P02	3	1	15	9	1	2	30.0	0.1	29.9	1.0	0.5	0.3	1	1	1	0	1	1	1	1	44.0	33.0	0.3
P16	2	4	11	12	2	3	45.2	0.6	36.6	1.3	0.4	0.3	1	1	1	1	1	0	0	0	98.0	37.0	0.4
PCT 1604 – Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy																							
P05	1	3	9	3	1	0	20.0	10.2	69.1	0.4	0.2	0.0	0	0	0	0	1	1	1	6	36.0	90.0	35.5
P08	3	3	14	15	2	3	25.2	0.4	32.2	1.9	5.1	0.4	1	1	1	1	1	0	0	0	28.0	12.0	0.9
P09	1	4	10	11	1	1	15.0	21.3	48.0	1.8	0.1	0.1	1	1	0	0	0	1	0	6	68.0	39.0	21.4
P11	2	2	10	15	2	3	20.2	5.2	51.4	1.8	10.2	0.3	1	1	1	0	0	1	0	1	35.0	17.0	0.6
PCT 1604 – Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – DNG																							
P03	0	1	10	7	0	1	0.0	0.1	67.4	0.8	0.0	0.2	0	0	0	0	0	0	0	0	3.8	0	0.3
P07	0	2	13	7	1	1	0.0	0.2	87.2	0.9	1.0	0.1	0	0	0	0	0	0	0	0	59.0	0.0	22.3
P10	0	3	10	1	0	1	0.0	0.4	57.3	0.1	0.0	0.1	0	0	0	0	0	0	0	0	46.0	0.0	15.4
P12	0	2	9	7	2	1	0.0	0.2	50.6	0.8	0.2	0.1	0	0	0	0	0	0	0	0	27.0	0.0	5.5
P13	0	3	16	3	2	2	0	0.5	68.9	5.4	10.2	0.2	0	0	0	0	0	0	0	0	40.0	0.0	15.4
PCT 1604 – Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – African Olive Infestation																							
P14	1	4	10	7	1	2	1.0	0.5	41.6	0.8	0.2	0.3	0	0	0	1	0	0	0	0	32.0	0.0	25.4
Exotic Grassland																							
P06	0	1	5	1	0	0	0.0	0.1	20.6	0.2	0.0	0.0	0	0	0	0	0	0	0	0	22.0	0.0	70.2

Table B5 Vegetation Integrity Data (ELA)

Plot	COMPOSITION						STRUCTURE						FUNCTION										
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
													<5	5-10	10-20	20-30	30-50	50-80					
P1	3	1	3	2	1	1	0	0	17	0	0	0	1	0	0	0	0	0	0	0	2.2	0	0
P2	1	4	8	2	1	2	10	1	3	0	0	0	1	0	1	1	0	0	0	0	31	5	0
P3	1	1	5	6	1	2	15	0	11	1	0	0	1	1	1	1	0	0	0	0	30	4	0
P4	2	1	6	3	0	1	14	0	2	0	0	0	1	0	1	1	0	1	1	1	62	6	0
P5	2	2	3	5	0	1	6	0	3	1	0	0	1	0	1	0	1	5	5	1	30	0	1
P6	3	2	4	4	1	2	20	2	4	1	1	0	1	1	1	1	1	0	0	2	13	17	1
P7	1	2	5	4	0	0	3	2	4	1	0	0	1	1	0	0	0	0	0	4	15	11	1
P8	0	2	6	0	0	1	0	1	36	0	0	0	0	0	0	0	0	0	0	0	15	0	0
P9	1	3	2	0	0	0	20	1	11	0	0	0	1	0	0	0	1	0	0	3	48	3	1
P10	0	1	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	78	0	0
P11	1	2	5	1	0	0	25	0	1	0	0	0	1	1	0	0	0	0	0	1	27	2	0
P12	3	1	7	6	1	2	25	0	6	1	0	0	1	1	1	1	1	0	0	0	23	8.5	1
P13	0	0	4	3	1	2	0	0	10	1	0	0	0	0	0	0	0	0	0	0	6	0	0
P14	0	1	4	3	1	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	29	0	0
P15	2	1	7	7	1	2	21	0	2	2	0	0	1	1	1	1	1	0	0	0	89	25	0
P16	0	0	6	2	1	2	0	0	24	0	0	0	0	0	0	0	0	0	0	0	29	0	0
P17	1	2	2	4	0	0	20	1	4	1	0	0	1	0	0	0	0	0	0	1	26	0	0
P18	0	1	1	1	1	0	0	0	5	0	2	0	0	0	0	0	0	0	0	0	66	0	0
P19	0	1	3	2	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	71	0	0
P20	2	6	7	9	1	4	25	19	5	2	1	0	1	1	1	1	1	0	0	0	61	8	0
P21	2	8	7	7	1	2	17	8	4	4	1	0	1	1	1	1	1	0	0	0	62	19	0
P22	2	8	7	7	1	2	17	8	4	4	1	0	1	1	1	0	1	0	0	0	82	0	1
P23	0	0	3	1	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	30	0	0
P24	1	2	5	4	0	0	25	0	11	5	0	0	1	1	1	1	0	2	2	1	82	21	0
P25	0	0	4	5	0	0	0	0	6	3	0	0	0	0	0	0	0	0	0	0	47	0	0
P26	1	3	12	13	0	0	25	7	43	2	0	0	0	0	0	0	1	4	4	5	26	22	1

Table B6 Vegetation Integrity Data (Niche)

Plot	FUNCTION									
	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)
	<5	5-10	10-20	20-30	30-50	50-80				
PCT 1600 – Good										
RM9	1	1	1	1	1	1	3	1	73	16
RM10	1	1	1	1	1	1	1	0	86	18
RM11	1	1	1	1	1	1	3	3	70	5
RM12	1	1	1	1	0	0	0	0	51	15
RM13	1	1	1	1	1	1	2	2	70	17
RM14	1	1	1	1	0	0	0	0	68	30
RM15	1	1	1	1	0	0	0	0	71	27.5
RM16	1	1	1	1	1	1	1	1	61	17
RM17	1	1	1	1	1	1	3	2	60	12.5
RM19	1	1	1	1	1	1	1	2	73	6.5
RM20	1	1	1	1	1	0	0	0	71	18
RM21	1	1	1	1	0	1	4	1	74	9
RM23	1	0	1	1	1	1	1	1	34	8
RM24	1	1	1	1	1	1	1	0	22	8.5
RM26	1	1	1	1	1	0	0	0	47	0
RM39	1	0	1	1	0	1	1	5	17.4	48
PCT 1601 – Good										
RM25	1	1	1	1	0	1	1	1	13	30
RM40	1	1	1	0	0	1	1	0	23	0
RM41	1	1	1	1	0	1	2	2	18	6
PCT 1601 - Moderate										
RM27	1	1	1	1	0	0	0	0	33	3
RM28	1	0	1	1	1	0	0	0	53	4
RM29	0	1	1	1	1	0	0	0	54	10
RM30	1	0	1	1	1	1	1	1	29	4.5
RM31	1	1	1	1	0	1	1	1	53	3
RM32	1	0	0	0	1	1	1	0	32	5.5
RM33	1	0	0	1	1	1	1	1	37	6
PCT 1603 – Good										
RM22	1	0	0	1	1	1	2	2	25	0
RM38	1	1	1	1	0	1	3	4	37	30.5
RM42	1	1	1	1	0	1	1	1	17	8

Plot	FUNCTION									
	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)
	<5	5-10	10-20	20-30	30-50	50-80				
RM43	1	1	1	0	0	1	3	3	29	5
RM44	1	1	1	0		1	1	2	38	15
RM45	1	1	1	1	1	1	2	2	49	32
PCT 1603 – Moderate										
RM4	1	1		1	1	1	2	2	44.6	12
RM34	0	1	1	0	0	1	3	3	30	40
RM35	1	1	1	0	0	1	2	2	49	32
RM36	1	1	1	1	0	0	1	1	17	6
PCT 1604 – Good										
RM37	1	1	1	1	1	1	4	4	59	39.5
PCT 1607 – Good										
RM46	0	1	1	0	1	1	1	2	18.4	22
RM47	0	1	1	0	0	1	3	2	18	11
PCT 1731 – Good										
RM1	1	1	1	1	1	1	2	3	32	107
RM2	1	1	1	1	1	1	4	3	50	38
RM3	1	1	1	1	1	1	1	1	26	78
RM7	1	1	1	1	0	0	0	0	69	25
RM8	1	1	1	1	0	0	0	0	54	35
RM18	1	1	1	1	1	1	1	1	82	28.5
PCT 1731 – Low										
RM5	1	1	1	1	0	1	1	0	56	25
RM6	1	1	1	1	0	0	0	0	91	28

Table B7 Fauna Species List (ELA)

Scientific Name	Common name	Status		Comments
		BC Act	EPBC Act	
Birds				
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill			
<i>Aegotheles cristatus</i>	Australian owl-nightjar			
<i>Alisterus scapularis</i>	Australian king-parrot			
<i>Anas superciliosa</i>	pacific black duck			
<i>Cacatua galerita</i>	sulphur-crested cockatoo			
<i>Cacatua sanguinea</i>	little corella			
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo			
<i>Chenonetta jubata</i>	Australian wood duck			
<i>Circus approximans</i>	swamp harrier			
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike			
<i>Corcorax melanorhamphos</i>	white-winged chough			
<i>Corvus coronoides</i>	Australian raven			
<i>Cracticus nigrogularis</i>	pied butcherbird			
<i>Cracticus torquatus</i>	grey butcherbird			
<i>Dacelo novaeguineae</i>	laughing kookaburra			
<i>Entomyzon cyanotis</i>	blue-faced honeyeater			
<i>Eolophus roseicapilla</i>	galah			
<i>Eurystomus orientalis</i>	dollarbird			
<i>Falco berigora</i>	brown falcon			
<i>Gallinula tenebrosa</i>	dusky moorhen			
<i>Glossopsitta concinna</i>	musk lorikeet			
<i>Grallina cyanoleuca</i>	magpie-lark			
<i>Gymnorhina tibice</i>	Australian magpie			
<i>Hieraaetus morphnoides</i>	little eagle	V		
<i>Hirundo neoxena</i>	welcome swallow			
<i>Malurus cyaneus</i>	superb fairywren			
<i>Manorina melanocephala</i>	noisy miner			
<i>Melithreptus lunatus</i>	white-naped honeyeater			
<i>Ocyphaps lophotes</i>	crested pigeon			
<i>Pardalotus striatus</i>	striated pardalote			
<i>Petrochelidon nigricans</i>	tree martin			
<i>Philemon corniculatus</i>	noisy friarbird			
<i>Platycercus eximius</i>	eastern rosella			
<i>Pomatostomus temporalis</i>	grey-crowned babbler (eastern subspecies)	V		

Scientific Name	Common name	Status		Comments
		BC Act	EPBC Act	
<i>Psephotus haematonotus</i>	red-rump parrot			
<i>Sturnus tristis</i>	common mynah			
<i>Threskiornis spinicollis</i>	straw-necked ibis			
<i>Trichoglossus moluccanus</i>	rainbow lorikeet			
<i>Tyto novaehollandiae</i>	masked owl	V		Potential sighting
<i>Vanellus miles</i>	masked lapwing			
Mammals				
<i>Austronomus australis</i>	white-striped free-tailed bat			
<i>Bos taurus</i>	cow			
<i>Chalinolobus gouldii</i>	Gould's wattled bat			
<i>Chalinolobus morio</i>	chocolate wattled bat			
<i>Falsistrellus tasmaniensis</i>	eastern false pipistrelle	V		Potential recording
<i>Felis catus</i>	feral cat			
<i>Macropus giganteus</i>	eastern grey kangaroo			
<i>Macropus rufogriseus</i>	red-necked wallaby			
<i>Micronomus norfolkensis</i>	eastern coastal free-tailed bat	V		
<i>Miniopterus australis</i>	little bent-winged bat	V		
<i>Miniopterus orianae oceanensis</i>	large bent-winged bat	V		
<i>Myotis macropus</i>	southern myotis	V		
<i>Nyctophilus</i> sp.	long-eared bat			Potential recording
<i>Oryctolagus cuniculus</i>	European rabbit			
<i>Ozimops ridei</i>	Ride's free-tailed bat			
<i>Petaurus norfolcensis</i>	squirrel glider	V		
<i>Phascogale tapoatafa</i>	brush-tailed phascogale	V		
<i>Pseudocheirus peregrinus</i>	ringtail possum			
<i>Pteropus poliocephalus</i>	grey-headed flying-fox	V	V	Flying over proposal area
<i>Rattus</i>	black rat			
<i>Scoteanax rueppellii</i>	greater broad-nosed bat	V		Potential recording
<i>Scotorepens balstoni</i>	inland broad-nosed bat			
<i>Scotorepens orion</i>	eastern broad-nosed bat			Potential recording
<i>Trichosurus vulpecula</i>	common brushtail possum			
<i>Vespadelus pumilus</i>	eastern forest bat			Potential recording
<i>Vespadelus regulus</i>	southern forest bat			Potential recording
<i>Vespadelus troungtoni</i>	eastern cave bat	V		Potential recording
<i>Vespadelus vulturnus</i>	little forest bat			Potential recording

Scientific Name	Common name	Status		Comments
		BC Act	EPBC Act	
<i>Vulpes</i>	red fox			
Amphibians				
<i>Litoria fallax</i>	eastern dwarf tree frog			
<i>Litoria latopalmata</i>	broad-palmed frog			
<i>Litoria peronii</i>	Peron's tree frog			
Reptiles				
<i>Varanus varius</i>	lace monitor			

Appendix C – Habitat Assessment Table

This table was developed by Niche, with additions made by Umwelt based on updated database searches.

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the proposal area during the current survey
High	It is highly likely that a species inhabits the proposal 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 (10km) and is known or likely to maintain resident populations in the proposal area. Also includes species known or likely to visit the proposal area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the proposal area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the proposal 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 proposal 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 proposal area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the proposal 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 proposal 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 proposal area.

Abbreviations used within the table include:

BC Act	<i>Biodiversity Conservation Act 2016</i>
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999 (federal)</i>
V	Vulnerable
E	Endangered
EEC	Endangered Ecological Community
EP	Endangered Population
CE	Critically Endangered
CEEC	Critically Endangered Ecological Community
M	Migratory

Table C1 Habitat assessment table

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
Threatened Ecological Communities					
Central Hunter Valley Eucalypt Forest and Woodland		-	CEEC	-	Recorded
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions		EEC	-	-	Recorded
Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions		EEC	-	-	Recorded
Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of New South Wales and South East Queensland		EEC	EEC	-	None
Hunter Valley Weeping Myall (<i>Acacia pendula</i>) Woodland		CEEC	CEEC	-	None
Lowland Rainforest of Subtropical Australia		EEC	CEEC	-	None
Warkworth Sands Woodland of the Hunter Valley		EEC	CEEC	-	None
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		EEC	CEEC	-	None
Flora					
A spear-grass (<i>Austrostipa wakoolica</i>)	Confined to the floodplains of the Murray River tributaries of central-western and south-western NSW. Floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils.	E	E	0	None
A Leek-orchid (<i>Prasophyllum</i> sp. Wybong)	Known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Occurs in open eucalypt woodland and grassland.	-	CE	0	Low
<i>Acacia pendula</i> population in the Hunter catchment	This population is known to occur as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. Heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations.	EP	-	2	Moderate
Bluegrass (<i>Dichanthium setosum</i>)	In NSW, found on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes. Cleared woodland, grassy roadside remnants and highly disturbed pasture, on heavy basaltic black soils and red-brown loams with clay subsoil.	V	V	0	Low
<i>Cymbidium canaliculatum</i> population in the Hunter	The Hunter population occurs as far south as Weston and Pokolbin in the Lower Hunter, but is centred in the Upper Hunter, predominantly north of Singleton. Isolated occurrences are also known from the Merriwa plateau,	EP	-	2	Moderate

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
Catchment	Bylong valley and the Gungal area near Goulburn River. Grows on trees in sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. Within the Hunter Catchment, most commonly found in <i>Eucalyptus albens</i> (White Box) dominated woodlands.				
<i>Eucalyptus camaldulensis</i> population in the Hunter catchment	Disjunct population occurring from Bylong, south of Merriwa, to the east at Hinton, on the bank of the Hunter River. Riparian and floodplain woodland, often with <i>Eucalyptus tereticornis</i> , <i>E. melliodora</i> , <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> and <i>Angophora floribunda</i> .	EP	-	85	Recorded
<i>Euphrasia arguta</i>	In NSW, recently recorded only from Nundle area of the north western slopes and tablelands, from near the Hastings River and from the Barrington Tops. Eucalypt forest with a mixed grass and shrub understorey, disturbed areas, along roadsides.	E	CE	0	None
Heath Wrinklewort (<i>Rutidosia heterogama</i>)	Between Cessnock and Kurri Kurri, in Howes Valley, and north from Wyong to Newcastle on the Central Coast. Also on the north coast and on the New England Tablelands Heath on sandy soils, moist areas in open forest, and along disturbed roadsides.	V	V	0	None
Illawarra Greenhood (<i>Pterostylis gibbosa</i>)	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). Open forest or woodland, on flat or gently sloping land with poor drainage.	E	E	0	None
Magenta Lilly Pilly (<i>Syzygium paniculatum</i>)	Found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the central coast occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	E	V	0	None
Singleton Mint Bush (<i>Prostanthera cineolifera</i>)	Grows in open woodlands on exposed sandstone ridges, usually found in association with shallow or skeletal sands.	V	V	0	Low
Slaty Red Gum (<i>Eucalyptus glaucina</i>)	Only on the north coast of NSW. Found near Casino and farther south, from Taree to Broke, west of Maitland. Grassy woodland on dry eucalypt forest on deep, moderately fertile and well-watered soils.	V	V	115	Moderate
Spreading Guinea Flower (<i>Hibbertia procumbens</i>)	Within NSW, known from several locations only on the Central Coast in the Gosford and Wyong local government areas. <i>Banksia ericifolia</i> – <i>Angophora hispida</i> – <i>Allocasuarina distyla</i> scrub/heath on skeletal sandy soils, or 'hanging swamp' vegetation on sandy deposits.	E	-	0	None

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
Tarengo Leek Orchid (<i>Prasophyllum petilum</i>)	Four sites in NSW: at Boorowa, Captains Flat, Ilford and Delegate. Natural Temperate Grassland, grassy woodland, and Box-Gum woodland.	E	E	0	Low
Trailing Woodruff (<i>Asperula asthenes</i>)	Only in NSW, in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area Damp sites, often along river banks.	V	V	1	Low
White-flowered Wax Plant (<i>Cynanchum elegans</i>)	Restricted to eastern NSW, from Brunswick Heads on the north coast to Gerroa in the Illawarra region, and as far west as Merriwa in the upper Hunter River valley. Dry rainforest; littoral rainforest; <i>Leptospermum laevigatum</i> - <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> (Coastal Tea-tree– Coastal Banksia) coastal scrub; <i>Eucalyptus tereticornis</i> (Forest Red Gum) or <i>Corymbia maculata</i> (Spotted Gum) open forest and woodland; and <i>Melaleuca armillaris</i> (Bracelet Honeymyrtle) scrub.	E	E	0	Low
Birds					
Australasian Bittern (<i>Botaurus poiciloptilus</i>)	Found over most of NSW except for the far north-west. Permanent freshwater wetlands with tall, dense vegetation, particularly <i>Typha</i> sp. (bullrushes) and <i>Eleocharis</i> sp. (spikerushes).	E	E	0	Low
Australian Painted Snipe (<i>Rostratula australis</i>)	In NSW most records are from the Murray-Darling Basin. Other recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. Swamps, dams and nearby marshy areas.	E	E	0	Moderate
Black-breasted Buzzard (<i>Hamirostra melanosternon</i>)	Areas receiving less than 500 mm rainfall from north-western NSW and north-eastern SA to the east coast at about Rockhampton, then across northern Australia south almost to Perth. Inland habitats, including timbered watercourses, grasslands and sparsely timbered woodlands.	V	-	0	Low
Black-necked Stork (<i>Ephippiorhynchus asiaticus</i>)	Coastal and subcoastal northern and eastern Australia, south to central-eastern NSW and with vagrants recorded further south and inland. In NSW, floodplain wetlands of the major coastal rivers are key habitat. Also, minor floodplains, coastal sandplain wetlands and estuaries.	E	-	9	None
Brown Treecreeper (eastern subspecies) (<i>Climacteris picumnus victoriae</i>)	From eastern through central NSW, west to Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell. Eucalypt woodlands and dry open forest.	V	-	4	Moderate
Curlew Sandpiper	Occurs along the entire coast of NSW, and sometimes in freshwater wetlands	E	CE, M	0	None

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
(<i>Calidris ferruginea</i>)	in the Murray-Darling Basin. Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.				
Diamond Firetail (<i>Stagonopleura guttata</i>)	Widely distributed in NSW, mainly recorded in the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina, and less commonly found in coastal areas and further inland. Grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland, secondary derived grassland, riparian areas and lightly wooded farmland.	V	-	1	Moderate
Dusky Woodswallow (<i>Artamus cyanopterus cyanopterus</i>)	Widespread in eastern, southern and south western Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. Also found in farmland, usually at the edges of forest or woodland.	V	-	2	Moderate
Eastern Curlew (<i>Numenius madagascariensis</i>)	Summer migrant to Australia. Primarily coastal distribution in NSW, with some scattered inland records. Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats or sandflats, ocean beaches, coral reefs, rock platforms, saltmarsh, mangroves, freshwater/brackish lakes, saltworks and sewage farms.	-	CE, M	0	None
Eastern Grass Owl (<i>Tyto longimembris</i>)	In NSW they are more likely to be resident in the north-east. 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.	V	-	1	None
Flame Robin (<i>Petroica phoenicea</i>)	In NSW, breeds in upland areas, and in winter many birds move to the inland slopes and plains, or occasionally to coastal areas. Likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands. In winter uses dry forests, open woodlands, heathlands, pastures and native grasslands. Occasionally occurs in temperate rainforest, herbfields, heathlands, shrublands and sedgeland at high altitudes.	V	-	4	Moderate
Gang-gang Cockatoo	In NSW, distributed from the south-east coast to the Hunter region, and inland	V	-	1	Low

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
(<i>Callocephalon fimbriatum</i>)	to the Central Tablelands and south-west slopes. Isolated records known from as far north as Coffs Harbour and as far west as Mudgee. Tall mountain forests and woodlands in summer; in winter, may occur at lower altitudes in open eucalypt forests and woodlands, and urban areas.				
Glossy Black-Cockatoo (<i>Calyptorhynchus lathamii</i>)	In NSW, widespread along coast and inland to the southern tablelands and central western plains, with a small population in the Riverina. Open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur.	V	-	0	Low
Grey-crowned Babbler (eastern subspecies) (<i>Pomatostomus temporalis temporalis</i>)	In NSW, occurs on the western slopes of the Great Dividing Range, and as far as Louth and Balranald on the western plains. Also occurs in woodlands in the Hunter Valley and in some locations on the north coast. Open woodland habitats; favours Box-gum woodlands on the slopes and Box-cypress and open Box woodlands on alluvial plains.	V	-	166	Recorded
Hooded Robin (south-eastern form) (<i>Melanodryas cucullata cucullata</i>)	Found throughout much of inland NSW, with the exception of the extreme north-west, where it is replaced by subspecies <i>picata</i> . Open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.	V	-	0	Moderate
Little Eagle (<i>Hieraaetus morphnoides</i>)	Throughout the Australian mainland, with the exception of the most densely-forested parts of the Dividing Range escarpment. Open eucalypt forest, woodland or open woodland, including sheoak or Acacia woodlands and riparian woodlands of interior NSW.	V	-	2	Recorded
Little Lorikeet (<i>Glossopsitta pusilla</i>)	In NSW, found from the coast westward as far as Dubbo and Albury. Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	V	-	6	High
Masked Owl (<i>Tyto novaehollandiae</i>)	Recorded over approximately 90% of NSW, excluding the most arid north-western corner. Most abundant on the coast but extends to the western plains. Dry eucalypt forests and woodlands from sea level to 1100 m.	V	-	4	Recorded (potential)
Painted Honeyeater (<i>Grantiella picta</i>)	Widely distributed in NSW, predominantly on the inland side of the Great Dividing Range but avoiding arid areas. Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	V	V	0	Low
Powerful Owl (<i>Ninox strenua</i>)	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains.	V	-	0	Low

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
	Woodland, open sclerophyll forest, tall open wet forest and rainforest.				
Red Goshawk (<i>Erythrorhynchus radiatus</i>)	In NSW, extends to ~30°S. Recent records confined to the Northern Rivers region north of the Clarence River. Open woodland and forest, often along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and coastal riparian Eucalyptus forest.	CE	V	0	Low
Regent Honeyeater (<i>Anthochaera phrygia</i>)	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	CE	CE	0	High
Scarlet Robin (<i>Petroica boodang</i>)	In NSW, it occurs from the coast to the inland slopes. Dry eucalypt forests and woodlands, and occasionally in mallee, wet forest, wetlands and tea-tree swamps.	V	-	4	Moderate
Speckled Warbler (<i>Chthonicola sagittata</i>)	From south-eastern Qld, the eastern half of NSW and into Victoria, as far west as the Grampians, mostly on hills and tablelands of the Great Dividing Range and rarely on coast. Eucalyptus-dominated communities with a grassy understorey and sparse shrub layer, often on rocky ridges or in gullies.	V	-	44	High
Spotted Harrier (<i>Circus assimilis</i>)	Found throughout the Australian mainland, except in densely forested or wooded habitats, and rarely in Tasmania. Grassy open woodland, inland riparian woodland, grassland, shrub steppe, agricultural land and edges of inland wetlands.	V	-	4	Moderate
Swift Parrot (<i>Lathamus discolor</i>)	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland they occur in areas where eucalypts are flowering profusely; favoured feed trees include winter flowering species.	E	CE	2	High
Turquoise Parrot (<i>Neophema pulchella</i>)	Occurs along the length of NSW from the coastal plains to the western slopes of the Great Dividing Range. Eucalypt and cypress pine open forests and woodlands, ecotones between woodland and grassland, or coastal forest and heath.	V	-	0	Low
Varied Sittella (<i>Daphoenositta</i>)	Distribution in NSW is nearly continuous from the coast to the far west. Inhabits eucalypt forests and woodlands, mallee and Acacia woodland.	V	-	1	Moderate

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
<i>chrysoptera</i>)					
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	Distributed along the coastline of mainland Australia and Tasmania, extending inland along some of the larger waterways, especially in eastern Australia. Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	V	-	4	Moderate
Mammals					
Brush-tailed Phascogale (<i>Phascogale tapoatafa</i>)	In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide. Dry sclerophyll open forest, heath, swamps, rainforest and wet sclerophyll forest.	V	-	72	Recorded
Brush-tailed Rock-wallaby (<i>Petrogale penicillata</i>)	In NSW they occur from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	E	V	0	None
Corben's Long-eared Bat (<i>Nyctophilus corbeni</i>)	Distribution coincides approximately with the Murray Darling Basin; the Pilliga Scrub region is the distinct stronghold for this species. Mallee, <i>Allocasuarina luehmannii</i> (bulloke) and box eucalypt- dominated communities, especially box/ironbark/cypress-pine vegetation.	V	V	0	Low
Eastern Cave Bat (<i>Vespadelus troughtoni</i>)	Found in a broad band on both sides of the Great Dividing Range south to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the Warrumbungle Range, and there is a single record from southern NSW, east of the ACT. Dry open forest and woodland, near cliffs or rocky overhangs, cliff-lines in wet eucalypt forest and rainforest.	V	-	2	Recorded (potential)

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
Eastern Coastal Freetailed-bat (<i>Micronomus norfolkensis</i>)	Found along the east coast from south Qld to southern NSW. Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	V	-	14	Recorded
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	South-east coast and ranges of Australia, from southern Qld to Victoria and Tasmania. In NSW, records extend to the western slopes of the Great Dividing Range. Tall (greater than 20m) moist habitats.	V	-	2	Recorded (potential)
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	Both sides of the great divide, from the Atherton Tableland in Qld to north-eastern Victoria, mainly along river systems and gullies. In NSW it is widespread on the New England Tablelands. Woodland, moist and dry eucalypt forest and rainforest.	V	-	5	Likely
Greater Glider (<i>Petauroides volans</i>)	Largely restricted to eucalypt forests and woodlands with an abundance of tree hollows.		V	0	Moderate
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria. Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	V	V	564	Recorded
Koala (<i>Phascolarctos cinereus</i>)	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands. Eucalypt woodlands and forests.	V	V	4	Moderate
Large Bentwinged-bat (<i>Miniopterus orianae oceanensis</i>)	In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga. Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	V	-	19	Recorded
Little Bentwing-bat (<i>Miniopterus australis</i>)	East coast and ranges south to Wollongong in NSW. Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub.	V	-	8	Recorded
New Holland Mouse (<i>Pseudomys novaehollandiae</i>)	Fragmented distribution across eastern NSW. Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.	-	V	0	None

Common Name (<i>Scientific Name</i>)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
Southern Myotis (<i>Myotis macropus</i>)	In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers. Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation.	V	-	3	Recorded
Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)	Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Qld. Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	V	E	13	Moderate
Squirrel Glider (<i>Petaurus norfolcensis</i>)	Widely though sparsely distributed on both sides of the Great Dividing Range in eastern Australia, from northern Qld to western Victoria. 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.	V	-	6	Recorded
Yellow-bellied Sheath-tail-bat (<i>Saccolaimus flaviventris</i>)	There are scattered records of this species across the New England Tablelands and North West Slopes. Rare visitor in late summer and autumn to south-western NSW. Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies.	V	-	3	Moderate

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
Amphibians					
Booroolong Frog (<i>Litoria booroolongensis</i>)	Restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. Several populations have recently been recorded in the Namoi catchment. Permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	E	E	0	None
Giant Burrowing Frog (<i>Heleioporus australiacus</i>)	South eastern NSW and Victoria, in two distinct populations: a northern population in the sandstone geology of the Sydney Basin as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	V	V	0	None
Green and Golden Bell Frog (<i>Litoria aurea</i>)	Since 1990, recorded from ~50 scattered sites within its former range in NSW, from the north coast near Brunswick Heads, south along the coast to Victoria. Records exist west to Bathurst, Tumut and the ACT region. Marshes, dams and stream-sides, particularly those containing <i>Typha</i> sp. (bullrushes) or <i>Eleocharis</i> sp. (spikerushes). Some populations occur in highly disturbed areas.	E	V	0	Low
Migratory					
Black-faced Monarch (<i>Monarcha melanopsis</i>)	In New South Wales and the Australian Capital Territory, the species occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park, Wombeyan Caves and Canberra. It generally occurs in rainforest habitats.	-	M	0	Low
Common Greenshank (<i>Tringa nebularia</i>)	Widespread west of the Great Dividing Range, especially between the Lachlan and Murray Rivers and the Darling River drainage basin, including the Macquarie Marshes, and north-west regions. Generally occurs in sheltered coastal mudflats and saltmarsh.	-	M	0	None
Common Sandpiper (<i>Actitis hypoleucos</i>)	Found along all coastlines of Australia and in many areas inland, the species is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia. Occurs in coastal wetland habitats.	-	M	0	None
Curlew Sandpiper (<i>Calidris ferruginea</i>)	Occurs along the entire coast of NSW, and sometimes in freshwater wetlands in the Murray-Darling Basin. Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes	E	CE, M	0	None

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
	inland.				
Eastern Curlew (<i>Numenius madagascariensis</i>)	Summer migrant to Australia. Primarily coastal distribution in NSW, with some scattered inland records. Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats or sandflats, ocean beaches, coral reefs, rock platforms, saltmarsh, mangroves, freshwater/brackish lakes, saltworks and sewage farms.	-	CE, M	0	None
Fork-tailed Swift (<i>Apus pacificus</i>)	Recorded in all regions of NSW. Riparian woodland, swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	-	M	1	Moderate
Latham's Snipe (<i>Gallinago hardwickii</i>)	Migrant to east coast of Australia, extending inland west of the Great Dividing Range in NSW. Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grasslands or heathlands.	-	M	1	Moderate
Oriental Cuckoo (<i>Cuculus optatus</i>)	Generally found in wet eucalypt forest, river margins and near mangroves	-	M	0	Low
Osprey (<i>Pandion haliaetus</i>)	The breeding range of the species extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in NSW; with a second isolated breeding population on the coast of South Australia, extending from Head of Bight east to Cape Spencer and Kangaroo Island. This species generally occurs in coastal and terrestrial wetland habitats.	V	M	0	Low
Pectoral Sandpiper (<i>Calidris melanotos</i>)	In NSW, the species 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. Generally occurs in coastal wetlands and estuaries.	-	M	0	None
Red-necked Stint (<i>Calidris ruficollis</i>)	Summer migrant to Australia, widespread coastal and inland NSW. Tidal mudflats, saltmarshes, sandy and shelly beaches, saline and freshwater wetlands, saltfields, sewage ponds.	-	M	1	None
Rufous fantail (<i>Rhipidura rufifrons</i>)	Occurs in coastal and near coastal districts of northern and eastern Australia. mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (<i>Eucalyptus microcorys</i>), Mountain Grey Gum (<i>E. cypellocarpa</i>), Narrow-leaved Peppermint (<i>E. radiata</i>), Mountain Ash (<i>E.</i>	-	M	0	Low

Common Name (Scientific Name)	Habitat requirements	BC Act	EPBC Act	Number of records within 10km (BioNet)	Likelihood of occurrence
	<i>regnans</i>), Alpine Ash (<i>E. delegatensis</i>), Blackbutt (<i>E. pilularis</i>) or Red Mahogany (<i>E. resinifera</i>), usually with a dense shrubby understorey often including ferns.				
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	In NSW, this species is widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. Generally occurs in tall, moist gully forest habitats.	-	M	0	Low
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	Widespread in most regions of NSW and Victoria, especially in coastal areas, but they are sparse in the south-central Western Plain and east Lower Western Regions of NSW, and north-east and north-central Victoria. Generally occur in wetlands with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	-	M	0	None
White-throated Needletail (<i>Hirundapus caudacutus</i>)	All coastal regions of NSW, inland to the western slopes and inland plains of the Great Divide. Occur most often over open forest and rainforest, as well as heathland, and remnant vegetation in farmland.	-	M	3	High
Yellow Wagtail (<i>Monarcha trivirgatus</i>)	Generally occurs in damp habitats, such as wet pastures, grazing marshes and river valleys.	-	M	0	Moderate

Appendix D – Five-part Test of Significance for Threatened Species under the BC Act (Umwelt)

Five-Part Test under the *Biodiversity Conservation Act 2016*

The impact area and ancillary facilities cover an area of approximately 109.69 hectares , with the proposal expected to result in the removal of 31.93 hectares of native vegetation and 96 hollow-bearing trees.

The vegetation to be removed comprises woodland and forest, and grassland which may be utilised by threatened species. These are comprised of the plant community types shown in Table .

Table D1 Habitats within the impact area

Plant community type (PCT)	Area in impact area (ha)
Woodland and Forest Habitat	
42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (OEH 2019b)	1.22
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate/Good (Umwelt 2019)	5.34
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy (Umwelt 2019)	6.35
1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter (OEH 2019b)	2.21
1601 Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter (OEH 2019b)	0.08
1731 Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley (OEH 2019b)	0.08
Total	15.28
Grassland Habitat	
1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – DNG (Umwelt 2019)	14.21
1600 Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter DNG (OEH 2019b)	2.44
Total	16.65

A total of 15.28 hectares of woodland and forest habitat and 16.65 hectares of grassland habitat will be removed.

The following Five-Part Tests of Significance have been conducted in accordance with Section 7.3 of the *Biodiversity Conservation Act 2016* (BC Act) for the species identified as recorded and potentially occurring within the impact area and ancillary facilities in Appendix C and includes:

Threatened Ecological Communities

- *Central Hunter Ironbark - Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions* EEC
- *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC

Endangered Populations

- *Eucalyptus camaldulensis* population in the Hunter catchment

Threatened Birds

- grey-crowned babbler (*Pomatostomus temporalis temporalis*) – vulnerable
- little eagle (*Hieraaetus morphnoides*) – vulnerable
- little lorikeet (*Glossopsitta pusilla*) – vulnerable
- koala (*Phascolarctos cinereus*) – vulnerable
- masked owl (*Tyto novaehollandiae*) – vulnerable
- speckled warbler (*Chthonicola sagittata*) – vulnerable
- spotted-tailed quoll (*Dasyurus maculatus maculatus*) – vulnerable
- swift parrot (*Lathamus discolor*) – endangered
- regent honeyeater (*Anthochaera phrygia*) – critically endangered

Threatened Mammals

- eastern cave bat (*Vespadelus trougtoni*) – vulnerable
- eastern false pipistrelle (*Falsistrellus tasmaniensis*) – vulnerable
- greater broad-nosed bat (*Scoteanax rueppellii*) – vulnerable
- grey-headed flying fox (*Pteropus poliocephalus*) – vulnerable
- large bent-winged bat (*Miniopterus orianae oceanensis*) – vulnerable
- little bent-winged bat (*Miniopterus australis*) – vulnerable
- southern myotis (*Myotis macropus*) – vulnerable.

Central Hunter Ironbark - Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions endangered ecological community (EEC)

The *Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions EEC* occurs on Permian sediments in the central Hunter Valley and is recorded from the Cessnock, Singleton and Muswellbrook local government areas. It typically comprises an open forest to woodland dominated by narrow-leaved ironbark (*Eucalyptus crebra*), spotted gum (*Corymbia maculata*) and grey box (*Eucalyptus moluccana*), with a sparse native shrub layer and sparse to moderately dense ground cover dominated by native forbs and grasses (NSW Scientific Committee 2010).

The vegetation communities described and mapped within the proposal area were assessed against the criteria that define this EEC, as described in the Final Determination (NSW Scientific Committee 2010). Based on this assessment Zone 3 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Moderate to Good Condition and Zone 4 – 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter – Thinned Canopy conform to the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC* as they meet the following attributes:

- occurs on Permian sediments within the NSW Sydney Basin Bioregion
- occurs in the Singleton Local Government Area (LGA)
- dominated by the characteristic canopy species spotted gum (*Corymbia maculata*), grey box (*Eucalyptus moluccana*), narrow-leaved ironbark (*Eucalyptus crebra*) and red ironbark (*Eucalyptus fibrosa*)
- supports a reasonable proportion of species that are in the list of characteristic species for the EEC

The total area of the *Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC* within the impact area and ancillary facilities is approximately 13.98 hectares.

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	
<p>Approximately 13.98 hectares that conforms to the EEC was identified within the impact area and ancillary facilities, and will be directly impacted as a result of the proposal. Additional remnants of the EEC are also known to occur within land adjacent to the proposal area.</p> <p>The total mapped area of <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC</i> is approximately 18,300 hectares (NSW Scientific Committee 2010). The EEC also occurs widely in the Singleton district. The permanent loss of approximately 13.98 hectares of the EEC as a result of the proposal represents a negligible reduction in the estimated current extent of the community across its range, estimated to be approximately 0.069 per cent of the current extent of the community. It is unlikely that the proposal will have a significant adverse effect on this ecological community such that its local occurrence is likely to be placed at risk of extinction.</p>	
ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	
<p>The proposal will result in removal of approximately 13.98 hectares of the <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC</i> within the impact area. This reduction in the extent of the EEC is not expected to result in a substantial change in native species composition, or any other form of composition, in the wider locality such that the composition of species in adjacent areas of EEC is affected.</p>	

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
Approximately 13.98 hectares that conforms to the EEC occur within the impact area and ancillary facilities and will be directly impacted as a result of the proposal.
ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
<p>This ecological community has been heavily cleared across most of its range. The remaining extent of the ecological community is highly fragmented, occurring in small isolated patches, most of which are less than 10 hectares in size (NSW Scientific Committee 2010). The vast majority of vegetation present today is regrowth from previous clearing over the past 20-50 years.</p> <p>Vegetation occurring within the impact area and ancillary facilities is currently highly fragmented as a result of historic agricultural land practices. The removal of 13.98 hectares of the <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest</i> EEC will result in an increase in the fragmentation of the community. The level of fragmentation will increase in the local area with the removal of remnants totalling 13.98 hectares, however given the current extent of approximately 18,300 hectares of the EEC and the currently highly fragmented nature of the EEC in the impact area, the level of increase in fragmentation is considered to be negligible across its range.</p>
iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
Given the current approximate extent of the community over its range (18,300 hectares), the removal of the small area of EEC resulting from the proposal is considered unlikely to affect the long-term survival of the <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest</i> EEC in the locality. The occurrence of this EEC within the impact area and ancillary facilities is not any more important to the survival of the EEC than any other location, and occurs in a relatively well vegetated part of the EECs range, that is the Singleton North and Singleton West districts.
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)
No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas 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.
<p>Four key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees • Invasion of native plant communities by exotic perennial grasses. <p>Given that a total of 13.98 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
Conclusion
The proposal includes the removal of approximately 13.98 hectares of <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest</i> EEC. The proposal will result in the clearing of approximately 0.069 per cent of the current mapped area of the ecological community across its range, will negligibly increase the level of fragmentation of the EEC, will negligibly decrease the area of habitat of the EEC and includes several key threatening processes. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the <i>Central Hunter Ironbark – Spotted Gum – Grey Box Forest</i> EEC listed under the BC Act.

Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC

The *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* is recorded from the Maitland, Mid-Western, Muswellbrook, Singleton, and Upper Hunter local government areas. It typically comprises a tall to very tall woodland dominated by river red gum (*Eucalyptus camaldulensis*) in combinations with forest red gum (*Eucalyptus tereticornis*), yellow box (*Eucalyptus melliodora*) and rough-barked apple (*Angophora floribunda*). Stands of river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) and swamp oak (*Casuarina glauca*) can form a part of this community, and the ground cover is generally dominated by native forbs and grasses (NSW Scientific Committee 2011).

In the absence of detailed floristic surveys of the vegetation likely to conform to this EEC where it occurs in the impact area, the precautionary principle has been applied. The vegetation community mapped as PCT 42 in regional mapping (OEH 2019b) has been assumed to be consistent with the criteria that define this EEC as described in the Final Determination (NSW Scientific Committee 2011) including:

- occurs on floodplains and associated floodplain rises along the Hunter River and tributaries
- occurs in the Singleton Local Government Area (LGA)
- dominated by the characteristic canopy species spotted gum river red gum (*Eucalyptus camaldulensis*).

The total area of the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC* within the impact area is approximately 1.22 hectares.

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	
Approximately 1.22 hectares that conform to the <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i> occurs within the impact area and will be directly impacted as a result of the proposal. Additional remnants of the EEC are also known to occur within land adjacent to the impact area, with areas being retained within a narrow corridor between the Impact area and the Hunter River. The total mapped area of <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i> is less than 50,000 hectares (NSW Scientific Committee 2011). The permanent loss of approximately 1.22 hectares of the EEC as a result of the proposal represents a negligible reduction in the estimated current extent of the community across its range. It is unlikely that the proposal will have a significant adverse effect on this ecological community such that its local occurrence is likely to be placed at risk of extinction.	
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	
The diversity of the EEC within the impact area is considered low due to the current disturbed state of the site. The clearing of 1.22 hectares of the <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC</i> is unlikely to substantially and adversely modify the composition of this EEC 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	
Approximately 1.22 hectares that conforms to the EEC occur within the impact area and will be directly impacted as a result of the proposal.	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>This ecological community has been heavily cleared across most of its range. The remaining extent of the ecological community is highly fragmented, occurring in small isolated patches, most of which are less than 10 hectares in size (NSW Scientific Committee 2011).</p> <p>Vegetation occurring within the impact area is currently highly fragmented as a result of historic agricultural land practices. The removal of 1.22 hectares of the <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> EEC will result in an increase in the fragmentation of the community in the local area. However given the current extent of approximately <50,000 hectares of the EEC and the currently highly fragmented nature of the EEC in the impact area, the level of increase in fragmentation is considered to be negligible across its range.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Given the current approximate extent of the community over its range (<50,000 hectares), the removal of the small area of EEC resulting from the proposal is considered unlikely to affect the long-term survival of the <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> EEC in the locality. The occurrence of this EEC within the impact area is not any more important to the survival of the EEC than any other location.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Three key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. <p>Given that a total of 1.22 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 1.22 hectares of <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> EEC. This will negligibly increase the level of fragmentation of the EEC, will negligibly decrease the area of habitat of the EEC and includes several key threatening processes. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the <i>Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions</i> EEC listed under the BC Act.</p>

***Eucalyptus camaldulensis* population in the Hunter catchment - endangered population**

River red gum (*Eucalyptus camaldulensis*) is the most widespread eucalypt in Australia, found in all mainland states and territories. In NSW, river red gum occurs along the western flowing rivers but is known from only one coastal catchment, the Hunter. It has been recorded in the local government areas of Lithgow, Maitland, Mid-Western Regional, Muswellbrook, Port Stephens, Singleton and Upper Hunter (OEH 2017).

River red gum may occur with forest red gum (*Eucalyptus tereticornis*), yellow box (*Eucalyptus melliodora*), river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) and rough-barked apple (*Angophora floribunda*). The species was recorded in the proposal area, adjacent to the impact area. It occurs along the Hunter River where PCT 42 has been mapped (OEH 2019b). Approximately 1.22 hectares of this PCT will be cleared as a result of the proposal; it is not expected that any river red gums will be removed.

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	
River red gum (<i>Eucalyptus camaldulensis</i>) that occurs within the proposal area forms part of the <i>Eucalyptus camaldulensis</i> population in the Hunter catchment - endangered population. The proposal will involve removal of 1.22 hectares of potential habitat for this species associated with PCT 42, however no individuals of this species will require removal as part of the proposal. Three individuals have been recorded by ELA adjacent to the impact area along the Hunter River. As part of Section 5.2 mitigation measures are proposed to minimise indirect impacts, including containing works outside the dripline of trees.	
The proposal will not significantly affect the endangered population such that it 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	
Not applicable.	
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	
The proposal will require removal of 1.22 hectares of potential habitat for this species associated with PCT 42. However the proposal will not require the complete removal of any river red gum. Due to the minor nature of the work, it is unlikely that the proposal will affect the extent of <i>Eucalyptus camaldulensis</i> population in the Hunter catchment.	
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	
Vegetation occurring within the impact area is currently highly fragmented as a result of historic agricultural land practices. The removal of 1.22 hectares of habitat for the <i>Eucalyptus camaldulensis</i> population in the Hunter catchment will result in a negligible increase in the existing fragmentation.	

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 will not require the removal of any river red gum. The occurrence of habitat for this endangered population within the development area is not any more important to the survival of the population than any other location.
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)
No declared areas of outstanding biodiversity value are located in, or near, the impact area. The proposed work will not impact any declared areas 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.
<p>One key threatening process is relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation <p>Given that a total of 1.22 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
Conclusion
The proposal includes the removal of approximately 1.22 hectares of PCT 42 that provides habitat for the <i>Eucalyptus camaldulensis</i> population in the Hunter catchment - endangered population. No river red gums will be removed. This will negligibly increase the level of fragmentation of habitat for this endangered population, will negligibly decrease the area of habitat of the endangered population and includes a single key threatening processes. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the <i>Eucalyptus camaldulensis</i> population in the Hunter catchment - endangered population listed under the BC Act.

Grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) – Vulnerable

The eastern form of the grey-crowned babbler (*Pomatostomus temporalis temporalis*) occurs on the western slopes and plains of NSW with isolated populations known from coastal woodlands on the North Coast, in the Hunter Valley and from the South Coast near Nowra. Grey-crowned babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. 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 (OEH 2017c).

This species was recorded in the proposal area on motion-sensing cameras and opportunistically during fauna surveys. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table D1**).

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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the grey-crowned babbler. While no active nests were observed during field surveys, areas containing mid-storey and canopy vegetation suitable for nests occur in the northern section of the impact area.</p> <p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 ha of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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	
Not applicable	
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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the grey-crowned babbler. The impact area and ancillary facilities are likely to form part of a larger territory for this species.</p>	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging and breeding habitat for the grey-crowned babbler is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area and ancillary facilities is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Three key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 15.28 hectares of potential foraging and breeding habitat for the grey-crowned babbler. This will negligibly increase the level of fragmentation of the habitat, negligibly decrease the area of habitat in the locality and includes several key threatening processes. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the grey-crowned babbler.</p>

Koala (*Phascolarctos cinereus*) – Vulnerable

In NSW, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range. The species inhabits eucalypt woodlands and forests, and home range size can vary from less than two hectares to several hundred hectares in size (OEH 2019f).

Three key feed tree species for the koala as listed in Schedule 2 of State Environmental Planning Policy No 44 Koala Habitat Protection (SEPP 44) have been recorded in the proposal area, being grey gum (*Eucalyptus punctata*), forest red gum (*Eucalyptus tereticornis*) and river red gum (*E. camaldulensis*). These species were not recorded within the impact area.

No koalas or signs of koala activity were observed during field surveys. Potential habitat for this species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table D1**).

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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential habitat for the koala, however no SEPP 44 koala feed trees have been recorded in the impact area or ancillary facilities. As a result, the habitat within the impact area and ancillary facilities is considered to be marginal.</p> <p>Extensive areas of similar or higher quality habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south.</p> <p>The proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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	
Not applicable	
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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential habitat for the koala, however no SEPP 44 koala feed trees have been recorded in the impact area or ancillary facilities.</p>	
ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and	
<p>Vegetation occurring within the impact area and ancillary facilities is currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential habitat for the koala is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>	

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
Extensive areas of similar or higher quality habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. The removal of potential, marginal habitat for this species in the impact area and ancillary facilities is unlikely to significantly impact 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)
No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas 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.
<p>one key threatening process is relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
Conclusion
The proposal includes the removal of approximately 15.28 hectares of potential marginal habitat for the koala. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the koala.

Little eagle (*Hieraaetus morphnoides*) – Vulnerable

The little eagle occupies habitats within open eucalypt forest, woodland or open woodland; sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites, the species requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. (OEH 2017d).

This species was recorded in the impact area opportunistically during fauna surveys. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest, and grassland areas which make up approximately 31.93 hectares (**Table D1**).

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	<p>The proposal will result in the removal of approximately 31.93 hectares of native vegetation which forms potential foraging and breeding habitat for the little eagle.</p> <p>While no active nests were observed during field surveys, large living trees suitable for the construction of stick nests occur in the northern section of the impact area. Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging or breeding habitat, and is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
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	Not applicable
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	<p>The proposal will result in the removal of approximately 31.93 hectares of native vegetation which forms potential foraging and breeding habitat for the little eagle. The impact area is likely to form part of a larger territory for this species.</p>
ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and	<p>Vegetation occurring within the impact area is currently highly fragmented as a result of historic agricultural land practices. The removal of 31.93 hectares of potential foraging and breeding habitat for the little eagle is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>

iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,
<p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area and ancillary facilities is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
<p>Two key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Removal of dead wood and dead trees. <p>Given that a total of 31.93 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
Conclusion
<p>The proposal includes the removal of approximately 31.93 hectares of potential foraging and breeding habitat for the little eagle. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the little eagle.</p>

Little lorikeet (*Glossopsitta pusilla*) – Vulnerable

In NSW little lorikeets are distributed from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little lorikeets mostly occur in dry, open eucalypt forests and woodlands, and have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. The species nests in small hollows (three centimetre diameter) generally located at heights of between two metres and 15 metres. These are mostly in living, smooth-barked eucalypts, especially Manna gum (*Eucalyptus viminalis*), Blakely's red gum (*E. blakelyi*) and tumbledown gum (*E. dealbata*) (OEH 2017e).

This species was not recorded in the proposal area during fauna surveys but is considered to have a high likelihood of occurrence based on suitable habitat and previous records in the locality. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table**).

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
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the little lorikeet.</p> <p>While no evidence of breeding was observed during field surveys, 96 hollow-bearing trees suitable for nesting occur in the northern section of the impact area. Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging or breeding habitat, and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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
Not applicable	
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
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the little lorikeet. The impact area and ancillary facilities are likely to form part of a larger territory for this species.</p>	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging and breeding habitat for the little lorikeet is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Three key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 15.28 hectares of potential foraging and breeding habitat for the little lorikeet. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the little lorikeet.</p>

Masked owl (*Tyto novaehollandiae*) – Vulnerable

In NSW masked owls are distributed from the coast, where they are most abundant, to the western plains. They occur in dry eucalypt forests and woodlands, often foraging along the forest edges and roadsides. The species has a large home-range of 500 to 1000 hectares, and is known to breed in large tree hollows or sometimes caves (OEH 2017f).

This species was tentatively sighted in the impact area during fauna surveys and has previously been recorded in the locality. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest, and grassland areas which make up approximately 31.93 hectares (**Table D1**).

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	<p>The proposal will result in the removal of approximately 31.93 hectares of native vegetation which forms potential foraging and breeding habitat for the masked owl.</p> <p>While no evidence of breeding was observed during field surveys, 15 hollow-bearing trees potentially suitable for nesting (hollows greater than 30 centimetres) occur in the northern section of the impact area. Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging or breeding habitat, and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
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	Not applicable
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	<p>The proposal will result in the removal of approximately 31.93 hectares of native vegetation which forms potential foraging and breeding habitat for the masked owl. The impact area and ancillary facilities are likely to form part of a larger territory for this species.</p>
ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and	<p>Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 31.93 hectares of potential foraging and breeding habitat for the masked owl is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>

<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Three key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. <p>Given that a total of 31.93 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 31.93 hectares of potential foraging and breeding habitat for the masked owl. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the masked owl.</p>

Speckled warbler (*Chthonicola sagittata*) – Vulnerable

In NSW, speckled warblers occupy eucalypt and cypress woodlands on the slopes west of the Great Dividing Range, with an extension of range into the cypress woodlands of the northern Riverina. Populations also occur in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River valleys. The species inhabits woodlands with a grassy understorey, often on ridges or gullies, and nests on the ground in grass tussocks, dense litter and fallen branches (OEH 2017g).

This species was not recorded in the proposal area during fauna surveys however is considered to have a high likelihood of occurrence based on suitable habitat and previous records in the locality. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table D1**).

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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the speckled warbler.</p> <p>While no evidence of breeding was observed during field surveys, areas of woodland and forest with a grassy understorey suitable for nesting occur in the northern section of the impact area. Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging or breeding habitat, and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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	
Not applicable	
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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the speckled warbler. The impact area and ancillary facilities are likely to form part of a larger territory for this species.</p>	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging and breeding habitat for the speckled warbler is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area and ancillary facilities is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Two key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Removal of dead wood and dead trees. <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 15.28 hectares of potential foraging and breeding habitat for the speckled warbler. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the speckled warbler.</p>

Spotted-tailed quoll (SE mainland population) (*Dasyurus maculatus maculatus*) – Vulnerable

The spotted-tail quoll (*Dasyurus maculatus maculatus*) has not been recorded within the impact area, however it has been recorded regularly between 1994 and 2014 (except 1998, 1999 and 2005) in Ravensworth State Forest and surrounding woodland and forest communities, approximately 15 kilometres north (Forest Fauna Surveys 2017). Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares (OEH 2017h).

This species was not recorded in the proposal area during fauna surveys but has potential to occur based on suitable habitat and previous records in the locality. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest, and grassland areas which make up approximately 31.93 hectares (**Table D1**).

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	
<p>The proposal will result in the removal of approximately 31.93 hectares of native vegetation which forms potential foraging and breeding habitat for the spotted-tailed quoll.</p> <p>While no den sites or other evidence of breeding was observed during field surveys, habitats in the disturbance footprint and ancillary facilities are considered to form part of the home range for the species and may be utilised as movement corridors.</p> <p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south.</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging or breeding habitat, and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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	
Not applicable	
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	
<p>The proposal will result in the removal of approximately 31.93 hectares of native vegetation which forms potential foraging and breeding habitat for the spotted-tailed quoll. The impact area and ancillary facilities are likely to form part of a larger territory for this species.</p>	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 31.93 hectares of potential foraging and breeding habitat for the spotted-tailed quoll is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south.</p> <p>The habitats within the impact area and ancillary facilities which will be impacted are unlikely to provide significant or substantial foraging or breeding habitat for the spotted-tailed quoll, and are not likely to be important to the long term survival of the species in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Two key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Removal of dead wood and dead trees. <p>Given that a total of 31.93 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 31.93 hectares of potential foraging and breeding habitat for the spotted-tailed quoll. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the spotted-tailed quoll.</p>

Swift parrot (*Lathamus discolor*) – Endangered

The swift parrot breeds in Tasmania during spring and summer, before migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia, to south-east Queensland. In NSW the species mostly occurs on the coast and south west slopes. 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 swamp mahogany (*Eucalyptus robusta*), spotted gum (*Corymbia maculata*), red bloodwood (*C. gummifera*), forest red gum (*E. tereticornis*), Mugga ironbark (*E. sideroxylon*), and white box (*E. albens*) (OEH 2019g).

This species was not recorded in the proposal area during fauna surveys but is considered to have a moderate likelihood of occurrence based on suitable habitat and previous records in the locality. Potential foraging habitat for this species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table**).

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	
<p>This species does not breed on mainland Australia, but may utilise approximately 15.28 hectares of native vegetation containing flowering eucalypt species within the northern section of the impact area and ancillary facilities as foraging habitat.</p> <p>Extensive areas of similar or higher quality foraging habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging habitat and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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	
Not applicable	
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	
The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging habitat for the swift parrot. The impact area forms part of a larger territory for this species.	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area and ancillary facilities is currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging habitat for the swift parrot is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area and ancillary facilities are not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>One key threatening processes is relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 15.28 hectares of potential foraging habitat for the swift parrot. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the swift parrot.</p>

Regent honeyeater (*Anthochaera phrygia*) – Critically endangered

Within NSW, breeding sub-populations of the regent honeyeater are fragmented and occur mainly around the Capertee Valley in central-eastern NSW and the Bundarra-Barraba region in northern inland NSW. Minor and sporadic breeding occurs in other areas such as Warrumbungle National Park, Pilliga forests, Mudgee-Wollar region, and the Hunter and Clarence Valleys. The regent honeyeater inhabits eucalypt open forests and woodlands, predominantly box-ironbark types, but also spotted gum (*Corymbia maculata*) and swamp mahogany (*Eucalyptus robusta*) on the coast. The species nests in branch forks of live eucalypts or she-oaks (OEH 2019h).

This species was not recorded in the proposal area during fauna surveys but is considered to have a moderate likelihood of occurrence based on suitable habitat in the locality. Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table**).

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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging habitat for the regent honeyeater. There are only three known key breeding regions remaining, including north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region.</p> <p>Extensive areas of similar or higher quality foraging and potential breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in potential foraging habitat, and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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	
Not applicable	
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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging habitat for the regent honeyeater. The impact area and ancillary compounds are likely to form part of a larger territory for this species.</p>	

<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging habitat for the regent honeyeater is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.</p>
<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>Extensive areas of similar or higher quality foraging and potential breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area and ancillary facilities is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near, the impact area. The proposed works will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>One key threatening process is relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 15.28 hectares of potential foraging habitat for the regent honeyeater. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the regent honeyeater.</p>

Greater broad-nosed bat (*Scoteanax rueppellii*) and eastern false pipistrelle (*Falsistrellus tasmaniensis*)– Vulnerable

The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range, and in NSW is widespread on the New England Tablelands. This species utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. It forages directly along creek and river corridors, and is known to roost in tree hollows, and occasionally building (OEH 2017i).

The eastern false pipistrelle is found on the south-east coast and ranges of Australia, and prefers moist habitats with trees taller than 20 metres. It generally roosts in eucalypt hollows but has also been found under loose bark on trees or in buildings (OEH 2017l).

These species were recorded as being potentially present in the proposal area based on ultrasonic recording surveys. Foraging and potential roosting habitat for these species in the impact area and ancillary facilities includes woodland and forest areas which make up approximately 15.28 hectares (**Table**).

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
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and roosting habitat for the greater broad-nosed bat and eastern false pipistrelle. While no evidence of breeding was observed during field surveys, 96 hollow-bearing trees potentially suitable for roosting occur in the northern section of the impact area. A sandstone block culvert is located adjacent to the impact area (within approximately 50 metres) and these two species were recorded as part of a species group (unable to be differentiated from similar calls of other species) during dusk surveys using ultrasonic call detectors to identify exiting micro-bats. The greater broad-nosed bat and eastern false pipistrelle generally roost in tree hollows and are considered unlikely to be breeding in the sandstone block culverts.</p> <p>Extensive areas of similar or higher quality foraging and roosting habitat for these species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in potential foraging habitat or roosting habitat, and the proposal is not likely to have an adverse effect on the life cycle of these species such that a viable local population of these species is likely to be placed at risk of extinction.</p>	
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
Not applicable	
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
The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and roosting habitat for the greater broad-nosed bat and eastern false pipistrelle. The impact area is likely to form part of a larger territory for these species.
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
Vegetation occurring within the impact area is currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging and roosting habitat for the greater broad-nosed bat and eastern false pipistrelle is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.
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,
Extensive areas of similar or higher quality foraging and roosting habitat for these species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019). The occurrence of this habitat within the impact area and ancillary facilities is not any more important to the survival of these species than any other similar or higher quality habitat 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)
No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas 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.
Three key threatening processes are relevant to the proposal, being: <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.
Conclusion
The proposal includes the removal of approximately 15.28 hectares of potential foraging and breeding habitat for the greater broad-nosed bat and eastern false pipistrelle. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the greater broad-nosed bat or eastern false pipistrelle.

Large bent-winged bat (*Miniopterus orianae oceanensis*), little bent-winged bat (*Miniopterus australis*) and eastern cave bat (*Vespadelus troughtoni*)– Vulnerable

Both the large bent-winged bat and little bent-winged bat occur along the east coast of Australia and forage for insects around the canopy of forested areas. Caves are the primary roosting habitat for both species, though they have also been recorded using tunnels, abandoned mines, stormwater drains, culverts and bridges. The little bent-winged bat has also been recorded utilising tree hollows. In NSW the largest maternity colony of the little bent-winged bat occurs in close association with a large maternity colony of the large bent-winged bat (OEH 2019i and OEH 2019j).

The eastern cave bat is 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. It is a cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. Eastern cave bats have been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals (OEH 2017m).

Both bent-winged bat species were recorded, and the eastern cave bat potentially recorded, in the proposal area during ultrasonic recording surveys. Potential foraging habitat for these species in the impact area and ancillary facilities includes woodland and forest and areas which make up approximately 15.28 hectares (**Table**).

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
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms foraging habitat for these species, as well as 96 hollow-bearing trees which form potential roosting habitat for the little bent-winged bat in the northern section of the impact area. No maternity caves have been recorded in or near the proposal area. A sandstone block culvert is located adjacent to the impact area (within approximately 50 metres) and the eastern cave bat was recorded as part of a species groups (unable to be differentiated from similar calls of other species) during dusk surveys using ultrasonic call detectors to identify exiting micro-bats. This species is a specialist cave roosting bat, also known to use disused mines, and is considered unlikely to be breeding in the sandstone block culverts.</p> <p>Extensive areas of similar or higher quality foraging and potential roosting habitat for these species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, which occur adjacent to Wollombi Brook. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging habitat or potential roosting habitat, and the proposal is not likely to have an adverse effect on the life cycle of these species such that a viable local population of these species is likely to be placed at risk of extinction.</p>	
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
Not applicable	
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
The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms foraging habitat for these species, and 96 hollow-bearing trees that may provide potential roosting habitat for the little bent-winged bat. The impact area and ancillary facilities is likely to form part of a larger territory for these species.
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
Vegetation occurring within the impact area and ancillary facilities is currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of foraging habitat for these species is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.
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,
Extensive areas of similar or higher quality foraging and potential roosting habitat for these species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, which occur adjacent to Wollombi Brook. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019). The occurrence of this habitat within the impact area and ancillary compounds is not any more important to the survival of these species than any other similar or higher quality habitat 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)
No declared areas of outstanding biodiversity value are located in, or near, the impact area or ancillary facilities. The proposed works will not impact any declared areas 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.
Three key threatening processes are relevant to the proposal, being: <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.
Conclusion
The proposal includes the removal of approximately 15.28 hectares of potential foraging habitat for the large bent-winged bat, little bent-winged bat and eastern cave bat as well as 96 hollow-bearing trees that may be used as potential roosting habitat for the little bent-winged bat. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality s. Given the information provided above, the proposal is considered unlikely to result in a significant impact on these species.

Southern myotis (*Myotis macropus*) – Vulnerable

The southern myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 kilometres inland, except along major rivers. This species generally roosts close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. The southern myotis forages over streams and pools, catching insects and small fish by raking their feet across the water surface (OEH 2017j).

This species was recorded in the proposal area during ultrasonic recording surveys and was captured outside of a sandstone block culvert adjacent (within approximately 50 metres) to the impact area during harp-trapping surveys, representing a roost site and a potential maternity roost site based on the species being captured during December when this species is known to have young. Whilst no lactating individuals or young were recorded, limited surveys were completed to confirm whether a maternity roost is present or absent. For the purposes of the assessment below, a precautionary approach has been adopted and the sandstone block culvert is assumed to potentially contain a maternity roost. In addition to the sandstone block culvert, potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland and riparian areas which make up approximately 15.28 hectares (Table D1). As part of the following assessment a range of mitigation measures as detailed in Section 5.2 have been considered for the species.

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**

While no evidence of breeding was observed during field surveys, 96 hollow-bearing trees potentially suitable for roosting occur in the northern section of the impact area with several small scattered farm dams suitable for foraging, and potential foraging habitat occurs along the Hunter River. The species was recorded utilising one culvert adjacent to the impact area (within approximately 50 metres), though no evidence of breeding (i.e. dependent young, lactating females) was observed during inspections of the roost. However given that limited surveys were completed to confirm whether a maternity roost is present and the fact that the species was utilising the culvert when this species is known to have young, the sandstone block culvert is precautionarily assumed to contain a maternity roost. Maternity roosts are primarily selected on the basis of their location close to permanent water (Campbell 2009), however Barclay (et al. 2000) found that individuals commuted over 10 kilometres from their diurnal roost to forage during lactation and post-lactation-periods. This culvert is located approximately 2 kilometres north of the Hunter River, and approximately 300 metres from a small farm dam.

The proposal will result in indirect impacts to this culvert including removal of foraging habitat, changes to drainage into the sandstone block culverts, disruption of flight paths into culverts, potential for increased weeds at the entrances due to increased runoff which could obstruct access/egress, potential for increased sedimentation within the sandstone block culverts resulting in loss of roosting habitat, increased noise, vibration and light impacts..

AECOM has confirmed the following in terms of indirect impacts to the sandstone block culverts:

- Impacts to drainage within the culverts is expected to be minor. There would be a relatively small increase in impermeable surface within the upstream catchments and so a potential increase in runoff. Conversely a section of catchment would also be diverted to drain down the proposal through the large cut area and empty into another catchment to the south, offsetting this increase.
- The closest part of the proposal to the sandstone block culverts is approximately 120 metres, noting that the impact area is within 20 to 50 metres of the two southern sandstone block culverts.
- Standard provisions for weed management would be incorporated into the CEMP to minimise dispersal during construction.
- Erosion and sedimentation would be managed during construction using standard measures to prevent sediment leaving the construction site. It is highlight unlikely that there would be offsite sediment transfer of a nature that could full the culverts. There would be no ongoing source of sediment once the bypass is operational and exposed soils have been stabilised and landscaped.
- Given that the road is generally in cutting near the culverts both noise and light from the bypass would be somewhat shielded. It should be noted that there is no street lighting along the alignment in this location. Lighting is only provided at the connection points.

<p>In order to reduce the impact of the above listed indirect impacts on the species, a range of mitigation measures would be undertaken, including:</p> <ul style="list-style-type: none"> • Prior to commencement of construction, carry out monitoring to determine the presence of threatened microbats in the culverts that are part of the former Great Northern Railway. • If roosting threatened microbats are found during pre-construction monitoring, prepare a specific micro-bat management plan to address the above listed indirect impacts, or any additional identified indirect impacts. • As part of the micro-bat management plan a monitoring strategy would be undertaken for both during and outside breeding periods. • Consideration of timing and nature of immediately adjacent works in relation to known breeding periods. According to Churchill (2008), populations of southern myotis in northern NSW produce two litters of single young in October and January, with young still occupying breeding habitat as late as April. The potential for the proposed works to impact this species is substantially higher during this breeding season due to the presence of dependant young and/or juveniles. Dependent young are less likely to vacate the roost and there is a high risk that juveniles would be abandoned in the roost by adults. • Mitigation measures to be implemented during construction, including regular inspections of impacts from sedimentation and weed encroachment to culvert entrances, timing immediately adjacent works outside the known breeding period of relevant threatened microbats. • Adaptive management measures to be implemented if monitoring indicates a decline in bat numbers or if bats are observed leaving the roost during construction activities.
<p>Additionally, extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, which occur adjacent to Wollombi Brook. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>Based on the appropriate utilisation of the mitigation measures described above, the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>
<p>b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</p>
<p>i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</p>
<p>Not applicable</p>
<p>ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction</p>
<p>Not applicable</p>
<p>c) in relation to the habitat of a threatened species or ecological community:</p>
<p>i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</p>
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging and breeding habitat for the southern myotis, and indirect impacts as described above to a sandstone block culvert containing individuals of the species assumed to precautionarily represent a maternity roost. The impact area is likely to form part of a larger territory for this species.</p>
<p>ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and</p>
<p>Vegetation occurring within the impact area is currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging and breeding habitat for the southern myotis is not likely to cause existing areas of habitat to become isolated given the highly mobile nature of this species, and the effects are considered to be negligible.</p>

<p>iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,</p>
<p>The sandstone block culvert adjacent to the impact area has been precautionarily assumed to represent a maternity roost. This sandstone block culvert has been assumed to be an important breeding site for the southern myotis and the above recommended mitigation measures are required to minimise any indirect impacts.</p> <p>Extensive areas of similar or higher quality foraging and breeding habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, which occur adjacent to Wollombi Brook. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth with hollow density greater than or equal to that being impacted occur adjacent to the impact area (Niche 2019).</p> <p>The occurrence of this habitat within the impact area is not any more important to the survival of the species than any other similar or higher quality habitat in the locality.</p>
<p>d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)</p>
<p>No declared areas of outstanding biodiversity value are located in, or near to, the impact area. The proposal will not impact any declared areas of outstanding biodiversity value.</p>
<p>e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.</p>
<p>Three key threatening processes are relevant to the proposal, being:</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Loss of hollow-bearing trees • Removal of dead wood and dead trees. <p>Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.</p>
<p>Conclusion</p>
<p>The proposal includes the removal of approximately 15.28 hectares of potential foraging and breeding habitat for the southern myotis and indirect impacts to a sandstone block culvert which is assumed to represent a potential maternity roost as a precaution, in the absence of definitive data. Taking into account the above described mitigation measures and level of direct and indirect impacts, the proposal is considered unlikely to result in a significant impact on the southern myotis. Residual impacts to this species will be offset in accordance with the BAM.</p>

Grey-headed flying-fox (*Pteropus poliocephalus*) – Vulnerable

The grey-headed flying-fox occurs primarily along the eastern coastal plain from Bundaberg in Queensland, through NSW and south to eastern Victoria. Regular movements are made over the Great Dividing Range to the western slopes of NSW and Queensland. This species is a canopy-feeding frugivore, blossom-eater and nectarivore of rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands. The species congregates in large numbers at roosting sites (camps) that may be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring. They forage opportunistically, often at distances up to 30 kilometres from camps, and occasionally up to 60 to 70 kilometres per night, in response to patchy food resources (OEH 2017k).

This species was recorded flying over the proposal area during spotlighting surveys, and a Nationally Important Camp for the species occurs approximately 40 kilometres to the north-west near Muswellbrook. This camp has been occupied by grey-headed flying-foxes since approximately 2005 and is known to be a maternity roost for the species. A small camp of grey-headed flying foxes also occurs in Burdekin Park, approximately 1.5 kilometres east of the proposal area. The assessment acknowledges that while grey-headed flying-foxes have a high level of fidelity to camp sites, it is also accepted that all grey-headed flying-foxes in Australia are regarded as one population that moves around freely within its entire national range (DoE 2015, DoEE 2017).

Potential foraging habitat for individuals from these camps in the impact area and ancillary facilities includes woodland and forest and riparian areas which make up approximately 15.28 hectares (Table).

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	
<p>The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging habitat for the grey-headed flying fox. No roosting activity or camps were observed within the proposal area.</p> <p>Extensive areas of similar or higher quality foraging habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, which occur adjacent to Wollombi Brook. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).</p> <p>The loss of native vegetation associated with the proposal will not result in a significant reduction in foraging habitat, and the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.</p>	
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
Not applicable	
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	
The proposal will result in the removal of approximately 15.28 hectares of native vegetation which forms potential foraging habitat for the grey-headed flying fox. The impact area and ancillary facilities are likely to form part of a larger territory for this species, which generally forage at distances up to 30 kilometres from camps.	
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	
Vegetation occurring within the impact area and ancillary facilities are currently highly fragmented as a result of historic agricultural land practices. The removal of 15.28 hectares of potential foraging habitat for the grey-headed flying fox is not likely to cause existing areas of habitat to become isolated, and the effects are considered to be negligible.	
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,	
Extensive areas of similar or higher quality foraging habitat for this species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019). The occurrence of this habitat within the impact area and ancillary facilities is not any more important to the survival of the species than any other similar or higher quality habitat 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)	
No declared areas of outstanding biodiversity value are located in, or near, the impact area. The proposed works will not impact any declared areas 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.	
One key threatening processes is relevant to the proposal, being: <ul style="list-style-type: none"> • Clearing of native vegetation Given that a total of 15.28 hectares will be removed, the implications of these KTPs are not considered to be significant.	
Conclusion	
The proposal includes the removal of approximately 15.28 hectares of potential foraging habitat for the grey-headed flying fox. This will negligibly increase the level of fragmentation of the habitat and negligibly decrease the area of habitat in the locality. Given the information provided above, the proposal is considered unlikely to result in a significant impact on the grey-headed flying-fox.	

Appendix E – Five-part Test of Significance for Threatened Species under the BC Act (Niche 2019)

Singleton Bypass Independent Assessments of Significance

Prepared for Roads and Maritime Services | 9 October 2019



Document control

Project number	Client	Project manager	LGA
5144	Roads and Maritime Services	Radika Michniewicz	Singleton Council

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Enquiries should be addressed to:

Sydney Head Office
Niche Environment and Heritage
02 9630 5658
info@niche-eh.com
PO Box 2443 North Parramatta
NSW 1750 Australia

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1. Introduction

1.1 Context

Niche Environment and Heritage Pty Ltd (Niche) were commissioned by NSW Roads and Maritime Services (Roads and Maritime) to undertake independent Assessments of Significance for threatened species in association with the Singleton Bypass (the Project). The focal species and their State (*Biodiversity Conservation Act 2016* (BC Act)) and Commonwealth (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) status are as follows:

- Brush-tailed Phascogale (*Phascogale tapoatafa*): listed as vulnerable under the BC Act, not listed under the EPBC Act.
- Eastern Coastal Free-tailed Bat (*Mormopterus norfolkensis*): listed as vulnerable under the BC Act, not listed under the EPBC Act.
- Squirrel Glider (*Petaurus norfolcensis*): listed as vulnerable under the BC Act, not listed under the EPBC Act.

As these species are listed as threatened only under state legislation, Assessments of Significance for each species was undertaken as required by the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and prescribed within the NSW *Biodiversity Conservation Act 2016* (BC Act). Further consideration under the EPBC Act was not required.

1.2 Investigation scope

The Study Area was originally defined by the area outlined within the data provided by Roads and Maritime and consisted of approximately 109.6 hectares (ha) with an Impact Area of approximately 23.4 ha (Figure 1). In addition to this Study Area, 287.9 ha of adjacent vegetated areas were surveyed for habitat suitability. The combined Study Area and surveyed adjacent vegetated areas are hereafter referred to as the Assessment Area. The following tasks were undertaken:

- A review of AECOM's sub-consultant's fauna surveys and results. The fauna survey methods and results prepared by AECOM's sub-consultant and provided by Roads and Maritime were reviewed.
- Additional habitat surveys were undertaken from 27 – 29 August 2019 in areas adjacent to the original Study Area.
- Based on the information provided by Roads and Maritime and the additional habitat surveys undertaken by Niche, Assessments of Significance were undertaken for the Brush-tailed Phascogale, Eastern Coastal Free-tailed Bat and the Squirrel Glider.

1.3 Limitations

Field surveys by Niche were limited to habitat assessments based on the presence of hollow-bearing trees, mature canopy growth and suitable foraging habitat. Targeted surveys for threatened species were not undertaken.

2. Results

The information used to undertake the Assessments of Significance is discussed below and included the following:

- Data review: a review of surveys results and data from the original survey of the Study Area provided by Roads and Maritime
- Additional habitat surveys: surveys of adjacent vegetated areas undertaken by Niche
- Mitigation measures: provided by Roads and Maritime to address breeding habitat loss and connectivity.

2.1 Data review

A review of surveys results and data from the original survey of the Study Area provided by Roads and Maritime was undertaken in order to extract the information necessary to support the Assessments of Significance.

The original surveys provided the following information:

- All three species were recorded within the Study Area during the original surveys.
- The Brush-tailed Phascogale and the Squirrel Glider were also recorded outside the original Study Area within the forested area immediately to the west of the Study Area.
- Approximately 30.9 hectares (ha) of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community with a retained canopy occurs within the Study Area, representing the majority of the forested area (as different condition classes) within the Study Area. The midstorey of this community was determined to be sparse to absent.
- The Project will result in the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community with retained canopy, which is considered suitable breeding habitat for the concerned species.
- A small area of Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter community occurs within the Study Area (0.7 ha). The midstorey of this community was determined to be absent apart from regenerating canopy species. This community will not be impacted.
- The Project will result in the widening of the existing New England Highway from between 30 metres (m) at Rix's Creek Lane (where the Project will not widen the existing New England Highway) to widths of up to approximately 100 m north of the McDougalls Hill Interchange. At the McDougalls Hill interchange the alignment deviates from the existing New England Highway and will not alter existing New England Highway conditions. The width of the new alignment will vary from 40 m to 250 m.
- Existing road lighting conditions will not be changed.
- The canopy species present within the Study Area include:
 - *Corymbia maculata* (Spotted Gum): a smooth-barked eucalypt, normally flowering in winter
 - *Eucalyptus crebra* (Narrow-leaved Ironbark): a rough-barked eucalypt, normally flowering in late winter to early spring
 - *Eucalyptus fibrosa* (Broad-leaved Red Ironbark): a rough-barked eucalypt, normally flowering in late autumn to winter
 - *Eucalyptus moluccana* (Grey Box): a smooth-barked eucalypt, normally flowering in summer to autumn
 - *Eucalyptus punctata* (Grey Gum): a rough-barked lower trunk and smooth-barked upper trunk and limbs eucalypt, normally flowering in summer to autumn

- *Eucalyptus tereticornis* (Forest Red Gum): a smooth-barked eucalypt, normally flowering in winter to spring.
- Foraging resources such as *Acacia* spp., *Melaleuca* spp. and *Banksia* spp. were not recorded in the Study Area.
- Moderate to substantial fallen logs and leaf litter (foraging resources for the Brush-tailed Phascogale) were present in locations throughout the Study Area.
- Ground cover within the Study Area was classified as mid-dense to dense and less than 0.5 m in height.
- The Project will result in the removal of 96 hollow-bearing trees consisting of (where multiple hollows may occur on a single tree):
 - 84 trees with 192 hollows <5 cm
 - 70 trees with 150 hollows 5-10 cm
 - 45 trees with 60 hollows 10-20 cm
 - 12 trees with 13 hollows 20-30 cm
 - Three trees with two hollows >30 cm.
- Five stags will be removed from within the Impact Area. An additional 24 stags occur in the wider Study Area, which will be retained.
- The Project will result in the Key Threatening Processes (KTPs) listed in Table 1. Those relevant to the focus species are highlighted in bold.

Table 1: Key Threatening Processes (provided by Roads and Maritime)

Key threatening process	Type of threat	Relevance to project	Relevance to species
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands	Habitat Loss/Change	Potential to occur from bridge works in river and other bulk earthworks.	None
Clearing of native vegetation	Habitat Loss/Change	Project will result in operation of this KTP.	All
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners <i>Manorina melanoccephala</i>	Pest Animal	Noisy Miner present.	None
Competition and grazing by the feral European rabbit	Pest Animal	European Rabbit present, pest animal management may be required to avoid/reduce impact of this KTP.	None
Competition from feral honeybees	Pest Animal	Feral honeybees likely to be present, pest animal management may be required to avoid/reduce impact of this KTP.	All
Invasion of native plant communities by exotic perennial grasses	Weed	Exotic perennial grasses present, particularly along roadsides, weed management required to avoid/reduce impact of this KTP.	None
Invasion of native plant communities by African Olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	Weed	African Olive present, currently managed on Bloomfield land, ongoing weed management required to avoid/reduce impact of this KTP.	None
Loss of hollow-bearing trees	Habitat Loss/Change	Project will result in operation of this KTP.	All
Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	Pest Animal	Feral dogs potentially present, pest animal management may be required to avoid/reduce impact of this KTP.	None
Predation by feral cats	Pest Animal	Feral cats present, pest animal management may be required to avoid/reduce impact of this KTP.	All
Predation by the European Red Fox	Pest Animal	European Red Fox present, pest animal management may be required to avoid/reduce impact of this KTP.	All
Removal of dead wood and dead trees	Habitat Loss/Change	Project will result in operation of this KTP.	All

2.2 Additional habitat surveys

Habitat surveys were undertaken in vegetated areas adjacent to the original Study Area. Habitat surveys involved the following:

- Determination of mapped plant community types (PCT) in adjacent areas
- Calculation of PCT areas within land parcels
- Sampling of PCTs within each land parcel using 50 m x 20 m transects to:
 - assess functional habitat characteristics of each mapped plant community type (PCT) within different land parcels
 - determine the presence of hollow-bearing trees and the number and type of hollows present
- Stratification of PCTs into habitat considered to support suitable foraging and/or hollow habitat.

Figure 1 shows the outcome of the additional habitat surveys. An additional 287.9 ha outside the original Study Area was considered to be potential habitat for all three species. Areas were classed as being “*included hollow habitat*”, where the habitat was considered to provide suitable hollow resources or “*excluded hollow habitat*” where hollow resources were limited or absent. The included areas were then used to calculate the area of suitable habitat available to the local populations. Habitat surveys and data analysis determined the following:

- Of the 287.9 ha considered, 208.4 ha was found to support suitable mature canopy growth with hollow density greater than or equal to that within the Impact Area (*included hollow habitat* in Figure 1)
- *Included hollow habitat* ranged from intact woodland and forest to retained mature eucalypt paddock trees and included stags
- *Excluded hollow habitat* were areas represented by a *Casuarina glauca* monoculture, young regenerating *Allocasuarina* spp. and *Eucalyptus* spp. stems, and *Eucalyptus* spp. stands represented by less mature growth with very limited hollows resources
- Of the 287.9 ha considered, 245.5 ha was found to support suitable foraging habitat for the Squirrel Glider and Brush-tailed Phascogale, and notably includes the areas of *Eucalyptus* spp. stands represented by less mature growth that were excluded from hollow habitat.

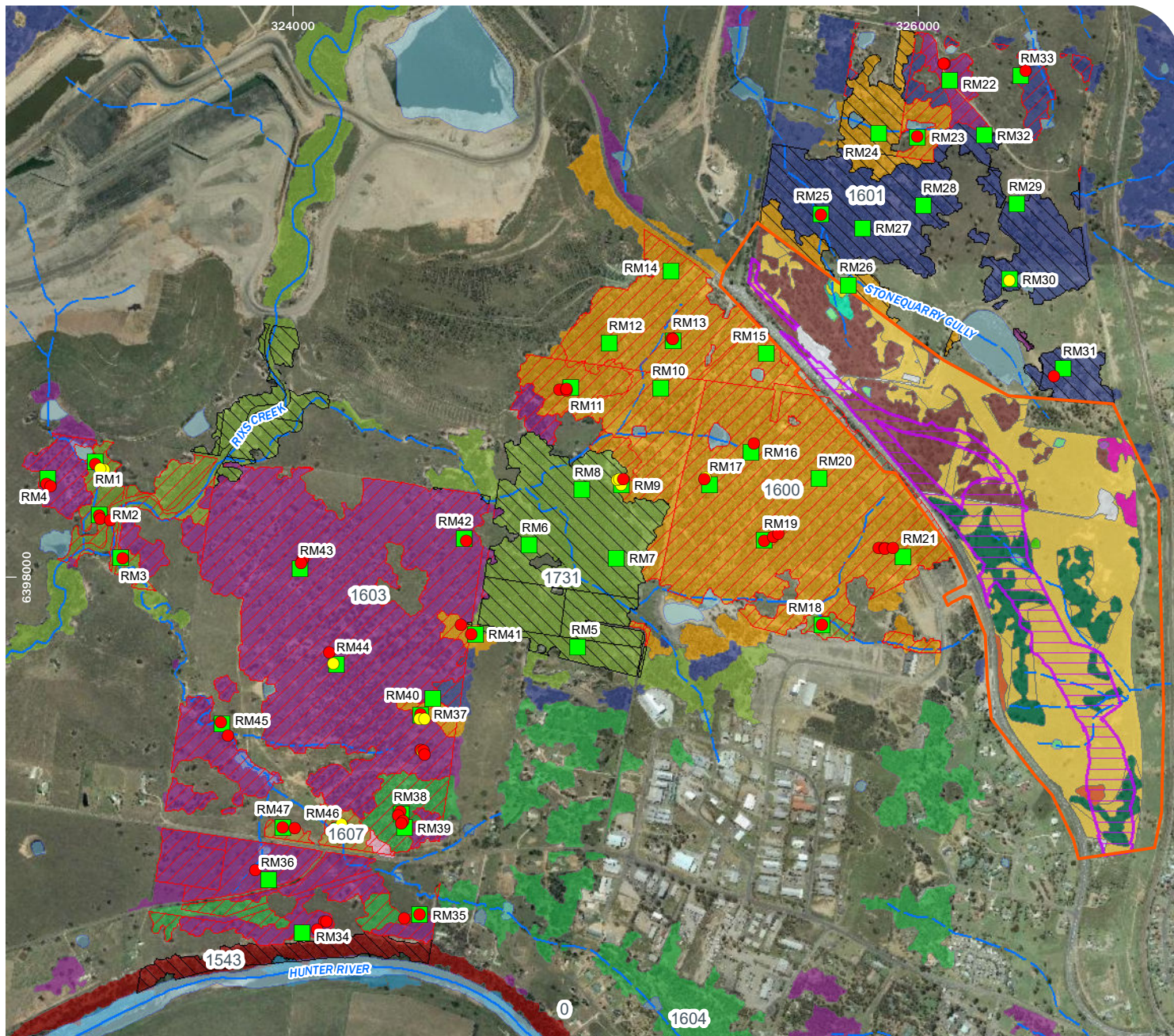
As such, available habitat and impact on habitat can be summarised as follows:

- Suitable breeding habitat available to the local populations of Brush-tailed Phascogale, Eastern Coastal Free-tailed Bat and the Squirrel Glider is considered to be 240.0 ha, represented by 31.6 ha of suitable habitat within the Study Area and 208.4 ha of suitable habitat adjacent to the Study Area. The Project will therefore result in the removal of 6.71% (13.98 ha) of suitable breeding habitat for the local populations.
- Suitable foraging habitat available to the local populations of Brush-tailed Phascogale and the Squirrel Glider is considered to be 277.1 ha, represented by 31.6 ha of suitable habitat within the Study Area and 245.5 ha of suitable habitat adjacent to the Study Area. The Project will therefore result in the removal of 5.05% (13.98 ha) of suitable foraging habitat for the local populations of these species.
- Foraging habitat for the Eastern Coastal Free-tailed Bat is not considered to be limited to the Study Area and adjacent habitat due to the wide ranging foraging of this species.
- The Project will result in a linear barrier width ranging between 30 m and 250 m.

2.3 Mitigation measures

Roads and Maritime provided Niche with a list of intended mitigation measures. These mitigation measures were taken into account when undertaking the Assessments of Significance and include:

1. A wildlife connectivity strategy will be finalised and implemented during the detailed design stage in accordance with the draft Roads and Maritime Wildlife Connectivity Guidelines. The strategy is to focus on maintaining connectivity in the northern extent of the proposal and is to include, but not be limited to:
 - a. provision for a rope crossing with an indicative location between chainages 8450 and 8725
 - b. identification of trees suitable for retention in the northern connection and tie in to facilitate glider crossings
 - c. consideration of additional gliding crossing structures where the width of disturbance is greater than 50 m
 - d. type and extent of any associated landscaping or structures such as fencing or fauna infrastructure.
2. A nest box strategy will be developed and implemented during the detailed design stage 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). The strategy is to include:
 - a. a trial of artificial hollow creations
 - b. reinstallation of suitable hollows removed by the Project
 - c. installation of nest boxes in the event that there are not sufficient trees for artificial hollow creation and hollows for reinstallation.



- Study Area
 - Impact Area
 - Included hollow habitat
 - Excluded hollow habitat
 - Assessment plots
 - Stag
 - Tree
 - Non Perennial Stream
 - Perennial Stream
 - Waterbody
- Vegetation outside the Study Area (State Vegetation Mapping HunterUpperSVM_v1_0_PCT_E_4894)**
- 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley
 - 1543: Rusty Fig - Native Quince - Native Olive dry rainforest of the Central Hunter Valley
 - 1600: Spotted Gum - Red Ironbark - Narrow-leaved Ironbark - Grey Box shrub-grass open forest of the lower Hunter
 - 1601: Spotted Gum - Narrow-leaved Ironbark-Red Ironbark shrub - grass open forest of the central and lower Hunter
 - 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter
 - 1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter
 - 1607: Blakelys Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter
 - 1692: Bull Oak grassy woodland of the central Hunter Valley
 - 1731: Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley
- Vegetation within the Study Area (Umwelt 2019)**
- Cleared
 - Dam
 - Exotic Grassland
 - Swamp Oak Plantings
 - Zone 1 - 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Moderate to Good Condition
 - Zone 2 - 1598 Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter - Derived Native Grassland
 - Zone 3 - 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter - Moderate to Good Condition
 - Zone 4 - 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter - Thinned Canopy
 - Zone 5 - 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter - Derived Native Grassland
 - Zone 6 - 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter - African Olive Infestation

3. Assessments of Significance

3.1 Brush-tailed Phascogale

Brush-tailed Phascogale (*Phascogale tapoatafa*) - Vulnerable species

The Brush-tailed Phascogale is known to occur in a range of vegetation community types but prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. This primarily arboreal species is an agile climber and will shelter and nest within many different hollows over short periods with entrances 2.5-4 centimetres (cm). They feed mostly on arthropods but will also eat other invertebrates, nectar when ironbarks and box gums are flowering, and sometimes small vertebrates, foraging preferentially in rough-barked trees of 25 cm diameter at breast height (DBH) or greater. The species occurs at low densities, females occupy exclusive territories of approximately 20 - 40 ha, while males have overlapping territories often greater than 100 ha. Recent research found areas with associations of Red Stringybark, Red Box, Grey Box and Broad-leaved and Narrow-leaved Peppermints (with Red Stringybark and Grey Box trees having small diameter and small hollows, low ground and shrub cover and low volumes of coarse woody debris) to support higher abundance of this species in Victoria (Mansfield *et al.* 2017). Previous research found preferential nesting within trees of larger class sizes (i.e. >80 cm DBH), the use of several nest trees spatially distributed throughout home ranges by individuals and use of clumped or isolated trees within farmland (van der Ree *et al.* 2006).

Threats to this species

Loss and fragmentation of habitat.

Loss of hollow-bearing trees.

Predation by foxes and cats.

Competition for nesting hollows with the introduced honeybee.

Conservation actions for this species

Undertake fox and feral cat control.

Retain and protect habitat, particularly mature or old growth forest containing hollow-bearing trees.

Retain nest trees and recruitment trees (future hollow-bearing trees).

Provide nest boxes in areas where tree-hollows have been removed.

Regional context

While no mapped environmental corridors from existing datasets were identified, the forested area of the Assessment Area is considered to be part of a corridor for wildlife movements in the locality, which connects the substantial vegetated area to the south west of the Study Area with vegetation to the north, in addition to patchy vegetation to the southeast of McDougalls Hill. These combined areas of vegetation have limited connectivity with larger tracks of vegetation in the broader region. The current New England Highway bisects this corridor and creates an approximate 30-metre wide linear barrier. The Project will result in the removal of approximately 13.98 ha of this forested corridor. Although the minimum width will not be increased, the Project will widen the existing highway barrier up to widths of approximately 100 m north of the McDougalls Hill Interchange. At the McDougalls Hill interchange the alignment deviates from the existing New England Highway and will not alter existing New England Highway conditions. The width of the new alignment will vary from 40 m to 250 m.

Survey records

Brush-tailed Phascogales were recorded during the original surveys at four arboreal motion-sensing camera sites and one ground motion-sensing camera site. Three of these records were from the forested area to the southwest of the Study Area, while the remaining two records were within the Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the

Brush-tailed Phascogale (*Phascogale tapoatafa*) - Vulnerable species

Central and Lower Hunter vegetation community within the Study Area. The Study Area provides substantial roosting, nesting and foraging habitat for this species, including moderate to substantial fallen logs and leaf litter in locations. This species is likely to use the Study Area for breeding and foraging.

Assessment of significance

The assessment of significance considers the following factors:

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

There are no Significant and Irreversible Impacts (SIIIs) listed for this species.

Additional habitat surveys found suitable foraging and roosting/breeding habitat to be present in areas adjacent to the Study Area. It is therefore considered likely that individuals recorded during the surveys would use habitat within the Assessment Area. A conservative estimate of the suitable habitat available within the Assessment Area for the local population is therefore considered to be:

- 30.9 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community within the Study Area
- 0.7 ha of Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter community within the Study Area
- 208.4 ha of suitable roosting/breeding habitat within the Assessment Area
- An additional 37.0 ha of suitable foraging habitat within the Assessment Area.

Therefore the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community represents 6.71% of the suitable roosting/breeding habitat and 5.05% of the suitable foraging habitat for the local population.

Considering the presence of suitable foraging habitat and hollows within the Assessment Area and the implementation of a nest box program that has the potential to improve the breeding habitat capacity in hollow-poor areas of the Assessment Area, the removal of 6.7% of the suitable roosting/breeding habitat and the loss of 5.1% of suitable foraging habitat for the local population is considered unlikely to significantly impact the life cycle of this threatened species such that the local population would be at risk of extinction.

N/A: The Brush-tailed Phascogale is not an ecological community.

b) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- 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

Brush-tailed Phascogale (*Phascogale tapoatafa*) - Vulnerable species

c) In relation to the habitat of a threatened species, population or ecological community:

- i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

d) Whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

e) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

Additional habitat surveys found suitable foraging and roosting/breeding habitat to be present in areas adjacent to the Study Area. It is therefore considered likely that individuals recorded during the surveys would use habitat within the Assessment Area.

i. Extent of impact on habitat

The Project will result in the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community, which represents 6.71% of the suitable roosting/breeding habitat available to the local population.

ii. Fragmentation

Although the minimum width will not be increased, the Project will increase the current barrier posed by the New England Highway (30 m wide) by introducing a broader linear deforested area, opening up to potentially 250 m at different locations. The Brush-tailed Phascogale is scansorial and as such spends time foraging on the ground and moving potentially over 200 m between habitat trees (van der Ree *et al.* 2006). The Project has the potential to impact this species via collisions with vehicles and fragmentation where the road barrier is deemed too great.

Measures have been proposed to mitigate this potential impact, including crossing structures and landscaping/fencing to be implemented during detailed design.

iii. Importance of habitat to be removed

The habitat to be removed includes 6.71% of the suitable roosting/breeding habitat and 5.05% of the suitable foraging habitat for the local population. Suitable foraging habitat and hollows are present across the Assessment Area and the implementation of a nest box program has the potential to improve the breeding habitat capacity in hollow-poor areas of the Assessment Area.

To date, no areas of outstanding biodiversity value have been declared for these species. No areas of declared outstanding biodiversity value (including critical habitat) will be affected by the Project either directly or indirectly.

KTPs relevant to the Project and this species include:

- Clearing of native vegetation: the Project will result in the clearing of 13.98 ha of suitable habitat for this species, representing 5.05% of the suitable habitat available to the local population.
- Competition from feral honeybees: feral honeybees are considered likely to be present within the Study Area. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- Loss of hollow-bearing trees: the Project will involve the removal of 6.71% of suitable roosting/breeding habitat.
- Predation by feral cats: cats were identified at one site. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- Predation by the European Red Fox: Foxes were identified at five sites, one observation occurred during spotlighting at the same site where the Brush-tailed Phascogale was identified. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.

Brush-tailed Phascogale (*Phascogale tapoatafa*) - Vulnerable species

Conclusion

- Removal of dead wood and dead trees: the Project will involve the removal of dead wood and trees. Seven stags will be removed. Stags are available across the Assessment Area.

Considering:

- The availability of hollow-bearing trees across the Assessment Area
- The availability of suitable foraging habitat across the Assessment Area
- The implementation of a nest box strategy to create hollows and reinstall hollows removed by the Project to potentially improve the breeding habitat capacity in hollow-poor areas of the Assessment Area
- The installation of crossing structures to provide opportunities for safe crossings
- The design/installation of suitable landscaping or structures such as fencing or fauna infrastructure to minimise risk of vehicle strike,

it is unlikely that the local population of Brush-tailed Phascogale would be significantly impacted by the Project.

3.2 Eastern Coastal Free-tailed Bat

Eastern Coastal Free-tailed Bat (*Mormopterus norfolkensis*) - Vulnerable species

The Eastern Coastal Free-tailed Bat mainly roosts in tree hollows, however, it has also been recorded roosting under bark or in man-made structures. The Eastern Coastal Free-tailed Bat forages over the tops of forest canopies or along forest edges and breeds in late spring to mid-summer (November-January). This species has been recorded roosting in tree hollows in *E. moluccana* and *C. maculata* in the Hunter Valley (McConville and Law 2013). Recent research on insectivorous bats has found artificial light sources that may reduce available habitat and reduce connectivity (Haddock *et al.* 2019a) and has highlighted the importance of reducing light penetration into urban bushlands and corridors in maintaining microbat communities (Haddock *et al.* 2019b).

Threats to this species

Loss of hollow-bearing trees.

Loss of foraging habitat.

Application of pesticides in or adjacent to foraging areas.

Artificial light sources spilling onto foraging and/or roosting habitat.

Large scale wildfire or hazard reduction burns on foraging and/or roosting habitat.

Conservation actions for this species

Retain hollow-bearing trees and provide for hollow tree recruitment.

Retain foraging habitat.

Minimise the use of pesticides in foraging areas.

Regional context

While no mapped environmental corridors from existing datasets were identified, the forested area of the Assessment Area is considered to be part of a corridor for wildlife movements in the locality, which connects the substantial vegetated area to the south west of the Study Area with vegetation to the north, in addition to patchy vegetation to the southeast of McDougalls Hill. These combined areas of vegetation have limited connectivity with larger tracks of vegetation in the broader region. The current New England Highway bisects this corridor and creates an approximate 30-metre wide linear barrier. The Project will result in the removal of approximately 13.98 ha of this forested corridor. Although the minimum width will not be increased, the Project will widen the existing highway barrier up to widths of approximately 100 m north of the McDougalls Hill Interchange. At the McDougalls Hill interchange the alignment deviates from the existing New England Highway and will not alter existing New England Highway conditions. The width of the new alignment will vary from 40 m to 250 m.

Survey records

Eastern Coastal Free-tailed Bats were recorded during the original surveys at four locations. Three of these records were from immediately to the east of the Impact Area and one was adjacent to the Hunter River, approximately 1.5 kilometres (km) from the northern connection. The Study Area provides substantial roosting and foraging habitat for this species. This species is likely to use the Study Area for foraging and roosting.

Assessment of significance

The assessment of significance considers the following factors:

- | | |
|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle | Additional habitat surveys found suitable foraging and roosting/breeding habitat to be present in areas adjacent to the Study Area. It is therefore considered likely that individuals recorded during the surveys would use habitat within the Assessment |
|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Eastern Coastal Free-tailed Bat (*Mormopterus norfolkensis*) - Vulnerable species

of the species such that a viable local population of the species is likely to be placed at risk of extinction

Area. This species is likely to travel distances greater than 1 km from their roost and traverse open paddocks to access foraging resources (McConville 2013). As such, it is considered likely that individuals recorded during the surveys would use breeding habitat within the Assessment Area and forage across the Assessment Area.

A conservative estimate of the suitable roosting habitat available for the local population is therefore considered to be:

- 30.9 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community within the Study Area
- 0.7 ha of Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter community within the Study Area
- 208.4 ha of suitable roosting/breeding habitat within the Assessment Area
- This species is likely to forage across wider areas of the Assessment Area at forest edges and within the open areas between patches of forested vegetation.

Therefore the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community represents 6.71% of the suitable roosting habitat for the local

Considering the presence of hollows across the Assessment Area and the implementation of a nest box program that has the potential to improve the breeding roosting habitat capacity in hollow-poor areas of the Assessment Area, the removal of 6.71% of the suitable roosting habitat for the local population is considered unlikely to significantly impact the life cycle of this threatened species such that the local population would be at risk of extinction.

N/A: The Eastern Coastal Free-tailed Bat is not an ecological community.

b) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- 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
- 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, population or ecological community:

- The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

As such, it is considered likely that individuals recorded during the surveys would use breeding habitat within the Assessment Area and forage across the Assessment Area

i. Extent of impact on habitat

The Project will result in the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community, which represents 6.71% of the suitable roosting/breeding habitat available to the local population. However, the species is likely to forage across a wider areas at forest edges and within the open areas between patches of forested vegetation within the Assessment Area.

Eastern Coastal Free-tailed Bat (*Mormopterus norfolkensis*) - Vulnerable species

iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

ii. Fragmentation

Although the minimum width will not be increased, the Project will increase the current barrier posed by the New England Highway (30 m wide) by introducing a broader linear deforested area, opening up to potentially 250 m at different locations. However, this species will traverse long distances to forage (McConville 2013) and functional connectivity will not be altered from current conditions as artificial lighting will not be introduced. Fragmentation for this species is unlikely to be increased by the Project.

iii. Importance of habitat to be removed

The habitat to be removed includes 6.71% of the suitable roosting/breeding habitat and 5.1% of the suitable foraging habitat for the local population. Suitable foraging habitat and hollows are present across the Assessment Area and the implementation of a nest box program has the potential to improve the breeding habitat capacity in adjacent hollow-poor areas of the Assessment Area.

d) Whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

To date, no areas of outstanding biodiversity value have been declared for these species. No areas of declared outstanding biodiversity value (including critical habitat) will be affected by the proposal either directly or indirectly.

e) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

KTPs relevant to the Project and this species include:

- Clearing of native vegetation: the Project will result in the clearing of 13.98 ha of suitable roosting habitat for this species, representing 6.71% of the suitable roosting habitat available to the local population.
- Competition from feral honeybees: feral honeybees are considered likely to be present within the Study Area. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- Loss of hollow-bearing trees: the Project will involve the removal of 6.71% of suitable roosting/breeding habitat.
- Predation by feral cats: cats were identified at one site. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- Removal of dead wood and dead trees: the Project will involve the removal of dead wood and trees. There are 29 stags within the Study Area, five of which will be removed. Stags are available across the Assessment Area.

Conclusion

Considering:

- The availability of hollow-bearing trees and stags across the Assessment Area
- The implementation of a nest box strategy to create hollows and reinstall hollows removed by the Project to potentially improve the breeding habitat capacity in adjacent hollow-poor areas of the Assessment Area
- The ability of this species to travel long distances to forage
- The availability of foraging habitat across the Assessment Area,

it is unlikely that the local population of Eastern Coastal Free-tailed Bat will be significantly impacted by the Project.

3.3 Squirrel Glider

Squirrel Glider (*Petaurus norfolcensis*) - Vulnerable species

The Squirrel Glider generally occurs in dry sclerophyll forests and woodlands, in 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. It requires abundant hollow bearing trees for refuge and nesting and prefers a mix of eucalypts, banksias and acacias. Squirrel Gliders have been observed using both living and dead trees as well as hollow stumps. Their diet is seasonal and includes *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked. Research regarding den trees found that the entrance size of hollows appeared to be the most important attribute and that hollow entrances varied in size (2.5–12 cm wide) but were mostly ≤ 5 cm in diameter (Beyer *et al.* 2008). This species was found to have overlapping home ranges varying from 4 to 14 ha (Sharp and Goldingay 2007; Goldingay *et al.* 2010).

Threats to this species

- Habitat loss and degradation.
- Fragmentation of habitat.
- Loss of hollow-bearing trees.
- Loss of understorey food resources.
- Inappropriate fire regimes.
- Reduction in food resources due to drought.
- Mortality due to entanglement on barbed wire.
- Occupation of hollows by exotic species.
- Mortality due to collision with vehicles.
- Predation by exotic predators.
- Changes in spatial and temporal distribution of habitat due to climate change.

Conservation actions for this species

- Retain den trees and recruitment trees (future hollow-bearing trees).
- Retain food resources, particularly sap-feeding trees and understorey feed species such as Acacias and banksias.
- Replace top one or two strands of barbed wire on fences with regular wire in and adjacent to habitat.
- Retain and protect areas of habitat, particularly mature or old growth forest containing hollow-bearing trees and sap-feeding trees.
- In urban and rural areas retain and rehabilitate habitat to maintain or increase the total area of habitat available, reduce edge effects, minimise foraging distances and increase the types of resources available.

Regional context

While no mapped environmental corridors from existing datasets were identified, the forested area of the Assessment Area is considered to be part of a corridor for wildlife movements in the locality, which connects the substantial vegetated area to the south west of the Study Area with vegetation to the north, in addition to patchy vegetation to the southeast of McDougalls Hill. These combined areas of vegetation have limited connectivity with larger tracks of vegetation in the broader region. The current New England Highway bisects this corridor and creates an approximate 30-metre wide linear barrier. The Project will result in the removal of approximately 13.98 ha of this forested corridor. Although the minimum width will not be increased, the

Squirrel Glider (*Petaurus norfolcensis*) - Vulnerable species

Project will widen the existing highway barrier up to widths of approximately 100 m north of the McDougalls Hill Interchange. At the McDougalls Hill interchange the alignment deviates from the existing New England Highway and will not alter existing New England Highway conditions. The width of the new alignment will vary from 40 m to 250 m.

Survey records

Squirrel Gliders were recorded during the original surveys at one site using arboreal motion-sensing cameras and on two occasions (three individuals) during spotlighting surveys. Two of these records were from the forested area to the south west of the Study Area, while the remaining two records were within the Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community within the Study Area. This species is likely to use the Study Area for breeding and foraging.

Assessment of significance

The assessment of significance considers the following factors:

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

There are no Significant and Irreversible Impacts (SAILs) listed for this species.

Additional habitat surveys found suitable foraging and roosting/breeding habitat to be present in areas adjacent to the Study Area. It is therefore considered likely that individuals recorded during the surveys would use habitat within the Assessment Area.

A conservative estimate of the suitable habitat available within the Assessment Area for the local population is therefore considered to be:

- 30.9 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community within the Study Area
- 0.7 ha of Forest Red Gum Grassy Open Forest on Floodplains of the Lower Hunter community within the Study Area
- 208.4 ha of suitable roosting/breeding habitat within the Assessment Area
- An additional 37.0 ha of suitable foraging habitat within the Assessment Area.

Therefore the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community represents 6.71% of the suitable roosting/breeding habitat and 5.1% of the suitable foraging habitat for the local population.

Considering the presence of suitable foraging habitat and hollows within the Assessment Area and the implementation of a nest box program that has the potential to improve the breeding habitat capacity in hollow-poor areas of the Assessment Area, the removal of 6.71% of the suitable roosting/breeding habitat and the loss of 5.1% of suitable foraging habitat for the local population is considered unlikely to significantly impact the life cycle of this threatened species such that the local population would be at risk of extinction.

Squirrel Glider (*Petaurus norfolcensis*) - Vulnerable species

b) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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, population or ecological community:

i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

N/A: The Squirrel Glider is not an ecological community

Additional habitat surveys found suitable foraging and roosting/breeding habitat to be present in areas adjacent to the Study Area. It is therefore considered likely that individuals recorded during the surveys would use habitat within the Assessment Area.

i. Extent of impact on habitat

The Project will result in the removal of 13.98 ha of Narrow-leaved Ironbark - Grey Box - Spotted Gum Shrub - Grass Woodland of the Central and Lower Hunter vegetation community, which represents 6.71% of the suitable roosting/breeding habitat available to the local population.

ii. Fragmentation

Although the minimum width will not be increased, the Project will increase the current barrier posed by the New England Highway (30 m wide) by introducing a broader linear deforested area, opening up to potentially 250 m at different locations. Given the Squirrel Glider is known to glide up to distances of 50 metres over flat terrain, the Project has the potential to impact this species.

Measures have been proposed to mitigate this potential impact, including crossing structures and retention of key trees to facilitate glider crossings.

iii. Importance of habitat to be removed

The habitat to be removed includes 6.71% of the suitable roosting/breeding habitat and 5.05% of the suitable foraging habitat for the local population. Suitable foraging habitat and hollows are present across the Assessment Area and the implementation of a nest box program has the potential to improve the breeding habitat capacity in adjacent hollow-poor areas of the Assessment Area.

Squirrel Glider (*Petaurus norfolcensis*) - Vulnerable species

d) Whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)

To date, no areas of outstanding biodiversity value have been declared for these species. No areas of declared outstanding biodiversity value (including critical habitat) will be affected by the proposal either directly or indirectly.

e) Whether the action proposed constitutes or is part of a Key Threatening Process (KTP) or is likely to result in the operation of, or increase the impact of, a KTP

KTPs relevant to the Project and this species include:

- Clearing of native vegetation: the Project will result in the clearing of 13.98 ha of suitable habitat for this species, representing 5.1% of the suitable habitat available to the local population.
- Competition from feral honeybees: feral honeybees are considered likely to be present within the Study Area. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- Loss of hollow-bearing trees: the Project will involve the removal of 6.71% of suitable roosting/breeding habitat.
- Predation by feral cats: cats were identified at one site. With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- With the implementation of a nest box strategy this existing KTP is considered unlikely to be exacerbated by the Project.
- Removal of dead wood and dead trees: the Project will involve the removal of dead wood and trees. Five stags will be removed. Stags are available across the Assessment Area.

Conclusion

Considering:

- The availability of hollow-bearing trees across the Assessment Area
- The availability of suitable foraging habitat across the Assessment Area
- The implementation of a nest box strategy to create hollows and reinstall hollows removed by the Project to potentially improve the breeding habitat capacity in adjacent hollow-poor areas of the Assessment Area
- The installation of crossing structures to provide opportunities for safe crossings,

it is unlikely that the local population of Squirrel Gliders would be significantly impacted by the Project.

4. Conclusion

The Assessments of Significance determined the following:

- Brush-tailed Phascogale (*Phascogale tapoatafa*): The Project is considered unlikely to have a significant impact on the local population of this species.
- Eastern Coastal Free-tailed Bat (*Mormopterus norfolkensis*): The Project is considered unlikely to have a significant impact on the local population of this species.
- Squirrel Glider (*Petaurus norfolcensis*): The Project is considered unlikely to have a significant impact on the local population of this species.

References

- Beyer G.L., Goldingay R.L., and Sharpe D.J. (2008) The characteristics of squirrel glider (*Petaurus norfolcensis*) den trees in subtropical Australia. *Australian Journal of Zoology* 56(1): 13-21.
- Goldingay R. L., Sharpe D.J. and Dobson M.D.J. (2010) Variation in the home-range size of the squirrel glider (*Petaurus norfolcensis*). *Australian Mammalogy* 32(2): 183-188.
- Haddock J.K., Threlfall C.G., Law B. and Hochuli F. (2019a) Light pollution at the urban forest edge negatively impacts insectivorous bats. *Biological Conservation* 236: 17-28.
- Haddock J.K., Threlfall C.G., Law B. and Hochuli F. (2019b) Responses of insectivorous bats and nocturnal insects to local changes in street light technology. *Austral Ecology*.
- Mansfield C., Arnold A.H., Bell T.L. and York A. (2017) Habitat characteristics of a threatened arboreal marsupial and its resource use in a degraded landscape: the brush-tailed phascogale (*Phascogale tapoatafa tapoatafa*) in central Victoria, Australia. *Wildlife Research* 44(2): 153-164.
- McConville A. (2013) The ecology of the east-coast free-tailed bat (*Mormopterus norfolkensis*) in the Hunter region. PhD Thesis. School of Environmental and Life Sciences, The University of Newcastle, Australia.
- McConville A. and Law B. (2013) Observations on the roost characteristics of the East-coast Free-tailed Bat *Mormopterus norfolkensis* in two different regions of New South Wales. *Australian Zoologist* 36(3): 355-363.
- OEH (2019) Threatened Species Profiles. Office of Environment and Heritage, threatened biodiversity profile search <https://www.environment.nsw.gov.au/threatenedspeciesapp/>
- RTA (2011) Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects. Revision 0/ September 2011. RTA Environment Branch.
- Sharp D. and Goldingay, R. (2007) Home range of the Australian Squirrel Glider *Petaurus norfolcensis* (Diprotodontia). *Journal of Mammalogy* 88(6): 1515-1522.
- van der Ree R., Bennett A. and Soderquist T. (2006) Nest-tree selection by the threatened brush-tailed phascogale (*Phascogale tapoatafa*) (Marsupialia: Dasyuridae) in a highly fragmented agricultural landscape. *Wildlife Research* 33: 113–119

Contact Us

Niche Environment and Heritage
02 9630 5658
info@niche-eh.com

NSW Head Office – Sydney
PO Box 2443 North Parramatta
NSW 1750 Australia

QLD Head Office – Brisbane
PO Box 540 Sandgate
QLD 4017 Australia

Sydney
Illawarra
Central Coast
Newcastle
Mudgee
Port Macquarie
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Conservation management
Community consultation
Archaeological, built and landscape values

Environmental management and approvals

Impact assessments
Development and activity approvals
Rehabilitation
Stakeholder consultation and facilitation
Project management

Environmental offsetting

Offset strategy and assessment (NSW, QLD, Commonwealth)
Accredited BAM assessors (NSW)
Biodiversity Stewardship Site Agreements (NSW)
Offset site establishment and management
Offset brokerage
Advanced Offset establishment (QLD)

Appendix F – Assessment of Significance for Threatened Species under the EPBC Act (Umwelt)

Assessment of Significance under the *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act requires an Assessment of Significance relating to the potential impacts of an Action on listed Matters of National Environmental Significance (MNES). This assessment has been conducted in accordance with the Significant Impact Guidelines 1.1 (DoE 2013).

The following critically endangered EPBC Act listed species are considered in this assessment:

- swift parrot (*Lathamus discolor*); and
- regent honeyeater (*Anthochaera phrygia*).

The following endangered EPBC Act listed species are considered in this assessment:

- spotted-tailed quoll (SE mainland population) (*Dasyurus maculatus maculatus*).

The following vulnerable EPBC Act listed species are considered in this assessment:

- grey-headed flying fox (*Pteropus poliocephalus*)
- koala (*Phascolarctos cinereus*).

The following migratory species is also considered in this assessment:

- White-throated Needletail (*Hirundapus caudacutus*)

For endangered and critically endangered species, a *population* means:

- a geographically distinct regional population, or collection of local populations; or
- a regional population, or collection of local populations, that occurs within a particular bioregion.

For vulnerable species, an *important population* means:

- key source populations either for breeding or dispersal; or
- populations that are necessary for maintaining genetic diversity; or
- populations that are near the limit of the species range.

For migratory species, a *population* means:

- the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia

The following critically endangered ecological community (CEEC) is also considered in this assessment:

- *Central Hunter Valley Eucalypt Forest and Woodland CEEC*

Swift parrot (*Lathamus discolor*) – critically endangered

The swift parrot (*Lathamus discolor*) exist as single populations, with some exchange of individuals among regularly used areas (Saunders & Tzaros 2011) therefore any record of this species would constitute part of a population as described above.

Of the eight key tree species listed for the swift parrot as important foraging habitat in NSW during autumn and winter by the National Recovery Plan for the species (Saunders and Tzaros 2011) only one (spotted gum (*Corymbia maculata*) has been recorded in the impact area. The proposal will involve the removal of potential foraging habitat for the species, which includes 15.28 hectares of forest and woodland areas.

The proposal area does not contain, nor is it adjacent to, important habitat mapping for the swift parrot according to email correspondence received from DPIE on 6 November 2019.

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:

- **lead to a long-term decrease in the size of a population; or**

No populations of the swift parrot have been recorded in the proposal area, however there are two records nearby, with the closest one occurring over five kilometres away from the proposal area.

As swift parrots are winter migrants, they would utilise the resources of the impact area and ancillary facilities as part of a wider foraging range. The proposal will involve the removal of 15.28 hectares of foraging habitat for the species. The proposal area is however not known as a historical or important foraging site for this species.

Extensive areas of similar or higher quality habitat for this species occurs in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).

Given the high-quality habitat in the surrounding area and relatively small amount of foraging habitat to be removed, it is unlikely that the proposal will lead to a long-term decrease in the size of a population of swift parrot.

- **reduce the area of occupancy of the species; or**

As swift parrots winter migrants, they may utilise the resources of the impact area and ancillary facilities as part of a wider foraging range. The proposal will involve the removal of 15.28 hectares of foraging habitat for the species.

Extensive areas of similar or higher quality habitat for these species occur in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).

Given the high-quality habitat in the surrounding area and relatively small amount of foraging habitat to be removed, it is unlikely that the proposed work will reduce the area of occupancy of the swift parrot.

- **fragment an existing population into two or more populations; or**

Given the highly dispersive nature of this species and the extensive areas of suitable and known foraging habitat in the surrounding locality, it is unlikely that the proposal would create a significant change to the species dispersal capacity or create a significant barrier to the movement of this species that would result in an existing population being fragmented.

- **adversely affect habitat critical to the survival of a species; or**

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:

Following is a comparison of the priority habitat areas identified for the swift parrot by Saunders and Tzaros (2011) against the potential occurrence of the species in the impact area:

- Habitat used for nesting. Nesting does not occur on the mainland and does not occur in the impact area or ancillary facilities.
- Habitat used by large proportions of the swift parrot population. The swift parrot has not been recorded in the impact area or ancillary facilities. No proportion of the swift parrot population is known to forage in the impact area.
- Habitat used repeatedly between seasons (site fidelity). The swift parrot has not been recorded in the impact area. The swift parrot has not repeatedly used any parts of the impact area or ancillary facilities.
- Habitats used for prolonged periods of time (site persistence). The swift parrot has not been recorded in the impact area or ancillary facilities.

The potential extent of mainland foraging habitat is not identified in the National Recovery Plan for the swift parrot. However, the potential foraging range is large, comprising most of Victoria (excluding northwest), eastern NSW and parts of southeastern Queensland. The removal of 15.28 hectares of potential foraging habitat for the species represents a minor amount of the species' mainland foraging range and is not considered critical for the survival of the swift parrot.

• **disrupt the breeding cycle of a population; or**

The swift parrot is not known to breed on mainland Australia, and the proposal will not disrupt the breeding cycle of a population of this species.

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

The proposal will involve the removal of approximately 15.28 hectares of forest and woodland habitat that may be utilised for foraging by the swift parrot. Given the widespread availability of potential habitats in the locality, the proposal will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species as a whole is likely to decline.

• **result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or**

It is not anticipated that the proposed activities would lead to the invasion of any exotic species that would threaten habitat for this species.

• **introduce disease that may cause the species to decline; or**

It is not likely that the activities will lead to the introduction of diseases that will cause this species to decline.

• **interfere with the recovery of the species.**

The following recovery plan has been prepared for this species:

- National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders & Tzaros 2011).

It is considered unlikely that the proposal will interfere with the recovery of the swift parrot throughout Australia.

Conclusion

The proposal is unlikely to have a significant impact on the swift parrot.

Regent honeyeater (*Anthochaera phrygia*) – critically endangered

The regent honeyeater (*Anthochaera phrygia*) exists as single populations, with some exchange of individuals among regularly used areas (CoA 2016) therefore any record of this species would constitute part of a population as described above.

Of the nine key tree species listed for the regent honeyeater by the National Recovery Plan for the species (CoA 2016) only one (spotted gum (*Corymbia maculata*)) has been recorded in the impact area. The proposal will involve the removal of potential foraging and breeding habitat for the species. This includes woodland and forest areas which make up approximately 15.28 ha.

The proposal area does not contain, nor is it adjacent to, important habitat mapping for the regent honeyeater according to email correspondence received from DPIE on 6 November 2019.

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:

• lead to a long-term decrease in the size of a population; or

The population of the regent honeyeater has not been recorded near the impact area or ancillary facilities.

The regent honeyeater may utilise the resources of the impact area and ancillary facilities as part of a wider foraging range. The proposal will involve the removal of 15.28 hectares of potential foraging habitat for the species. The proposal area is however not known as a historical or important foraging site for this species.

Extensive areas of similar or higher quality habitat for this species occurs in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).

Given the high-quality habitat in the surrounding area and lack of records of the species, it is unlikely that the proposed work will lead to a long-term decrease in the size of a population of regent honeyeater.

• reduce the area of occupancy of the species; or

The regent honeyeater may utilise the resources of the impact area as part of a wider foraging range. The proposal will involve the removal of 15.28 hectares of potential foraging habitat for the species.

Extensive areas of similar or higher quality habitat for this species occurs in the surrounding locality and region, some of which are protected. These include Yengo National Park (NP) and Wollemi NP to the west, Mount Royal NP to the north-east and Belford NP to the south. Over 200 hectares of suitable forested habitat supporting suitable mature canopy growth occur adjacent to the impact area (Niche 2019).

Given the high-quality habitat in the surrounding area and lack of records of the species, it is unlikely that the proposal will reduce the area of occupancy of the regent honeyeater.

• fragment an existing population into two or more populations; or

The regent honeyeater occurs as a single population and has not been recorded near the proposal area. Given the highly dispersive nature of this species and the extensive areas of suitable and known foraging habitat in the surrounding locality, it is unlikely that the proposal would create a significant change to the species' dispersal capacity or create a significant barrier to the movement of this species that would result in an existing population being fragmented.

• adversely affect habitat critical to the survival of a species; or

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:

The National Recovery Plan for the Regent Honeyeater (CoA 2016) describes habitat critical to the survival of the species as including:

- any breeding or foraging areas where the species is likely to occur
- any newly discovered breeding or foraging locations.

No records of the regent honeyeater foraging or breeding occur in the locality, and the impact area is not considered to contain habitat critical to the survival of these species.

• disrupt the breeding cycle of a population; or

There are three known key breeding areas of the regent honeyeater, two of which occur in NSW - Capertee Valley and Bundarra-Barraba regions (OEH 2019h) and no breeding activity for this species has been recorded within the impact area or ancillary facilities.

The proposal is not expected to disrupt the breeding cycle of a population of regent honeyeater.

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

The proposed work will involve the removal of approximately 15.28 hectares of woodland and forest habitat that may be utilised by the regent honeyeater. Given the widespread availability of potential habitats in the locality, the proposed work will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species as a whole is likely to decline.

• result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or

It is not anticipated that the proposed activities would lead to the invasion of any exotic species that would threaten habitat for this species.

• introduce disease that may cause the species to decline; or

It is not likely that the activities will lead to the introduction of diseases that will cause this species to decline.

• interfere with the recovery of the species.

The following recovery plan has been prepared for the species:

- National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (Commonwealth of Australia 2016)

It is considered unlikely that the proposal will interfere with the recovery of the regent honeyeater throughout Australia.

Conclusion

The proposed activity is unlikely to have a significant impact on the regent honeyeater.

Spotted-tailed quoll (SE mainland population) (*Dasyurus maculatus maculatus*) – Endangered

According to the National Recovery Plan for the species (DELWP 2016) it is considered that this species has declined by 50 to 90 per cent. Home range estimates vary considerably according to location and habitat quality, however females can occupy home ranges up to 1515 hectares and males up to 5512 hectares and both sexes usually traverse their ranges along densely vegetated creek lines. Extant populations are highly fragmented and declining. The geographic distribution of the species is contracting, and its subpopulations are becoming increasingly fragmented.

The vegetation communities within the impact area and ancillary facilities are unlikely to provide significant or substantial foraging or habitat for the spotted-tail quoll, however habitats are considered to form part of the home range for the species and may be utilised as movement corridors. The impact area or ancillary facilities do not contain known den or breeding sites for the species, which have been recorded approximately 15 kilometres north in Ravensworth State Forest. Woodland, grassland and riparian habitats within the impact area may provide potential foraging habitat of up to 31.93 hectares.

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:

- **lead to a long-term decrease in the size of a population; or**

The spotted-tail quoll is known to occur within woodland, open forest and derived native grassland communities (DELWP 2016). Frequent records of the spotted-tailed quoll in combination with the known location of den sites, latrines and breeding records indicate that intact vegetation associated within Ravensworth State Forest 15 kilometres north of the impact area provides important habitat for the species in the locality.

The vegetation communities within the impact area and ancillary facilities are considered to form part of the home range for the species and may be utilised as a movement corridor and as potential foraging habitat. The proposal will result in a reduction of 31.93 hectares of forest, woodland and derived native grassland within the potential home range of a population of spotted-tailed quoll.

This minor impact is not considered likely to lead to a long-term decrease in the size of a population of the spotted-tailed quoll.

- **reduce the area of occupancy of the species; or**

The proposed work will result in the loss of approximately 31.93 hectares of forest, woodland and derived native grassland habitats.

This reduction in the area of occupancy of the species is not considered important, notable, or of consequence to the area of occupancy for the species, in accordance with the significant impact guidelines (DoE 2013) given that the vegetation is highly fragmented and represents a relatively small area when compared to available habitat in the local area.

- **fragment an existing population into two or more populations; or**

No populations of spotted-tailed quoll have been recorded in the impact area or ancillary facilities, though it occurs in the home range of individuals recorded in the local area.

The proposal will contribute to the further fragmentation of habitat for the species in the region, however it will not result in the removal of habitat considered to be important foraging or breeding habitat for the species.

It is therefore considered unlikely that the proposed work will result in substantial fragmentation of a population of the spotted-tailed quoll into two or more populations.

- **adversely affect habitat critical to the survival of a species; or**

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:

The habitat critical to the survival of the spotted-tail quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey (DELWP 2016). The threshold densities of these critical habitat components to support quoll populations are currently unknown meaning that the critical habitat to the survival of the species is not possible to define (DELWP 2016). Therefore, all habitats within the species current distribution that are known to be occupied are considered important.

The vegetation communities within the impact area and ancillary facilities are considered to form part of the home range for the species and may be utilised as a movement corridor and as potential foraging habitat. Important habitat is present in the wider region, including den sites, known breeding habitat and high quality foraging habitat associated with Ravensworth State Forest which will not be impacted by the proposed work.

While the proposed works will impact approximately 31.93 hectares of grassland, woodland and forest habitat for the species, it is unlikely to adversely affect habitat that is critical to the survival of the species.

• disrupt the breeding cycle of a population; or

The spotted-tailed quoll generally dens in rock shelters, small caves, hollow logs or tree hollows and utilises numerous dens within its home range.

The species has not been recorded breeding within the impact area or ancillary facilities, and potential den sites were not recorded during surveys. There is no evidence to suggest that breeding has occurred within the impact area. Known breeding habitat for the species is unlikely to be impacted by the proposal.

While the proposal is likely to result in very minor local impacts to movement corridors and potential foraging habitat for the species, the breeding cycle of a population of the spotted-tailed quoll is unlikely to be adversely affected.

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

The proposed work will involve the removal of approximately 31.93 hectares of derived native grassland, woodland and forest that may be utilised as movement corridors and potential foraging for this species. The area of habitat to be removed is not important, notable, or of consequence, in accordance with the significant impact guidelines (DoE 2013).

The proposed work will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species as a whole is likely to decline.

• result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; or

It is not anticipated that the proposed activities would lead to the invasion of any exotic species that would threaten habitat for the spotted-tailed quoll.

• introduce disease that may cause the species to decline; or

It is not likely that the activities will lead to the introduction of diseases that will cause the spotted-tailed quoll to decline.

• interfere with the recovery of the species.

The following recovery plan has been prepared:

- National Recovery Plan for the Spotted-tailed Quoll (*Dasyurus maculatus*) (DELWP 2016).
- It is considered unlikely that the proposal will interfere with the recovery of the spotted-tailed quoll.

Conclusion

Although the proposal may provide a movement corridor and potential foraging habitat for this species, it is unlikely to result in a significant impact on a population of the spotted-tailed quoll.

Grey-headed flying-fox (*Pteropus poliocephalus*) – Vulnerable

This species was recorded flying over the proposal area during fauna surveys, and a number of grey-headed flying-fox camps occur in the surrounding locality and region. Individuals from these camps may utilise vegetation within the impact area and ancillary areas for foraging, including woodland and riparian areas which make up approximately 15.28 hectares.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
<ul style="list-style-type: none"> lead to a long-term decrease in the size of an important population; or 	<p>No important populations of grey-headed flying fox were recorded within the impact area or ancillary facilities.</p> <p>The proposed work will not lead to a long-term decrease in the size of an important population of this species.</p>
<ul style="list-style-type: none"> reduce the area of occupancy of an important population; or 	<p>No important populations of grey-headed flying fox were recorded within the impact area or ancillary facilities.</p> <p>The proposal will not reduce the area of occupancy of an important population of this species.</p>
<ul style="list-style-type: none"> fragment an existing important population into two or more populations; or 	<p>No important populations of grey-headed flying fox were recorded within the impact area.</p> <p>The proposal will not fragment an important population of this species into two or more populations.</p>
<ul style="list-style-type: none"> adversely affect habitat critical to the survival of a species; or 	<p>The impact area or ancillary facilities does not support any areas of critical habitat for this species.</p>
<ul style="list-style-type: none"> disrupt the breeding cycle of an important population; or 	<p>No important populations of grey-headed flying fox were recorded within the impact area or ancillary facilities.</p> <p>The proposed work will not disrupt the breeding cycle of an important population of this species.</p>
<ul style="list-style-type: none"> modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or 	<p>Given that an important population of grey-headed flying fox has not been identified in the impact area or ancillary facilities, the proposal is unlikely to lead to the decline of this species.</p>
<ul style="list-style-type: none"> result in invasive species that are harmful to a critically endangered or endangered species becoming established in the vulnerable species' habitat; or 	<p>It is not anticipated that the proposal would lead to the invasion of any exotic species that would threaten habitat for this species.</p>
<ul style="list-style-type: none"> introduce disease that may cause the species to decline; or 	<p>It is not likely that the proposal would lead to the introduction of diseases that will cause this species to decline.</p>
<ul style="list-style-type: none"> interfere with the recovery of the species. 	<p>No important populations of this species were recorded within the impact area.</p> <p>The is unlikely to interfere with the recovery of this species.</p>
Conclusion	
The proposal is unlikely to have a significant impact on the grey-headed flying-fox.	

Koala (*Phascolarctos cinereus*) – Vulnerable

In accordance with the EPBC Referral Guidelines, the habitat assessment tool was applied (Table F1) to determine whether the habitat within the impact area and ancillary facilities is considered critical for the survival of the koala.

Table F1 Assessment of Koala Habitat in the Impact area

Koala Habitat Assessment Tool (Table 3 from DoE 2014)			Survey Area Assessment	
Attribute	Score	Coastal	Allocated Score	Score Justification
Koala occurrence	+2 (high)	Evidence of one or more koalas within the last 2 years.	0	Atlas of NSW Wildlife point buffer search identified one koala record within 2 km of the impact area, however it was recorded in 2006.
	+1 (medium)	Evidence of one or more koalas within 2 km of the edge of the impact area within the last 5 years.		
	0 (low)	None of the above.		
Vegetation composition	+2 (high)	Has forest or woodland with emerging trees with 2 or more known koala food tree species in the canopy. OR 1 food tree species that alone accounts for >50% of the vegetation in the relevant strata.	0	The impact area or ancillary facilities are not known to contain any key feed tree species as per Schedule 2 of SEPP 44.
	+1 (medium)	Has forest or woodland with only 1 species of known koala food tree present in the canopy.		
	0 (low)	None of the above.		
Habitat connectivity	+2 (high)	Area is part of a contiguous landscape ≥ 500 hectares.	0	The impact area and ancillary facilities contain fragmented woodland habitat which does not form part of a large contiguous landscape > 300 ha.
	+1 (medium)	Area is part of contiguous landscape < 500 hectares, but ≥ 300 hectares.		
	0 (low)	None of the above.		
Key existing threats	+2 (low)	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.	0	Likely risk of vehicle strike threat due to the impact area and ancillary facility location relative to the New England Highway.

Koala Habitat Assessment Tool (Table 3 from DoE 2014)			Survey Area Assessment	
Attribute	Score	Coastal	Allocated Score	Score Justification
	+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 are likely to have some degree of dog or vehicle threat present.		
	0 (high)	Evidence of frequent or regular koala mortality from vehicle strike or dog attack in the Survey Area at present, 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 (of the referral guideline).	+1	<p>Table 1 of the Referral Guidelines (DoE 2014) prescribes, that for inland areas, the interim recovery objective(s) are to:</p> <ul style="list-style-type: none"> • <i>Protect and conserve large, connected areas of koala habitat, particularly large, connected areas that support koalas that are:</i> <ul style="list-style-type: none"> ○ <i>Of sufficient size to be genetically robust/operate as a viable sub-population OR</i> ○ <i>free of disease or have a very low incidence of disease OR</i> ○ <i>breeding.</i> • <i>Maintain corridors and connective habitat that allow movement of koalas between large areas of habitat</i>".
	+1 (medium)	Uncertainty exists as to 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.		
TOTAL SCORE			+1	≤ 4 indicates habitat is not critical for the survival of the koala.

As the habitats identified in the impact area scored one using the Referral Guidelines habitat assessment tool, the impact area is not considered to contain habitat critical to the survival of the koala (DoE 2014). Potential foraging and breeding habitat for this species in the impact area and ancillary facilities includes woodland areas which make up approximately 15.28 hectares (Table D1).

This species has not been recorded during fauna surveys, though individuals may utilise vegetation within the impact area and ancillary areas for marginal foraging habitat, including woodland and forest areas which make up approximately 15.28 ha.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	
<ul style="list-style-type: none"> lead to a long-term decrease in the size of an important population; or 	<p>No important populations of koala were recorded within the impact area or ancillary facilities. The proposal will not lead to a long-term decrease in the size of an important population of this species.</p>
<ul style="list-style-type: none"> reduce the area of occupancy of an important population; or 	<p>No important populations of koala were recorded within the impact area or ancillary facilities. The proposed work will not reduce the area of occupancy of an important population of this species.</p>
<ul style="list-style-type: none"> fragment an existing important population into two or more populations; or 	<p>No important populations of koala were recorded within the impact area or ancillary facilities. The proposed work will not fragment an important population of this species into two or more populations.</p>
<ul style="list-style-type: none"> adversely affect habitat critical to the survival of a species; or 	<p>As the habitats identified in the impact area scored one using the Referral Guidelines habitat assessment tool, the impact area is not considered to contain habitat critical to the survival of the koala (DoE 2014).</p>
<ul style="list-style-type: none"> disrupt the breeding cycle of an important population; or 	<p>No important populations of koala were recorded within the impact area or ancillary facilities. The proposed work will not disrupt the breeding cycle of an important population of this species.</p>
<ul style="list-style-type: none"> modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline; or 	<p>Given that an important population of the koala has not been identified in the impact area or ancillary facilities and identified koala feed trees are absent, the proposal is unlikely to lead to the decline of this species.</p>
<ul style="list-style-type: none"> result in invasive species that are harmful to a critically endangered or endangered species becoming established in the vulnerable species' habitat; or 	<p>It is not anticipated that the proposed activities would lead to the invasion of any exotic species that would threaten habitat for this species.</p>
<ul style="list-style-type: none"> introduce disease that may cause the species to decline; or 	<p>It is not likely that the proposed activities will lead to the introduction of diseases that will cause this species to decline.</p>
<ul style="list-style-type: none"> interfere with the recovery of the species. 	<p>No important populations of this species were recorded within the impact area or ancillary facilities. The proposed work will not interfere with the recovery of this species.</p>

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

Conclusion

The proposal is unlikely to have a significant impact on the koala.

Central Hunter Valley Eucalypt Forest and Woodland CEEC

The total area of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC within the impact area and ancillary facilities is approximately 16.89 hectares, comprising 13.53 hectares of woodland and forest form and 3.37 hectares of derived native grassland from.

An assessment of significance of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC has been conducted in accordance with the Significant Impact Guidelines 1.1 (DoE 2013) below.

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;

Approximately 16.89 hectares that conforms to the CEEC was identified within the impact area and ancillary facilities, and will be directly impacted as a result of the proposal.

The total current extent of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC is estimated to be approximately 37,000 hectares (TSSC 2015). The permanent loss of approximately 16.89 hectares of the CEEC as a result of the proposal represents a negligible reduction in the estimated current extent of the community across its range, estimated to be approximately 0.043 per cent of the current extent of the community, however it clearly forms an absolute reduction in its extent.

• fragment or increase fragmentation of an ecological community;

This ecological community has been heavily cleared across most of its range. The remaining extent of the ecological community is highly fragmented, occurring in small isolated patches, most of which are less than 10 hectares in size (TSSC 2015).

Vegetation occurring within the impact area and ancillary facilities is currently highly fragmented as a result of historic agricultural land practices. The removal of 16.89 hectares of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC will result in an increase in the fragmentation of the community. The level of fragmentation will increase in the local area with the removal of remnants totalling 16.89 hectares, however given the current extent of approximately 37,000 hectares of the CEEC, the level of increase in fragmentation is considered to be negligible across its range.

• adversely affect habitat critical to the survival of an ecological community;

The conservation advice for the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC identifies any areas that meet the minimum moderate quality condition class as being areas critical to the survival of the community. Patches within the impact area meet the moderate and high quality condition classes of the CEEC and therefore, under this interpretation, would be regarded as habitat critical to the survival of the CEEC.

• modify or destroy abiotic factors necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;

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:

While approximately 16.89 hectares of the CEEC will be removed from the impact area and ancillary facilities, the proposal is not expected to adversely affect retained areas of the CEEC occurring outside the impact area as the proposal will be designed to avoid offsite impacts. The modification is unlikely to modify or destroy the abiotic factors that affect the survival of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC in surrounding areas.

- **cause substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species; or**

The proposal will result in removal of approximately 16.89 hectares of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC within the impact area and ancillary facilities. This reduction in the extent of the CEEC is not expected to result in a substantial change in native species composition in the wider locality such that the composition of species in adjacent (or other more distant) areas of CEEC is affected.

- **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**

No substantial reduction in the quality or integrity of the surrounding or nearby occurrences of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC is considered likely to occur as a result of the proposal.

The removal of approximately 16.89 hectares of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC is unlikely to result in assisting any invasive species that is harmful to the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC to become established.

- **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 proposal is not expected to cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the surrounding extent of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC.

- **interfere with the recovery of an ecological community**

The removal of 16.89 hectares of the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC as a result of the proposal will interfere with the recovery of the CEEC in a minor way.

Conclusion

The proposal includes the removal of approximately 16.89 hectares of *Central Hunter Valley Eucalypt Forest and Woodland* CEEC. The proposal will result in the clearing of approximately 0.043 per cent of the current extent the community across its range, will negligibly increase the level of fragmentation of the CEEC, will adversely impact some areas of critical habitat of the CEEC and may interfere with the recovery of the CEEC. Given the information provided above, the proposal is likely to result in a significant impact on the *Central Hunter Valley Eucalypt Forest and Woodland* CEEC listed under the EPBC Act.

White-throated Needletail (*Hirundapus caudacutus*)– migratory

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

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

An area of ‘important habitat’ for a migratory species is:

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

The habitats within the proposal area for the white-throated needletail is not considered to meet the criteria above, and important habitat is not likely to occur.

The study is not considered to comprise important habitat for the white-throated needletail, and therefore the proposal is not likely to substantially modify or destroy important habitat for the white-throated needletail. Similarly, the proposal will not disrupt the lifecycle of an ecologically significant proportion of the population of white-throated needletail; or result in an invasive species that is harmful to the white-throated needletail becoming established within the proposal area.

Appendix G – Seven-part Test for Threatened Species under the FM Act (Umwelt)

Seven-Part Test under the *Fisheries Management Act 1994*

The *Fisheries Management Act 1994* (FM Act) provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The FM Act establishes mechanisms for:

- the listing of threatened species, populations and ecological communities or key threatening processes
- the declaration of critical habitat
- consideration and assessment of threatened species impacts in the development assessment process.

A review of available databases has been identified that the proposal area may contain suitable habitat for the southern purple spotted gudgeon (*Mogurnda adspersa*). Two populations of purple spotted gudgeon have historically occurred in NSW. An eastern population found in coastal catchments north of the Clarence River and a western population found intermittently distributed throughout Murray Darling Basin drainages.

The southern purple spotted gudgeon (*Mogurnda adspersa*), listed as endangered under the FM Act, is reported in the Freshwater Threatened Species Distributions of NSW (DPI 2018b) and the species' Primefact document (DPI 2017) to occur in the Hunter River Catchment. Specifically, in Goorangoola Creek, a tributary of the Glennies Creek broadly located approximately 20 kilometres to the north east of the proposal area, in a catchment that flows into the Hunter River. The species usually occurs in small to medium sized streams with aquatic vegetation, overhanging vegetation, rocks or snags.

While the species presence in the Hunter River cannot be discounted, to date this species has not been recorded in lower reaches of creeks and rivers within the Hunter Catchments. More prominently, the species is known from the Murray-Darling Basin and north of the Clarence River (DPI 2017).

The proposal would involve temporary instream structures (access ramps, sheet piling and a rock platform) to enable construction of the bridge piers. During construction the proposal would involve reclamation work (deposition and draining water for construction), dredging (excavation of material in the river) and would temporarily alter fish passage in this section of the Hunter River. The bridge piers would alter the channel and habitat value of the Hunter River.

An assessment of the impacts of the proposal on the southern purple spotted gudgeon is provided below in accordance with Section 221ZV of the FM Act.

The following factors are to be taken into account in making a determination under Section 220ZZ of the FM Act as to whether the action proposed is likely to significantly affect threatened species, populations or ecological communities, or their habitats:

- 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,

The construction methodologies within the Hunter River would not obstruct fish passage during construction as during any stage of construction the main channel of the Hunter River would remain open so that fish passage will not be blocked.

The purple spotted gudgeon has not been recorded within the proposal area or surrounding waterways. The closest record of this species is from 2009 in Goorangoola Creek in the Hunter Catchment; over 20 kilometres north-east from the Hunter River (DPI 2013) in the Glennies Creek catchment.

It is unlikely that the proposal would 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,

Not applicable.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- 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

Not applicable.

- 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.

- d) in relation to the habitat of a threatened species, populations or ecological community:

- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The Hunter River has been modified in the proposal area but does have some potential habitat value. However, it is noted that the southern purple spotted gudgeon has not been recorded within the proposal area or surrounding creeks and river systems. No known habitat for this species would be removed or modified as a result of the proposal.

- ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal, and

Sediment fencing, sheet piling, controlled site access and silt curtains would be provided and implemented for work in and surrounding the Hunter River. Instream silt curtains shall be implemented and maintained for construction where temporary infrastructure required for the construction of bridge piers extends into the waterway. Silt curtains would be installed so that they do not block fish passage. The proposal would maintain fish passage and disturbance of overhanging vegetation would be minimised. The proposal would not fragment or isolate any areas of habitat.

- 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,

In accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (DPI 2013), the proposal area constitutes Type 1 Highly sensitive fish habitat to the potential habitat to the southern purple spotted gudgeon and Class 1 Major key fish habitat as it is a permanently flowing waterway.

The southern purple spotted gudgeon has not been recorded within the proposal area or surrounds. The proposal area is not important habitat for this species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly,
The proposal will not impact on critical habitat.
f) whether the action proposed is consistent with the objective or actions of a recovery plan or threat abatement plan,
The proposal will include management measures to manage sedimentation and erosion, minimise potential water quality impacts and will include revegetation of disturbed areas on the banks. None of the other priority actions listed in https://www.dpi.nsw.gov.au/fishing/threatened-species/what-current/endangered-species/purple-spotted-gudgeon/priorities-action-statement-actions-for-the-purple-spotted-gudgeon apply to the proposal.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of a key threatening process.
<p>The proposal may result in operation of the following key threatening processes:</p> <ul style="list-style-type: none"> • removal of large woody debris (not confirmed) • installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams. <p>This key threatening process would only operate during construction and is associated with the temporary instream structures to allow for construction of the bridge piers. This key threatening process would not operate following removal of the temporary structures, as the bridge structure itself is considered to have minimal impact on flow regimes and are excluded from the key threatening process.</p> <p>The proposal would not result in operation of any of the key threatening processes listed in Schedule 6 of the FM Act.</p>
Conclusion
Given that the species is not known to occur within the immediate proposal area and work would be managed to maintain fish passage and flow in the main channel of the Hunter River, the proposal is considered unlikely to significantly impact the southern purple spotted gudgeon.

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Your comments and suggestions to improve this or any of the EIA guidelines may be sent to:

Senior Environmental Specialist (Biodiversity)
Customer, Engagement and Planning Division
Roads and Maritime Services
Level 3, 27 Argyle Street
Parramatta, NSW 2150
Ph: 8843 3052



rms.nsw.gov.au



contactus@rms.nsw.gov.au



Customer feedback

Roads and Maritime
Locked Bag 928,
North Sydney NSW 2059



Transport
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