



# **New England Highway bypass of Muswellbrook**

## **Chapter 6.1 Biodiversity**

Transport for NSW | October 2021

## 6. Environmental assessment

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This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines *Is an EIS required?* (DUAP 1995/1996), as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000 and the *Roads and Related Facilities EIS Guideline (DUAP 1996)*. The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in Appendix H.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

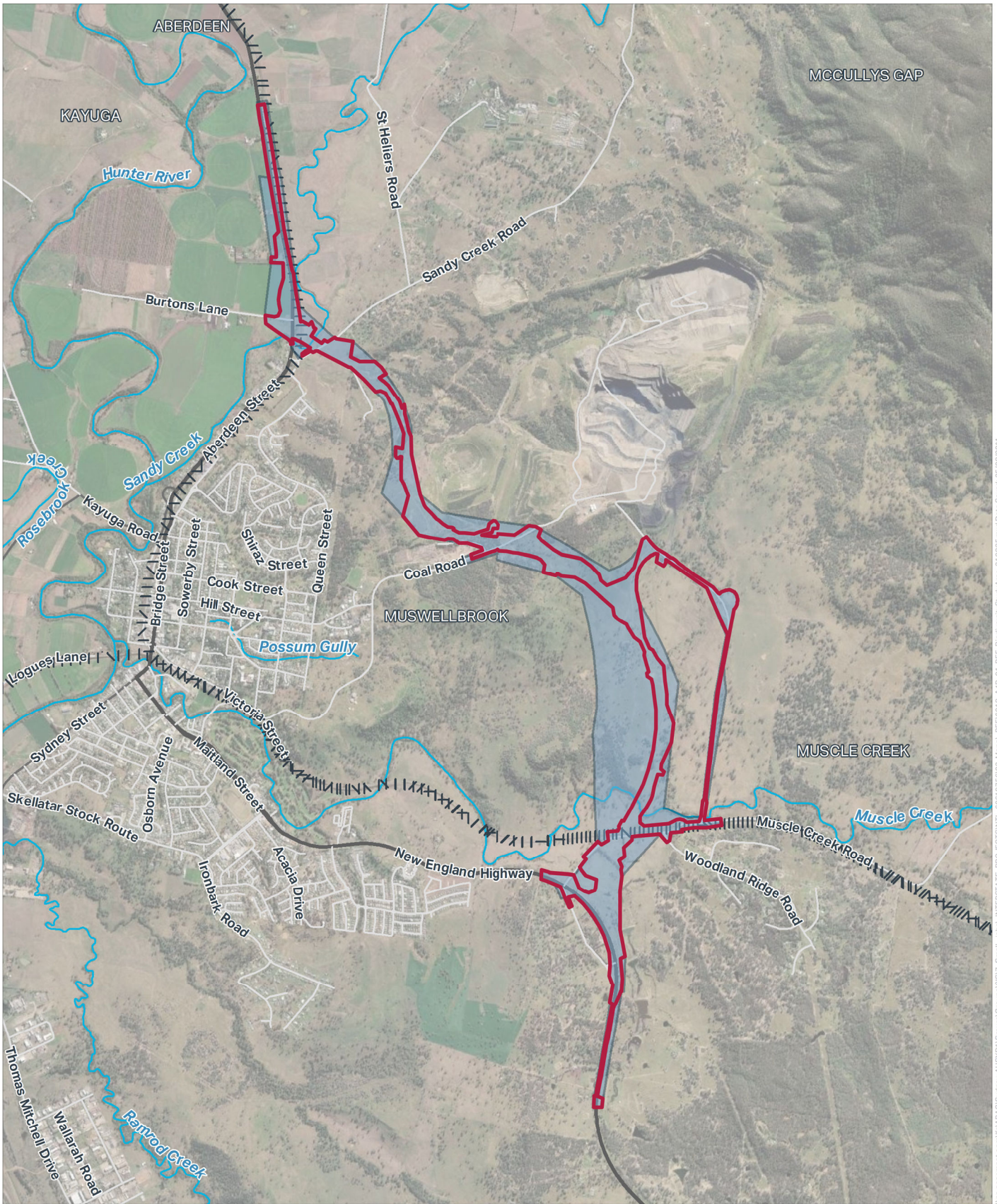
### 6.1 Biodiversity

A Biodiversity Assessment Report (BAR) was prepared by WSP (2021) to assess the potential terrestrial and aquatic biodiversity impacts associated with the proposal and detail the management measures proposed to mitigate these impacts (refer Appendix A).

#### 6.1.1 Methodology

##### *Study area*

The study area for the BAR includes the construction footprint and the areas surveyed as part of the biodiversity assessment (refer to Figure 6-1). The locality is taken to be a 10 kilometre radius surrounding the study area.



**FIGURE 6-1: STUDY AREA FOR BIODIVERSITY ASSESSMENT**

- Legend**
- Construction footprint
  - Study area
  - State Road
  - Regional Road
  - Local Road
  - Railway
  - ~ Watercourse



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### Background searches

A background review of existing information was completed to identify the existing environment within the locality. The background review included analysis of biodiversity reports previously prepared for the proposal and local broad-scale vegetation mapping of the study area.

A range of database searches were also carried out to obtain records of threatened species, populations and ecological communities known or predicted to occur in the locality of the study area (refer to Table 6-1).

Table 6-1: Database searches completed

Database	Area searched
BioNet Atlas of NSW Wildlife (Environment Energy and Science Group, 2020a)	10 km buffer around the study area and subregion
Protected Matters Search Tool (Department of Environment and Energy, 2020)	10 km buffer around the study area
PlantNet (Royal Botanic Gardens, 2020)	Muswellbrook LGA
Fishing and Aquaculture spatial data (Department of Primary Industries, 2020a)	10 km buffer around the study area
Coastal SEPP search (Department of Planning and Environment, 2018)	10 km buffer around the study area
NSW Areas of Outstanding Biodiversity Value Register (Environmental Energy and Science Group, 2020b)	10 km buffer around the study area
Australian Government Critical Habitat register (Department of Agriculture Water and the Environment, 2020)	10 km buffer around the study area
Critical Habitat Register (Department of Primary Industries, 2020b)	10 km buffer around the study area
Atlas of Groundwater Dependent Ecosystems (Bureau of Meteorology, 2020)	10 km buffer around the study area

### Habitat assessment and likelihood of occurrence

A habitat assessment was completed to assess the likelihood of occurrence of each threatened species, population and community (threatened biodiversity) identified with the potential to occur in the study area. All threatened biodiversity identified during the background research were considered.

The likelihood of occurrence criteria used for the assessment is shown in Table 6-2 below.

Table 6-2: Likelihood of occurrence classification and criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat

Likelihood	Criteria
Moderate	Potential habitat is present in the study area
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality
None	Suitable habitat is absent from the study area

### **Field survey**

Field surveys aimed to ground-truth the results of the background research. As such, all threatened biodiversity that were considered likely to occur within the study area were targeted during the field survey to determine presence or likely occurrence.

Surveys generally adhered to the methods described in the following guidelines:

- NSW Guide to Surveying Threatened Plants (Office of Environment & Heritage, 2016)
- Surveying threatened plants and their habitats (Department of Planning Industry and Environment, 2020)
- Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities – Working Draft (Department of Environment and Conservation, 2004).

A description of all field surveys completed is provided below with further detail included in Appendix A.

### **Vegetation surveys**

Vegetation surveys were carried out, using a combination of survey techniques, to verify existing vegetation mapping, map derived native grasslands (DNG) and assess the condition of vegetation.

Native vegetation recorded within the study area was aligned to Plant Community Types (PCTs) and corresponding Threatened Ecological Communities (TEC) (where applicable). This was achieved by identifying native vegetation by formation, class and type.

Areas of non-native vegetation were also identified and mapped.

### **Targeted flora surveys**

Targeted threatened flora surveys were conducted for candidate species that were considered to have a moderate or higher likelihood of occurrence.

### **Targeted fauna surveys**

Fauna surveys were conducted within the study area during all survey periods in 2019 and 2020. Surveys were undertaken for threatened species identified during desktop assessments, that were considered likely to use habitats within the study area. Survey session seasonality was selected to target candidate species with seasonal survey requirements and activity.

Habitat assessments were also conducted to assess the value of the habitats present for threatened fauna.

A range of fauna surveys were undertaken across the proposed construction footprint, including:

- Nocturnal surveys
- Spotlighting
- Call playback
- Stag watches
- Diurnal bird surveys

- Koala spot assessments
- Artificial shelter site surveys
- Arboreal and terrestrial mammal trapping
- Yangochiroptera bat surveys
- Opportunistic sightings.

#### Comprehensive hollow-bearing tree survey

A comprehensive hollow-bearing tree (HBT) survey was undertaken within the 20 per cent design construction footprint. The aim of the survey was to identify all habitat trees within the 20 per cent design construction footprint, due to their importance to diversity of threatened fauna species. Key design refinements which have occurred from the 20 per cent design to the 80 per cent design are discussed in Section 2.6.

#### Aquatic surveys

Aquatic habitat assessments were completed at Sandy Creek, Muscle Creek and some of their unnamed tributaries to confirm potential habitat for threatened aquatic species. No threatened aquatic habitat was identified and as such no targeted surveys were required.

### 6.1.2 Existing environment

#### *Plant community types*

Seven native PCTs were recorded within the study area, including:

- PCT 1691 Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter (PCT 1691)
- PCT 1604 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter (PCT 1604)
- PCT 1605 Narrow-leaved Ironbark - Native Olive shrubby open forest of the central and upper Hunter (PCT 1605)
- PCT 1607 Blakely's Red Gum - Narrow-leaved Ironbark - Rough-barked Apple shrubby woodland of the upper Hunter (PCT 1607)
- PCT 1693 Yellow Box - Rough-barked Apple grassy woodland of the upper Hunter and Liverpool Plains (PCT 1693)
- PCT 42 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley (PCT 42)
- PCT 485 River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion) (PCT 485).

The area for each PCT within the construction footprint is provided in Table 6-3 along with associated TECs, where applicable.

Table 6-3: PCT's and associated TECs identified within the construction footprint

PCT	Condition class	TEC (BC Act)	TEC (EPBC Act)	Area (ha) in construction footprint
PCT 1691	Moderate	Central Hunter Grey Box-Ironbark Woodland	Central Hunter Valley eucalypt forest and woodland	8.82
	Low (remnant)		-	4.93

PCT	Condition class	TEC (BC Act)	TEC (EPBC Act)	Area (ha) in construction footprint
	Low (DNG)		-	38.39
PCT 1604	Low (remnant)	Central Hunter Ironbark - Spotted Gum -Grey Box Forest	-	0.67
PCT 1605	Moderate	Central Hunter Grey Box - Ironbark Woodland	Central Hunter Valley eucalypt forest and woodland	0.06
PCT 1607	Good	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0.56
	Low (remnant)		-	0.09
	Low (DNG)		-	1.02
PCT 1693	Good	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0.00
	Moderate			0.02
	Low (remnant)		-	5.07
	Low (DNG)		-	31.19
PCT 42	Low (remnant)	Hunter Floodplain Red Gum Woodland	-	0.08
	Low (DNG)		-	3.38
PCT 485	Moderate	-	-	1.78
	Low (remnant)	-	-	0.18
	Low (DNG)	-	-	1.68
<b>Total extent of DNG</b>				75.66
<b>Total extent of remnant vegetation</b>				22.26
<b>Total extent of native vegetation</b>				97.92

Four non-native miscellaneous ecosystems were also recorded within the construction footprint as outlined in Table 6-4.

Table 6-4: Non-native miscellaneous ecosystems recorded in the construction footprint

Non native miscellaneous ecosystems	Area (ha) in construction footprint
Highly disturbed areas with no or limited native vegetation	78.46
Urban/exotic plantings	0.48

Non native miscellaneous ecosystems	Area (ha) in construction footprint
Native plantings (including mine rehabilitation)	5.87
Cropping	5.36
<b>Total</b>	<b>90.17</b>

### **Flora and fauna**

#### Flora species

Within the study area, a total of 345 flora species were recorded. Of these, 138 species were exotic species or native planted ornamental species and 207 species were native. Of the 138 exotic species recorded, 10 are listed as Priority Weeds under the Biosecurity Act for the Greater Hunter Local Land Service region and seven are listed as Weeds of National Significance.

#### Fauna species

A total of 153 fauna species were recorded within the study area of which 144 were native and nine were introduced. This included a total of 113 bird species, 23 mammals, nine reptiles, seven amphibians and one fish species.

### **Fauna habitat**

#### Terrestrial fauna

Habitat features recorded within the study area were largely dominated by open forest/woodland, riparian woodland, native grasslands and cleared land with scattered trees and/or native plantings. Although some of the terrestrial fauna habitat is highly disturbed and modified, it protects the integrity of adjoining remnants and supports wildlife movement within a fragmented mosaic landscape which many fauna species locally depend upon.

#### Aquatic fauna

Most waterways within the study area are typical of a highly modified agricultural landscape and are largely ephemeral. The waterways were either not classified as Key Fish Habitat (Department of Primary Industries, 2013) and/or based on observations were likely to align to Class 4 (unlikely key fish habitat). Aquatic habitats within these waterways are largely absent and unlikely to support aquatic or wetland vegetation. Two exceptions to this include:

- Sandy Creek
- Muscle Creek.

Sandy Creek is a tributary of the Hunter River and is recognised as Key Fish Habitat (Department of Primary Industries, 2013). Within the study area, Sandy Creek is considered a Class 3 watercourse (i.e. minimal key fish habitat). Although the creek has defined banks, it is ephemeral in nature and does not appear to support native aquatic or wetland vegetation given its highly disturbed nature. As such, Sandy Creek and its tributaries within the study area are likely to align to Type 3 (minimally sensitive key fish habitat).

Muscle Creek is a tributary of the Hunter River and is also recognised as Key Fish Habitat (Department of Primary Industries, 2013). Within the study area, Muscle Creek is considered a Class 2 watercourse (i.e. moderate key fish habitat) as it has well defined banks, semi-permanent to permanent water, pools and contains freshwater aquatic vegetation. Muscle Creek is likely to align to Type 1 (highly sensitive key fish habitat) given the presence of microhabitats such as rocks, snags and gravel.

No threatened species listed under the FM Act are considered likely to occur within any of the aquatic habitat identified due to its poor condition which is largely the result of past and current land uses.



## Fauna microhabitats

A total of 65 hollow-bearing trees were recorded within the 20 per cent design construction footprint. The number and size of each hollow identified is presented in Figure 6-2.

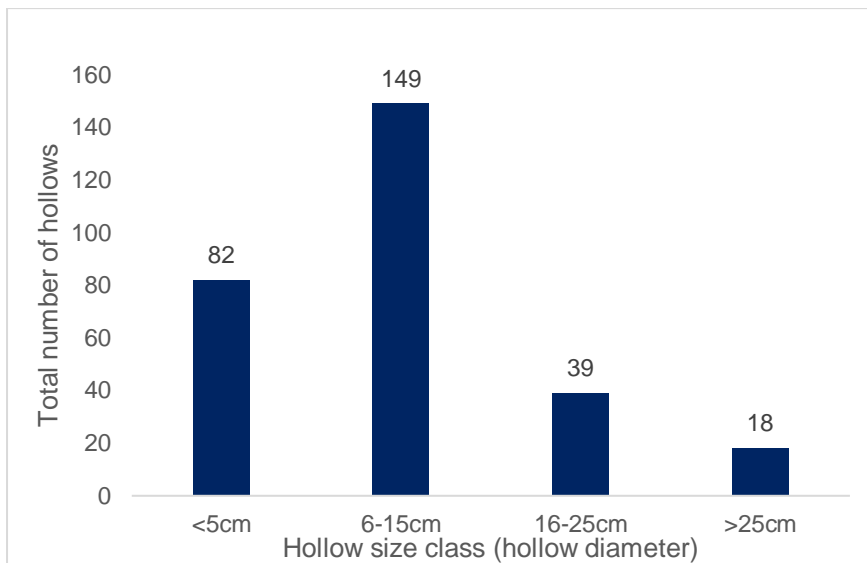


Figure 6-2: Hollows within the 20 per cent design construction footprint

Since the completion of the comprehensive hollow-bearing tree survey, the construction footprint has been expanded to encompass areas needed for temporary works such as sedimentation basins, drainage channels, access roads, construction compounds and ancillary sites to support the construction of the proposal. A total of 42 hollow bearing trees were recorded within the 80 per cent construction footprint, based on data collected as part of the comprehensive hollow-bearing tree survey of the 20 per cent construction footprint and the large hollow tree survey. There is however potential for more hollow-bearing trees to occur within the 80 per cent construction footprint where it extends past the 20 per cent construction footprint as comprehensive surveys have not been conducted in these areas. Despite comprehensive hollow-bearing tree surveys having not been completed throughout the 80 per cent construction footprint, it is anticipated that no more than 42 hollow-bearing trees would be impacted by the proposal. Given the temporary nature of the works to occur in areas which have not been subjected to comprehensive surveys, it is anticipated that trees containing hollow resources would be able to be avoided through careful site selection. Furthermore, impacts to the 42 hollow-bearing trees assessed in this report may also be reduced through further design changes and site selection.

Numerous bird nests were recorded, largely focused around Muscle Creek in the south of the study area where vegetation was in higher condition. One large predatory stick nest was also recorded in the study area.

Although varied, foraging resources within the study area were largely restricted to canopy, sub-canopy and groundcover species. Shrub stratum was either absent or sparse in cover, except for vegetation along and immediately north of Muscle Creek.

The study area includes several built structures that are known to occasionally provide habitat opportunities for threatened species such as Yangochiroptera bats. These structures include:

- A single lane old wooden rail bridge
- Two concrete box culverts

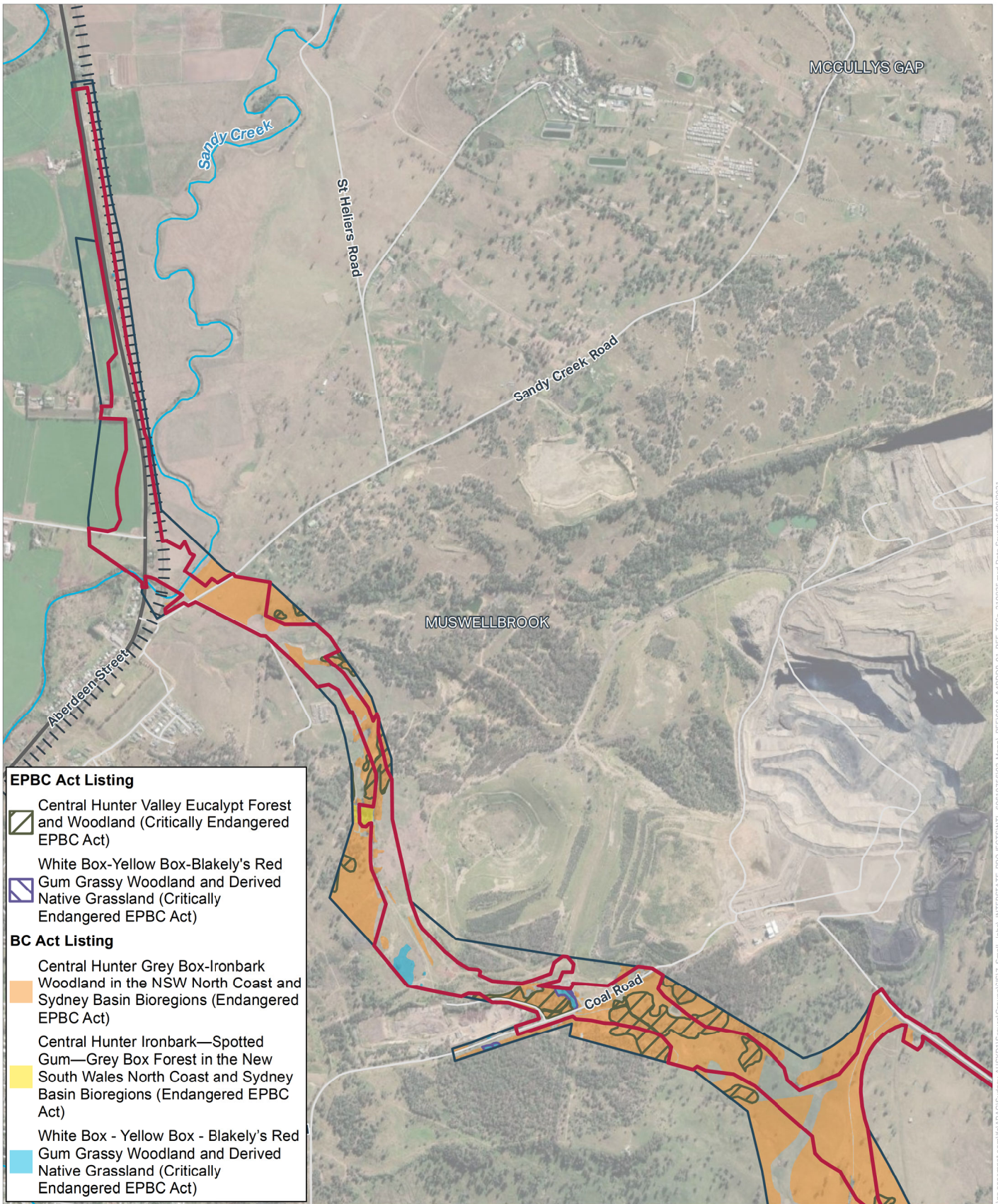
No bats were observed roosting under the bridge and no evidence of usage was observed, however access was limited. Two Southern Myotis (*Myotis macropus*) individuals were recorded roosting within one of the concrete box culverts.

### ***Threatened ecological communities***

The following four BC Act listed TECs were identified within the study area:

- Central Hunter Grey Box - Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions (Endangered)
- Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions (Endangered)
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Critically Endangered)
- Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions (Endangered).

Two EPBC Act listed TECs were also identified within the study area. These are discussed further under 'Matters of National Environmental Significance'. Table 6-3 shows conditions of the PCTs identified within the construction footprint and the associated TEC under both the BC Act and EPBC Act. Figure 6-3 and Figure 6-4 shows the locations of the TECs.



**EPBC Act Listing**

Central Hunter Valley Eucalypt Forest and Woodland (Critically Endangered EPBC Act)

White Box-Yellow Box-Blakely's Red

Gum Grassy Woodland and Derived Native Grassland (Critically Endangered EPBC Act)

**BC Act Listing**

Central Hunter Grey Box-Ironbark

Woodland in the NSW North Coast and Sydney Basin Bioregions (Endangered EPBC Act)

Central Hunter Ironbark—Spotted Gum—Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions (Endangered EPBC Act)

White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered EPBC Act)

**FIGURE 6-3: THREATENED ECOLOGICAL COMMUNITIES  
NORTHERN SECTION**

**Legend**

Construction footprint

Study area

State Road

Local Road

Railway

Watercourse



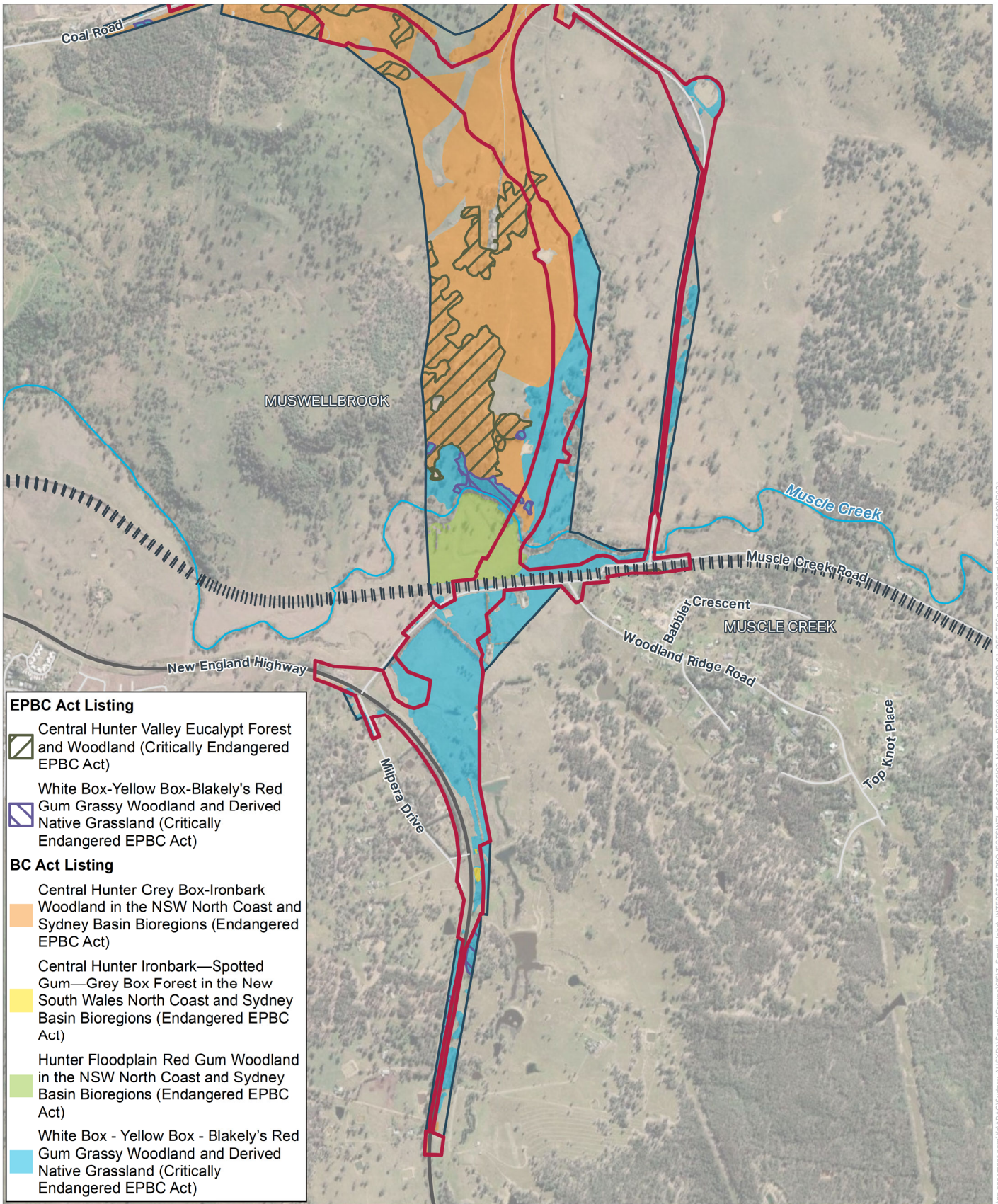
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**FIGURE 6-4: THREATENED ECOLOGICAL COMMUNITIES SOUTHERN SECTION**

**Legend**

- Construction footprint
- Study area
- State Road
- Local Road
- Railway
- Watercourse



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## Groundwater dependent ecosystems

Although Muscle Creek, Sandy Creek and their tributaries have not been mapped as having groundwater dependent ecosystems (GDE) potential within the study area, they have been mapped downstream within the locality as having high GDE potential (Bureau of Meteorology, 2020). Considering this, riparian vegetation along these waterways are considered to have high GDE potential.

Based on regional studies:

- PCT 42 and PCT 485 are highly likely to be GDEs
- PCT 1604, PCT 1605, PCT 1607 and PCT 1691 have low GDE potential
- PCT 1693 is likely a terrestrial GDE which may access the water table on an intermittent basis.

An artificially modified wetland was identified bordering the northern boundary of the study area between Muscle Creek Road and the New England Highway (outside of the construction footprint). No groundwater aquifer or cave systems were identified within the study area.

## Threatened species and populations

### Threatened flora species

Under the BC Act, 10 listed threatened flora species were considered to have a moderate likelihood of occurrence based on the habitat available within the study area. Table 6-5 outlines these species, their conservation status and potential occurrence based on detailed targeted surveys. Threatened flora species recorded within the study area are shown on Figure 6-5.

Table 6-5: Threatened flora habitat and survey results

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Potential occurrence
<i>Acacia pendula</i>	Weeping Myall, Boree	E2	-	Moderate
<i>Cymbidium canaliculatum</i>	Tiger Orchid	E2	-	Moderate
<i>Diuris tricolor</i>	Pine Donkey Orchid, Painted Diuris	V, E2	-	Moderate
<i>Eucalyptus camaldulensis</i>	River Red Gum	E2	-	Recorded
<i>Eucalyptus glaucina</i>	Slaty Red Gum	V	V	Moderate
<i>Ozothamnus tessellatus</i>	-	V	V	Moderate
<i>Pomaderris queenslandica</i>	Scant Pomaderris	E1	-	Moderate
<i>Prasophyllum petilum</i>	Tarengo Leek Orchid	E	E	Moderate
<i>Pterostylis chaetophora</i>	-	V	V	Moderate
<i>Thesium australe</i>	Austral Toadflax	V	V	Moderate

1. Vulnerable (V), Endangered (E), Endangered Population (E2), Critically Endangered (CE) as listed on the BC Act

2. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.

One Endangered Population was recorded within the study area, being River Red Gum (*Eucalyptus camaldulensis*) which is listed as an Endangered Population in the Hunter catchment under the BC Act. A population of 12 *Eucalyptus camaldulensis* individuals were recorded.

EPBC Act listed threatened flora species are discussed below under 'Matters of National Environmental Significance'.

## Threatened fauna species

Under the BC Act, 45 listed threatened fauna species were considered to have a moderate to high likelihood of occurrence based on the habitat available within the study area. Table 6-6 lists these species, their conservation status and potential occurrence based on detailed targeted fauna surveys.

Threatened fauna species recorded within the study area are shown on Figure 6-5.

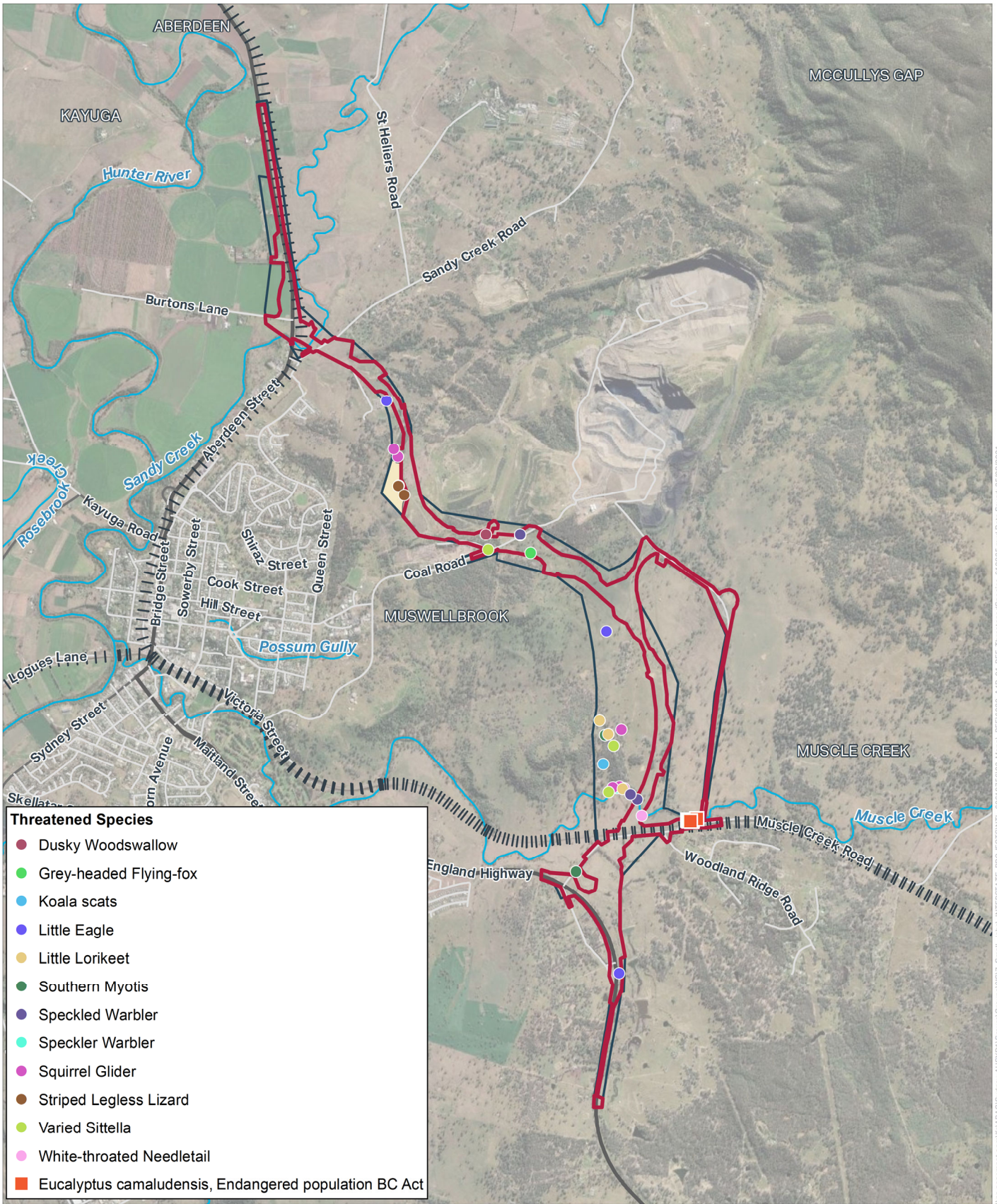
Table 6-6: Threatened fauna habitat and survey results

Scientific name	Common Name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Potential occurrence
<b>Birds</b>				
<i>Anseranas semipalmata</i>	Magpie Goose	V	-	Moderate
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	Moderate
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	Recorded
<i>Callocephalon fimbriatum</i>	Gang-Gang Cockatoo	V	-	Moderate
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	Recorded
<i>Circus assimilis</i>	Spotted Harrier	V	-	Moderate
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (eastern subspecies)	V	-	Moderate
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Recorded
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	Moderate
<i>Falco subniger</i>	Black Falcon	V	-	Moderate
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Recorded
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Moderate
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	V	-	Recorded
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Recorded
<i>Lathamus discolor</i>	Swift Parrot	CE	CE	Moderate
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Moderate
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	V	-	Moderate
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-	Moderate
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Moderate
<i>Ninox connivens</i>	Barking Owl	V	-	Moderate
<i>Ninox strenua</i>	Powerful Owl	V	-	Moderate
<i>Petroica boodang</i>	Scarlet Robin	V	-	Moderate

Scientific name	Common Name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Potential occurrence
<i>Petroica phoenicea</i>	Flame Robin	V	-	Moderate
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	V	-	High
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	Moderate
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Moderate
<i>Tyto novaehollandiae novaehollandiae</i>	Masked Owl (southern mainland)	V	-	Moderate
<b>Mammals</b>				
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Moderate
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll	V	E	Moderate
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	High
<i>Miniopterus australis</i>	Little Bent-wing Bat	V	-	High
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat	V	-	High
<i>Mormopterus norfolkensis</i>	Eastern Coastal Free-tailed Bat	V	-	High
<i>Myotis macropus</i>	Southern Myotis	V	-	Recorded
<i>Nyctophilus corbeni</i>	Corben's Long-eared bat	V	V	Moderate
<i>Petauroides volans</i>	Greater Glider	-	V	Moderate
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Recorded
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	V	-	Moderate
<i>Phascolarctos cinereus</i>	Koala	V	V	Recorded
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Recorded
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Moderate
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Moderate
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	Moderate
<b>Reptiles</b>				
<i>Delma impar</i>	Striped Legless Lizard	V	V	Recorded
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V	-	Moderate

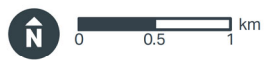
1. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the BC Act

2. Vulnerable (V), Endangered (E), Critically Endangered (CE) as listed on the EPBC Act.



**FIGURE 6-5: THREATENED FLORA AND FAUNA SPECIES**

- Legend
- Construction footprint
  - Study area
  - State Road
  - Regional Road
  - Local Road
  - Railway
  - Watercourse



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### **Critical habitat**

No critical habitat was found to occur within or in the locality of the study area.

### **Wildlife connectivity corridors**

Wildlife corridors within the study area are already subject to fragmentation due to the existing road and rail infrastructure, which may already limit regular fauna movement. Similarly, most native vegetation in the locality has been historically cleared or thinned, which has also fragmented local wildlife connectivity.

The main remaining connected wildlife corridors are:

- Along Muscle Creek and associated areas
- In areas to the north and south of Coal Road
- Remnant treed areas between Sandy Creek and Coal Road.

### **Matters of National Environmental Significance**

#### Threatened communities listed under the EPBC Act

The two EPBC Act listed TECs identified within the study area included:

- Central Hunter Valley eucalypt forest and woodland (Critically Endangered under EPBC Act)
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (Critically Endangered under EPBC Act).

#### Threatened flora listed under the EPBC Act

Five listed threatened flora species under the EPBC Act were considered to have a moderate likelihood of occurrence based on the habitat available within the study area. Table 6-5 outlines these species. No EPBC Act listed threatened flora species were recorded within the study area during targeted surveys.

#### Threatened fauna listed under the EPBC Act

Eleven listed threatened fauna species were considered to have a moderate likelihood of occurrence based on the habitat available within the study area. Table 6-6 lists these species (as they are also listed under the BC Act), their conservation status and potential occurrence based on detailed targeted fauna surveys.

The other EPBC Act listed species is White-throated Needletail (*Hirundapus caudacutus*) which is not listed under the BC Act, but listed as vulnerable under the EPBC Act.

Four EPBC Act listed threatened fauna species were recorded within the study area during targeted surveys, including:

- Striped Legless Lizard (*Delma impar*)
- White-throated Needletail (*Hirundapus caudacutus*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*).

#### Migratory species

One migratory species listed under the EPBC Act was recorded within the study area and six migratory species are considered to have a moderate likelihood of occurring within the study area as outlined in Table 6-7.

Table 6-7: Migratory fauna species recorded or with a moderate or higher likelihood of occurrence

Scientific name	Common name	BC Act <sup>1</sup>	EPBC Act <sup>2</sup>	Potential occurrence
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE, M	Moderate
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	Moderate
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	V, M	Recorded
<i>Monarcha melanopsis</i>	Black-faced Monarch	-	M	Moderate
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	M	Moderate
<i>Rhipidura rufifrons</i>	Rufous Fantail	-	M	Moderate
<i>Rostratula australis</i>	Australian Painted Snipe	E	E, M	Moderate

1. Critically Endangered (CE) as listed on the BC Act

2. Migratory (M), Critically Endangered (CE), Vulnerable (V) as listed on the EPBC Act

### Wetlands of international importance

Databases searches revealed one wetland of international importance within proximity to the study area, being The Hunter Estuary Wetlands. This wetland is located about 50 to 100 kilometres downstream from the study area. The study area does not contain waterways that are connected to the above wetland of international importance and therefore the proposal is considered unlikely to impact upon these wetlands.

### World or national heritage

Databases searches revealed one national heritage place within 10 kilometres of the study area, being the Muswellbrook Post Office. This national heritage place is not located within the study area and is therefore unlikely to be impacted by the proposal.

### Priority weeds

Of the 138 exotic species recorded, 10 are listed as Priority Weeds under the NSW Biosecurity Act 2015 (Biosecurity Act) for the Greater Hunter Local Land Service region and seven are listed Weeds of National Significance (WONS). Weeds of concern are identified in Table 6-8.

Table 6-8: Weeds of concern recorded within the study area

Scientific name	Common name	Priority weed duty	WONS
<i>Lycium ferocissimum</i>	African bothorn	<u>Prohibition on dealings</u> Must not be imported into the state or sold.	Yes
<i>Tamarix aphylla</i>	Athel pine		Yes
<i>Senecio madagascariensis</i>	Fireweed		Yes
<i>Opuntia stricta</i>	Prickly Pear		Yes
<i>Salix sp.</i>	Willow		Yes

Scientific name	Common name	Priority weed duty	WONS
<i>Bryophyllum x hoghtonii</i>	-	<u>Regional recommended measure</u> Land managers should mitigate the risk of new weeds being introduced to their land.	-
<i>Echium plantagineum</i>	Paterson's curse	Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Land managers reduce impacts from the plant on priority assets	-
<i>Hyparrhenia hirta</i>	Coolatai grass	Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Land managers reduce impacts from the plant on priority assets	-
<i>Opuntia aurantiaca</i>	Tiger Pear	<u>Prohibition on dealings</u> Must not be imported into the state or sold	Yes
<i>Rubus fruticosus species aggregate</i>	Blackberry	<u>Regional recommended measure</u> Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment. Land managers reduce impacts from the plant on priority assets	Yes

### 6.1.3 Potential impacts

#### Construction

##### Removal of native vegetation

It is estimated that up to 97.92 hectares of native vegetation would require removal. Of this, 75.66 hectares is comprised of DNG and 22.26 hectares consists of remnant vegetation (refer to Table 6-3).

The proposal would also result in the removal of 90.17 hectares of the non-native miscellaneous ecosystems identified in Table 6-4.

##### Removal of threatened flora

There would be no direct impacts on threatened flora species listed under the BC Act or the EPBC Act. All direct impacts to the River Red Gum (*Eucalyptus camaldulensis*) Endangered Population have also been avoided through design.

##### Removal of threatened fauna habitat

Vegetation requiring removal provides suitable habitat and habitat features for a range of threatened fauna species listed under the BC Act and/or EPBC Act. As such, direct impacts to habitat for threatened fauna species would occur during construction. The direct impacts of the proposal on threatened fauna habitat has been estimated based on a worst-case scenario (i.e. removal of all vegetation within the construction footprint) (refer to Appendix A for breakdown of direct impacts).

##### Aquatic impacts

The proposal has potential to have minor impacts to Type 1 (highly sensitive key fish habitat - Muscle Creek) and Type 3 (minimally sensitive key fish habitat - Sandy Creek). Impacts on both Sandy Creek and

Muscle Creek would include construction of bridges over the waterways. Specific impacts which may arise from the construction of the bridges could include:

- Alterations to hydrology of the immediate area via the construction of drainage designed to convey flows towards catchments, culverts and containment basins
- Direct impacts on substrate and groundcover vegetation which may induce sedimentation, erosion and edge effects
- Long-term shading of waterway
- Aquatic vegetation and microhabitat (such as snags, river pebbles etc.) removal.

#### Invasion and spread of weeds

The spread of weed and pest species is likely to occur during construction as an indirect impact of the proposal. Impacts would be greatest during vegetation clearing with the most likely causes of weed dispersal and importation being associated with earthworks, movement of soil, and attachment of seed (and other propagules) to vehicles and machinery.

Managing the spread of weed species is particularly important in areas immediately adjacent to Striped Legless Lizard habitat towards the north of the construction footprint. Although currently exposed to weed incursion edge effects, the results of the field investigations identified that the species did not occur in nearby areas dominated by exotic grasses (i.e. within areas of mine rehabilitation).

#### Invasion and spread of pests

The study area provides habitat for a range of commonly occurring pest species and the proposal has the potential to disperse pest species out of the construction footprint across the surrounding landscape, however the magnitude of this impact would be low and mitigation measures are not deemed necessary.

#### Invasion and spread of pathogens and disease

The following pathogens are considered to have potential to affect biodiversity within the construction footprint:

- Amphibian Chytrid Fungus (*Batrachochytrium dendrobatidis*)
- Exotic Rust Fungi (order *Pucciniales*, e.g. Myrtle rust fungus *Uredo rangeli*)
- Phytophthora Root Rot Fungus (*Phytophthora cinnamomi*).

The construction and operation of the proposal may increase the risk of disturbing and spreading these pathogens. With the implementation of appropriate mitigation measures, the risk of introducing these pathogens would be low.

#### Changes to hydrology

The study area's natural soil infiltration features and properties has been used as a drainage design philosophy to minimise impacts associated with hydrology, however the proposal would result in further alteration to hydrology due to an increase in surface runoff.

#### Groundwater dependent ecosystems

The proposal has potential to directly and indirectly interfere with subsurface and/or groundwater flows associated with the GDEs identified within the study area. These impacts would be largely associated with construction activities within proximity to Muscle Creek, Sandy Creek and their tributaries. The proposal also has potential to indirectly impact the wetland identified north of the construction footprint via changes to hydrology and sedimentation.

## Noise, light and vibration

There is potential for impacts to fauna from noise and vibration during construction, however these species would already be impacted from existing traffic noise, therefore the magnitude of this impact would be low and specific mitigation measures are not deemed necessary.

## Injury and mortality

Injury and mortality of fauna could occur during construction activities, when:

- Vegetation and habitat are being cleared and when trenches are dug
- Machinery and plant are moved to, from and on site.

## **Operation**

### Alteration to wildlife connectivity and habitat fragmentation

The proposal would fragment habitat, as it would create a new linear barrier through the landscape and would also result in an increase in isolation of habitats by increasing physical distance between some habitat fragments. This is unlikely to have a substantial impact on nomadic or migratory species, however is likely to be detrimental to the dispersal of arboreal mammals and other species. These effects however would only be marginally greater than that which is already experienced.

The proposal would not completely prevent fauna movement between habitat fragments as no impassable barriers such as solid concrete median barriers would be constructed.

The predicted level of isolation is not likely to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches.

### Edge effects on adjacent native vegetation and habitat

The proposal would likely introduce new edge effects and incrementally increase existing edge effects within the study area. However, given the highly modified nature of large areas which would be impacted, this increase is likely to be of low magnitude.

## Noise, light and vibration

Even though noise and vibration levels would increase during operation of the proposal, biodiversity are unlikely to be significantly affected given the existing levels of noise and vibration from the surrounding land uses (i.e. mine activities, existing roads and road traffic, existing rail corridors).

New roadway lighting or adjustments to existing lighting would be provided as part of the proposal. Lighting throughout the evening/night associated with the operational phase of the proposal may result in impacts on nocturnal fauna. The magnitude of this impact would be low and mitigation measures are not deemed necessary. Additionally, there are species which forage on insects attracted to lights, thereby lighting as part of the proposal may benefit some species.

## Injury and mortality

Injury and mortality of fauna could occur when the road is operational (i.e. roadkill). As there is no definitive data on current rates of roadkill or fauna population densities in the study area, the consequences of vehicle strike on local populations of fauna is relatively unknown.

## **Summary of potential impacts**

A summary of the potential impacts is presented in Table 6-9.

Table 6-9: Summary of potential biodiversity impacts

Impact	Biodiversity values	Nature of impact	Extent of impact	Duration
Removal of native vegetation (including TECs)	All native vegetation	Direct	Up to 97.92 ha including 22.6 ha of remnant and 75.66 ha of DNG	Long term
Removal of fauna habitat and habitat features	Threatened fauna species	Direct	Up to 97.92 ha including 42 HBTs	Long term
Aquatic impacts	Muscle Creek, Sandy Creek and their unnamed tributaries	Direct / Indirect	Site based	Short term
Injury and mortality of fauna	Less mobile or sedentary fauna	Direct	Site based	Short term / Long term
Wildlife connectivity and habitat fragmentation	Less mobile or sedentary fauna	Direct / Indirect	Local	Long term
Edge effects on adjacent native vegetation and habitat	All areas of native vegetation adjacent to the construction footprint	Indirect	Local	Long term
Invasion and spread of weeds	All areas of native vegetation and areas of Striped Legless Lizard habitat	Indirect	Local / Regional	Long term
Invasion and spread of pests	All flora and fauna species and habitat	Indirect	Local / Regional	Long term
Invasion and spread of pathogens and disease	All flora and fauna species and habitat	Indirect	Local / Regional	Long term
GDEs	All native vegetation	Indirect	Local	Long term
Changes to hydrology	All native vegetation	Direct / Indirect	Local	Long term
Noise, light and vibration	All fauna species	Direct / Indirect	Local	Short term / Long-term

**Conclusion on significance of impacts**

The proposal is not likely to significantly impact threatened species or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a SIS or BDAR is not required.

The proposal is not likely to significantly impact threatened species, ecological communities or migratory species, within the meaning of the EPBC Act.

#### 6.1.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Biodiversity	<p>A Flora and Fauna Management Plan (FFMP) will be prepared in accordance with Transport for NSW's <i>Biodiversity Guidelines: Protecting and Managing Biodiversity on Projects</i> (RMS, 2011) and implemented as part of the CEMP. The FFMP will include, but not be limited to:</p> <ul style="list-style-type: none"> <li>Plans showing areas to be cleared and areas to be protected, including exclusion zones, protected habitat features and revegetation areas</li> <li>Requirements set out in the <i>Landscape Guideline</i> (RMS, 2008)</li> <li>Pre-clearing survey requirements</li> <li>Procedures for unexpected threatened species finds and fauna handling</li> <li>Procedures addressing relevant matters specified in the <i>Policy and guidelines for fish habitat conservation and management</i> (DPI Fisheries, 2013)</li> <li>Protocols to manage weeds and pathogens</li> </ul>	Construction contractor	Detailed design / pre-construction	Additional safeguard
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design and implemented where practicable and feasible	Construction contractor	Detailed design / pre-construction	Additional safeguard
Removal of native vegetation	Native vegetation removal will be minimised through detailed design	Transport	Detailed design	Additional safeguard
Removal of native vegetation	Native vegetation removal will be minimised via selective placement of temporary ancillary facilities i.e. preference is to avoid areas of higher biodiversity value and to select areas already subject to disturbance	Construction contractor	Pre-construction and construction	Additional safeguard
Removal of native vegetation	Pre-clearing surveys will be undertaken in accordance with Guide 1: Pre-clearing process of the <i>Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects</i> (Roads and Traffic Authority, 2011)	Construction contractor	Pre-construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
Removal of native vegetation	Exclusion zones will be set up at the limit of clearing or where areas containing pathogens or disease are identified in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Construction contractor	Construction	Additional safeguard
Removal of native vegetation	Vegetation removal will be undertaken in accordance with Guide 4: Clearing of vegetation and removal of bushrock of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Construction contractor	Construction	Additional safeguard
Removal of native vegetation	Native vegetation will be re-established (particularly along new road verge within proximity to known Striped Legless Lizard habitat) in accordance with Guide 3: Re-establishment of native vegetation of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011) to minimise weed encroachment (in particular perennial grass species)	Construction contractor	Construction and post construction	Additional safeguard
Removal of native vegetation	The unexpected species find procedure is to be followed under Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011) if threatened entities, not assessed in the biodiversity assessment, are identified in the construction footprint	Construction contractor	Construction	Additional safeguard
Removal of threatened species habitat and habitat features	Habitat will be replaced or re-instated in accordance with Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Construction contractor	Construction	Additional safeguard
Removal of threatened species habitat and habitat features	Site personnel working within proximity of Striped Legless Lizard habitat will be provided with an information sheet and/or induction. An exclusion zone will be set up around known Striped Legless Lizard habitat during construction in accordance with Guide 2: Exclusion zones of the Biodiversity Guidelines: Protecting and managing	Construction contractor	Pre-construction and construction	Additional safeguard



Impact	Environmental safeguards	Responsibility	Timing	Reference
	biodiversity on RTA projects (Roads and maritime Authority, 2011)			
Removal of threatened species habitat and habitat features	A nest box strategy will be developed in accordance with Guide 8: Nest boxes of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011). The nest box strategy will primarily target the replacement of hollow resources being removed by the proposal on the Squirrel Glider. Final hollow resource impacts and subsequent nest boxes required will be informed by the tree clearing program	Construction contractor	Pre-construction	Additional safeguard
Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the Policy and guidelines for fish habitat conservation and management Update 2013 (Department of Primary Industries, 2013)	Construction contractor	Construction	Additional safeguard
Injury and mortality of fauna and fragmentation of identified habitat corridors	Fauna will be managed in accordance with Guide 9: Fauna handling of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Construction contractor	Construction	Additional safeguard
Injury and mortality of fauna and fragmentation of identified habitat corridors	Road-kill and connectivity impacts will be minimised via: <ul style="list-style-type: none"> <li>• installation of one aerial fauna crossing structure to retain fauna connectivity in the vicinity of where Squirrel Gliders have been recorded. The final location, design and type of structure will be determined during detailed design</li> <li>• Construction of a bridge over Muscle Creek to provide underpass fauna crossing for terrestrial fauna species such as the Koala</li> <li>• Consideration of fauna exclusion fencing in areas where fauna crossing structures are proposed for example near Muscle Creek</li> </ul>	Construction contractor	Detailed design, construction and post construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	and/or near known habitat for Striped Legless Lizard <ul style="list-style-type: none"> <li>Installation of 'Koala Warning Signs' or 'Injured Native Wildlife Signs' in areas of potential wildlife conflict areas or crossing points</li> </ul>			
Invasion and spread of weeds	Priority weed species will be managed in accordance with Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Construction contractor	Construction	Additional safeguard
Invasion and spread of pests	Pest species will be managed within the construction footprint	Construction contractor	Construction	Additional safeguard
Invasion and spread of pathogens and disease	Hygiene procedures will be implemented for the use of vehicles and the importation of materials to the proposal footprint in accordance with Guide 7: Pathogen management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (Roads and Traffic Authority, 2011)	Construction contractor	Construction	Additional safeguard
Groundwater dependant ecosystems	Interruptions to water flows associated with GDEs will be minimised through detailed design	Transport	Detailed design	Additional safeguard
Habitat removal	A Biodiversity Offset Strategy will be prepared for the proposal in accordance with Guidelines for Biodiversity Offsets (Roads and Maritime Services, 2016)	Construction contractor	Pre-construction	Additional safeguard

### 6.1.5 Biodiversity offsets

Transport's Guideline for Biodiversity Offsets (Roads and Maritime, 2016) requires consideration of biodiversity offsets (or where offsets are not reasonable or feasible, supplementary measures) where impacts exceed predetermined thresholds, as detailed in Table 6-10.

Table 6-10: Offsetting thresholds for REFs (Roads and Maritime 2016)

Description of Activity or Impact	Consider Offsets of Supplementary Measures
Works involving clearing of national or NSW listed critically endangered ecological communities (CEEC)	Where there is any clearing of a CEEC in moderate to good condition

Description of Activity or Impact	Consider Offsets of Supplementary Measures
Works involving clearing of nationally listed threatened ecological community (TEC) or nationally listed threatened species habitat	Where clearing greater than one hectare of a TEC or habitat in moderate to good condition
Works involving clearing of NSW endangered or vulnerable ecological community	Where clearing greater than five hectares 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 EES s Threatened Species Profile Database	Where clearing greater than one hectare 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 EES s Threatened Species Profile Database	Where clearing greater than five hectares 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 22.96 hectares of White box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland CEEC in moderate to good condition
- Clearing of 55.24 hectares of Central Hunter Valley Grey Box – Ironbark Woodland TEC in moderate to good condition (at least 28.72 hectares consistent with EPBC Act listing for Central Hunter Valley eucalypt forest and woodland)
- Clearing of 66.78 hectares of habitat for Barking Owl, Powerful Owl, Masked Owl, Spotted Harrier, Black Falcon, Little Eagle, Square-tailed Kite, Black-chinned Honeyeater, Swift Parrot, Regent Honeyeater, Little Lorikeet, Painted Honeyeater, Brown Treecreeper, Dusky Woodswallow, Diamond Firetail, Flame Robin, Scarlet Robin, Grey-crowned Babbler (eastern subspecies), Hooded Robin, Speckled Warbler, Turquoise Parrot, Varied Sittella, Gang-Gang Cockatoo, Corben’s Long-eared Bat, Eastern Cave Bat, Eastern Coastal Freetail Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Large-eared Pied-bat, Large Bent-winged Bat, Little Bent-wing Bat, Yellow-bellied Sheath-tail-bat, Grey-headed Flying-fox, Koala, Spotted-tailed Quoll, White-bellied Sea-eagle and White-throated Needle-tail.
- Clearing of 36.81 hectares of habitat for Southern Myotis
- Clearing of 0.16 hectares of Type 1 key fish habitat.

A Biodiversity Offset Strategy would be considered to identify biodiversity credits and/or supplementary measures for those entities impacted.