A.2 Threatened and migratory fauna recorded in the study locality

Scientific name	Common name	Status		Preferred habitat	Potential to occur in project area
		Cwlth	NSW		
Botaurus poiciloptilus	Australasian Bittern		V	Freshwater wetlands, rivers and streams	No
Ninox connivens	Barking Owl		V	Woodlands and riparian habitats	No
Coracina lineate	Barred Cuckoo-Shrike		V	Rainforest and wet sclerophyll forests	No
Esacus neglectus	Beach Stone-Curlew		E1	Open beaches and coastal dunes	No
Mormopterus beccarii	Beccari's Freetail-Bat		V	Open forests, woodlands and grasslands	Yes
Pteropus alecto	Black Flying-Fox		V	Diversity of natural and modified habitats	Yes
Turnix melanogaster	Black-Breasted Button-Quail		E1	Rainforest and wet sclerophyll forests	No
Hamirostra melanosternon	Black-Breasted Buzzard		V	Woodlands and grasslands	No
Thalassarche melanophris	Black-browed Albatross		V	Oceanic, marine	No
Melithreptus gularis gularis	Black-chinned Honeyeater		V	Woodlands, open forest	Present
Ephippiorhynchus asiaticus	Black-necked Stork		E1	Open wetlands & adjoining agricultural areas	No
Limosa limosa	Black-tailed Godwit		V	Oceanic, marine and estuarine	No
Litoria booroolongensis	Boorolong Frog		E1	Creeks and wetlands	Unlikely
Limicola falcinellus	Broad-billed Sandpiper		V	Oceanic, marine and estuarine	No
Grus rubicundus	Brolga		V	Open wetlands & adjoining agricultural areas	No
Climacteris picumnus	Brown Treecreeper		V	Woodlands, open forest	Present
Phascogale tapoatafa	Brush-tailed Phascogale		V	Woodlands, open forest	Present
Petrogale penicillata	Brush-tailed Rock Wallaby	E	E1	Open forest on sandstone ridges	No
Burhinus grallarius	Bush Stone-Curlew		E1	Woodlands, open forest	Yes
Irediparra gallinacea	Comb-crested Jacana		V	Open wetlands & adjoining agricultural areas	No
Syconycteris australis	Common Blossom-Bat		V	Rainforest and wet sclerophyll forests	No
Planigale maculata	Common Planigale		V	Woodlands, open forest	Yes
Stagonopleura guttata	Diamond Firetail		V	Woodlands, open forest	Yes
Cyclopsitta diophthalma coxeni	Double-Eyed Fig-Parrot	E	E1	Rainforest and wet sclerophyll forests	No
Miniopterus schreibersii oceanenis	Eastern Bent-Wing Bat		V	Woodlands, open forest	Yes

Scientific name	Common name	Status		Preferred habitat	Potential to occur in project area
		Cwlth	NSW		
Vespadelus troughtoni	Eastern Cave Bat		V	Woodlands, open forest	Yes
Pseudomys gracilicaudatus	Eastern Chestnut Mouse		V	Woodlands, open forest	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle		V	Woodlands, open forest	Yes
Mormopterus norfolkensis	Eastern Freetail-Bat		V	Woodlands, open forest	Yes
Nyctophilus bifax	Eastern Long-Eared Bat		V	Woodlands, open forest	Yes
Cercartetus nanus	Eastern Pygmy-Possum		V	Heath, open forest	No
Dromaius novaehollandiae	Emu		E2	Woodlands, open forest	No outside of range of population
Stictonetta naevosa	Freckled Duck		V	Open wetlands & adjoining agricultural areas	No
Mixophyes iteratus	Giant Barred Frog	E	E1	Wet sclerophyll forests and rainforest streams	No
Petalura gigantea	Giant Dragonfly		E1	Open wetlands & adjoining agricultural areas	No
Litoria subglandulosa	Glandular Frog		V	Swamps, wetlands	No
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	Woodlands, open forest	Yes
Kerivoula papuensis	Golden-Tipped Bat		V	Rainforest and wet sclerophyll forests	No
Tyto capensis	Grass Owl		V	Open wetlands and grasslands	No
Calidris tenuirostris	Great Knot		V	Oceanic, marine and estuarine	No
Scoteanax rueppellii	Greater Broad-Nosed Bat		V	Woodlands, open forest	Yes
Charadrius leschenaultia	Greater Sand Plover		V	Oceanic, marine and estuarine	No
Litoria aurea	Green and Golden Bell Frog	E	E1	Open wetlands & adjoining agricultural areas	No
Litoria brevipalmata	Green-thighed Frog		V	Wet heaths and sclerophyll forests	No
Pomatostomus temporalis temporal	Grey-crowned Babbler		V	Woodlands, open forest	Yes
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Diversity of forest and modified habitats	Present
Pezoporus wallicus wallicus	Ground Parrot		V	Heaths, open forests	No
Pseudomys oralis	Hastings River Mouse		E1	Woodlands, open forest	No
Chalinolobus nigrogriseus	Hoary Wattled Bat		V	Woodlands, open forest	Yes
Melanodryas cucullata	Hooded Robin		V	Woodlands, open forest	Yes

Scientific name	Common name	Status		Preferred habitat	Potential to occur in project area
		Cwlth	NSW		
Phascolarctos cinereus	Koala		V	Woodlands, open forest	Yes
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Woodlands, open forest	Yes
Myotis adversus	Large-footed Myotis		V	Woodlands, open forest near water	Yes
Charadrius mongolus	Lesser Sand Plover		V	Oceanic, marine and estuarine	No
Miniopterus australis	Little Bentwing-Bat		V	Woodlands, open forest	Present
Sterna albifrons	Little Tern	E	E1	Oceanic, marine and estuarine	No
Potorous tridactylus	Long-nosed Potoroo	V	V	Woodlands, open forest	No
Anseranas semipalmata	Magpie Goose		V	Open wetlands & adjoining agricultural areas	No
Lichenostomus fasciogularis	Mangrove Honeyeater		V	Mangroves, estuarine	No
Tyto novaehollandiae	Masked Owl		V	Woodlands, open forest	Yes
Pachycephala olivacea	Olive Whistler		V	Rainforest and wet sclerophyll forests	No
Litoria olongburensis	Olongburra Frog		V	Wetlands and swamps	No
Pandion haliaetus	Osprey		V	Estuarine and rivers	No
Grantiella picta	Painted Honeyeater		V	Woodlands, open forest	No
Hoplocephalus bitorquatus	Pale-Headed Snake		V	Woodlands, open forest	No
Macropus parma	Parma Wallaby		V	Rainforest and wet sclerophyll forests	No
Haematopus longirostris	Pied Oystercatcher		V	Oceanic, marine and estuarine	No
Assa darlingtoni	Pouched Frog		V	Rainforest and wet sclerophyll forests	No
Ninox strenua	Powerful Owl		V	Woodlands, open forest	Yes
Erythrotriorchis radiates	Red Goshawk	E	E1	Woodlands, open forest	Marginal
Thylogale stigmatica	Red-legged Pademelon		V	Rainforest and wet sclerophyll forests	No
Xanthomyza phrygia	Regent Honeyeater	E, M	E1	Woodlands, open forest	Yes
Ptilinopus regina	Rose-crowned Fruit-Dove		V	Rainforest and wet sclerophyll forests	Marginal
Aepyprymnus rufescens	Rufous Bettong		V	Woodlands, open forest	Present
Atrichornis rufescens	Rufous Scrub-Bird		V	Woodlands, open forest	Marginal
Calidris alba	Sanderling		V	Oceanic, marine and estuarine	No
Tyto tenebricosa	Sooty Owl		V	Rainforest and wet sclerophyll forests	No
Haematopus fuliginosus	Sooty Oystercatcher		V	Oceanic, marine and estuarine	No
Sterna fuscata	Sooty Tern		V	Oceanic, marine and estuarine	No

Scientific name	Common name	Status		Preferred habitat	Potential to occur in project area
		Cwlth	NSW		
Pyrrholaemus sagittatus	Speckled Warbler		V	Woodlands, open forest	Yes
Philoria sphagnicola	Sphagnum Frog		V	Rainforest and wet sclerophyll forests	No
Dasyurus maculatus	Spotted-tailed Quoll	E	V	Woodlands, open forest	Yes
Lophoictinia isura	Square-tailed Kite		V	Woodlands, open forest	Yes
Petaurus norfolcensis	Squirrel Glider		V	Woodlands, open forest	No
Hoplocephalus stephensii	Stephens' Banded Snake		V	Woodlands, open forest	No
Mixophyes balbus	Stuttering Frog	V	E1	Rainforest and wet sclerophyll forests	No
Ptilinopus superbus	Superb Fruit-Dove		V	Rainforest and wet sclerophyll forests	No
Lathamus discolor	Swift Parrot	E, M	E1	Woodlands, open forest	Yes
Xenus cinereus	Terek Sandpiper		V	Oceanic, marine and estuarine	No
Coeranoscincus reticulates	Three-toed Snake-tooth Skink	V	V	Woodlands, open forest	Marginal
Neophema pulchella	Turquoise Parrot		V	Woodlands, open forest	Marginal
Crinia tinnula	Wallum Froglet		V	Wet heaths and acid swamps	No
Cacophis harriettae	White-crowned Snake		V	Woodlands, open forest	Marginal
Monarcha leucotis	White-eared Monarch		V	Woodlands, open forest	No
Ptilinopus magnificus	Wompoo Fruit-Dove		V	Rainforest and wet sclerophyll forests	No
Petaurus australis	Yellow-bellied Glider		V	Woodlands, open forest	Present
Saccolaimus flaviventris	Yellow-bellied Sheathtail-Bat		V	Woodlands, open forest	Yes
Hirundapus caudacutus	White-throated Needletail	Mt		Woodland, open forest, cleared land	Yes
Ardea ibis	Cattle Egret	Mw		Agricultural land	No
Ardea alba	Great Egret	Mw		Swamps, floodplains	No
Monarcha melanopsis	Black-faced Monarch	Mt		Rainforest, dense moist forests	No
Monarcha trivergatus	Spectalced Monarch	Mt		Rainforest, dense moist forests	No
Merops ornatus	Rainbow Bee-eater	Mt		Open country, agricultural lands	No
Gallingo hardwicki	Lathams Snipe	Mw		Estuaries, beaches, lakes	No
Haliaeetus leucogaster	White-bellied Sea Eagle	Mt		Estuaries, beaches, lakes	No
Myiagra cyanoleuca	Satin Flycatcher	Mt		Woodlands	No
Rhipidura rufifrons	Rufous Fantail	Mt		Moist forests, gullies, rainforest	No
Cyclopsitta diophtthalma coxeni	Coxens Fig Parrot	Mt		Rainforests	No
Rostratula bengalensis s.lat	Painted snipe	Mw		Wetlands	No

Scientific name	Common name	Status		Preferred habitat	Potential to occur in project area
		Cwlth	NSW		
Charadrius mongolus	Lesser Sand plover	Mw		Beaches, estuaries	No
Numenius phaeopus	Whimbrel	Mw		Estuaries, sandflats, mudflats	No

E1 = endangered species; E2 = endangered population; V = vulnerable species, Mt = migratory terrestrial species, Mw = Migratory wetland species

Appendix B Assessment of significance (Part 3A EP&A Act)

B.1 Threatened flora recorded in project area

Eucalyptus tetrapleura (vulnerable species, TSC Act)

How is the project likely to affect the lifecycle of a threatened species and/or population?

The major populations for *Eucalyptus tetrapleura* were recorded in the Glenugie area including the population in the project footprint. Large populations are predicted to be present to the east of Glenugie State Forest on private property adjoining Yuraygir State Conservation Area and Glenugie Peak Flora Reserve.

The population in the project footprint is estimated to occur over a 613 ha area supporting about 103,300 individual *Eucalyptus tetrapleura* from all age classes. Additionally there are nearby populations to the south and east not directly linked to the population in the project footprint on private land, in Glenugie State Forest, New Foundland State Forest , Wells Crossing Flora Reserve and Yuraygir State Recreation Area. The total individuals estimated to occur in these populations within about six kilometres of the project footprint is 147,000 over area of 1,010 ha.

The life cycle of *Eucalyptus tetrapleura* is likely to be linked to a large range of factors, but several important components include:

- A wide range of potential pollinator species including insects, birds, bats and arboreal mammals.
- Fire regime including fire intensity, frequency and season.
- Available gene pool.
- Other disturbance regimes such as forestry activities and grazing.

The 147,000 individuals within six kilomatres of the project footprint could be considered to be within a single population considering the high mobility of some pollinator species such as insects, birds and bats, and wind dispersal of pollen. The total population of *Eucalyptus tetrapleura* is known to occur between Glenreagh in the south to Casino in the north within a range of about 100 km north-south and 50 km east-west. The total population is estimated to be between 170,000 and 250,000 individuals based on recorded locations to date and regional records (DECC 2009) comprising 50 or more different sub-groups.

There are estimated to be approroximately 6156 individuals within the project footprint which would potentially be removed comprising about 36 ha of habitat. This potential removal is estimated to constitute about 4.2 per cent of the local population and between 3.6 per cent and 2.5 per cent of the total known population. This would have impacts to the local distribution of the species, removing part of the local gene pool and 36 ha of known habitat for the species. The

project would also result in the further fragmentation of the population on the western side of the existing highway from populations to the east. About 95 per cent of the local population is estimated to remain following the proposed impact in the surrounding areas within conservations reserves, state forests and private lands.

The local abundance of the species varied considerably within each of the different populations. The density of trees was often dependant on the degree of recruitment, with some areas supporting a large number of juvenile trees and smaller saplings, whilst other areas supported more mature trees with fewer juveniles. The abundance of juveniles is dependent on several factors including fire history, understorey structure and other disturbances such as logging activities. Many of the State Forest areas supported a large number of juveniles possibly due to past disturbance from logging activities providing bare soil for germination. However certain fire regimes are likely to favour recruitment, such as a fire during the major fruiting period for *Eucalyptus tetrapleura*, providing bare surface substrates for germination of plant-stored seed. Although there is potential for fire regimes to change following the project it is considered unlikely to significantly impact the life cycle of populations of *Eucalyptus tetrapleura*.

The project is unlikely to significantly impact the local gene pool or lead to inbreeding depressions due to fragmentation. Habitat for pollinator species would be removed, however sufficient habitat for large populations of potential pollinator species would remain in surrounding areas. Considering the above the life cycle of *Eucalyptus tetrapleura* in the local area is unlikely to be significantly affected.

To mitigate the ecological impacts from the project an offset strategy is proposed to provide greater protection of *Eucalyptus tetrapleura* and habitat for other threatened flora and fauna, through placing an area of private land or state forest under conservation. Several options for the offset strategy are proposed, several of which include extending current conservation reserves in the area including Wells Crossing Flora Reserve, Yuraygir State Recreation Area and Glenugie Peak Flora Reserve.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

Habitat for *Eucalyptus tetrapleura* is not well defined and is not restricted to one particular vegetation association, landform, soil type or geology. Its occurrence was observed to be more associated with a number of physical features influencing soil moisture and groundwater levels, including soil texture, soil depth, slope, bedrock geology, subsoil permeability. Overall, *Eucalyptus tetrapleura* seems to occupy a niche where it is able to out-compete other Eucalypt species where soils are not too dry or wet, where drainage is not significantly impeded and in some circumstances where soils are not too shallow but shallow enough for the bedrock to influence groundwater levels.

The project would result in the removal of up to 36 ha of known habitat for *Eucalyptus tetrapleura.* This constitutes about 3 per cent of the total known habitat for *Eucalyptus tetrapleura* identified in the field surveys for this project and significantly less than the total area of habitat occupied by and potentially available to the species.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

Eucalyptus tetrapleura is endemic to coastal lowlands and foothills from near Glenreagh in the south to Casino in the north, occurring within a range of about 100 km north-south and 50 km east-west. Within this range, the current known distribution is patchy, however the species has not been extensively surveyed and the full extent of the population is unknown.

The population with the project footprint is towards the southern end of known distribution of *Eucalyptus tetrapleura*. There are known populations assessed in the field surveys about 12.5 km to the east and 30 km to the west of the population within the project footprint. There are records of *Eucalyptus tetrapleura* (DECC 2009) about 14 km to the south and 70 km to the north of the population in the project footprint, however the extent and abundance of these populations were not assessed during the field surveys.

How is the project likely to affect current disturbance regimes?

The project would result in a larger fire break to wildfire approaching from the west of the existing highway, potentially resulting in the frequency of wildfire to be reduced in populations to the east. However state forest areas are likely to be fire-managed with control burns implemented in areas during cooler months. Although there is potential for fire regimes to change following the project it is considered unlikely to significantly impact the life cycle of populations of *Eucalyptus tetrapleura*.

Vegetation clearing would potentially contribute to further invasion of *Lantana camara* and other exotic species particularly along the edges of the project footprint where there would be increased sunlight availability. Other indirect impacts such as stormwater run-off potentially increasing water and nutrient loads entering adjacent bushland areas, leading to the increased growth and spread of exotic species.

How is the project likely to affect habitat connectivity?

The population is currently fragmented by the existing highway and the project would widen the disturbance width further fragmenting habitats on the western side of the existing highway from populations to the east. However, considering the high mobility of some pollinator species such as insects, birds and bats, and wind dispersal of pollen gene flow is expected to continue across the existing highway and the width of the project. There are estimated to be about 7,100 individuals on the western side of the existing highway, and this is likely to be a large enough gene pool to continue to successfully reproduce without inbreeding depressions.

How is the project likely to affect critical habitat?

No critical habitat has been identified for this species.

Melaleuca irbyana (endangered species, TSC Act)

How is the project likely to affect the lifecycle of a threatened species and/or population?

A small population of *Melaleuca irbyana* was recorded in the study area comprising about 31 individuals. Of these 31 individuals recorded up to 10 may be impacted from the project however there is potential to retain more individuals adjacent to the project footprint and reduce the impacts to 5 individuals. The project would fragment the population in the project footprint with individuals retained on both sides of the project. The population included both seedlings, juvenile and adult plants.

The life cycle of *Melaleuca irbyana* is likely to be linked to a large range of factors, but several important components include:

- A wide range of potential pollinator species including insects, birds, bats and arboreal mammals.
- Fire regime including fire intensity, frequency and season;
- Available gene pool.
- Other disturbance regimes such as forestry activities and grazing.

Surrounding the project footprint in the local area there are several populations of *Melaleuca irbyana* recorded on the DECC Atlas of NSW Wildlife (2009), with at least 166 individuals recorded. One of the main populations indicated in the records is about 2.5 km north east of the project footprint and comprises 114 individuals on the eastern edge of Glenugie State Forest.

The local population for *Melaleuca irbyana* could be considered to include both the population within the project footprint and the population 2.5 km to the north east, considering the high mobility of potential pollinator species and wind dispersal of pollen. Additionally, there may be other locations of *Melaleuca irbyana* between these two sub-populations which have not been detected. The total population size is estimated to be 145 individuals. Therefore the individuals potentially impacted from the project comprises between 3 and 7 per cent of the local population. However, the project will potentially remove between 16 and 32 per cent of the sub-population in the project footprint which is considered a relatively significant removal, however when considering other nearby sub-populations and potential pollinator movements and wind dispersal of pollen it is unlikely the project would result in a significant loss to the local gene pool.

To mitigate the loss of individuals within the project footprint and prevent significant losses to the local gene pool, it is proposed that seed collection and propagation program be implemented for *Melaleuca irbyana* in close proximity to the project footprint. This population has a

relatively low abundance and is likely to benefit from supplementary plantings within suitable areas of habitat.

Additionally an offset strategy is proposed to provide greater protection of *Eucalyptus tetrapleura* and habitat for other threatened flora and fauna, through placing an area of private land or state forest under conservation. Several options for the offset strategy are proposed, several of which include extending current conservation reserves in the area including Wells Crossing Flora Reserve, Yuraygir State Recreation Area and Glenugie Peak Flora Reserve. *Melaleuca irbyana* could potentially be present within these offset area/s and provide greater protection for the species.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

Melaleuca irbyana doesn't have a well defined habitat preference within the study area. It appears to be associated with creek line areas and lower, mid slopes surrounding drainage lines. It occurs in relatively low abundance within this area of habitat. The project would result in the removal of about 3 ha of known *Melaleuca irbyana* habitat, from the 17 ha of habitat estimated to be present in close proximity to the project footprint. The potential habitat for the species in Glenugie State Forest includes a very large area, however the sporadic occurrence of the species suggests that its distribution is dependent on a range of factors.

Surrounding the project footprint in the local area there are several populations of *Melaleuca irbyana* recorded on the DECC Atlas of NSW Wildlife (2009), with at least 166 individuals recorded. One of the main populations indicated in the records is about 2.5 km north east of the project footprint and comprises 114 individuals on the eastern edge of Glenugie State Forest, occurring about over a 6 ha area. More investigations would be required to accurately determine the total area of habitat occupied by *Melaleuca irbyana* in the local area

The local population for *Melaleuca irbyana* could be considered to include both the population within the project footprint and the population 2.5 km to the north east, considering the high mobility of potential pollinator species and wind dispersal of pollen. There may be additional locations of *Melaleuca irbyana* between these two sub-populations. The total population size is estimated to be 145 individuals.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

Melaleuca irbyana is found in only a few places in north-east NSW, including near Coraki, Casino, Coutts Crossing south of Grafton, and also near Ipswich south-east Queensland. The study area represents the known southern extent of the species, however there is a record within Glenugie State Forest about five kilometres to the south of the population within the project

footprint. Additionally there are also populations about 12 km to the west of the project footprint and to the north in the Pillar Valley area.

How is the project likely to affect current disturbance regimes?

The project would result in a larger fire break to wildfire approaching from the west of the existing highway, potentially resulting in the frequency of wildfire to be reduced in populations to the east. However state forest areas are likely to be fire-managed with control burns implemented in areas during cooler months. Although there is potential for fire regimes to change following the project it is considered unlikely to significantly impact the life cycle of populations of *Melaleuca irbyana*.

Vegetation clearing will potentially contribute to further invasion of *Lantana camara* and other exotic species particularly along the edges of the project footprint where there would be increased sunlight availability. Other indirect impacts include stormwater run-off potentially increasing water and nutrient loads entering adjacent bushland areas, leading to the increased growth and spread of exotic species.

How is the project likely to affect habitat connectivity?

The project would result in the sub-population within the project footprint to fragmented, as individuals would be retained on either side of the project. However a continuous band of vegetation would link remaining individuals on the eastern side of the project to the sub-population located about 2.5 km to the east of the project footprint.

How is the project likely to affect critical habitat?

No critical habitat has been identified for this species.

B.2 Endangered Ecological Communities

Subtropical Coastal Floodplain Forest

How is the project likely to affect the lifecycle of a threatened species and/or population?

Subtropical Coastal Floodplain Forest is not threatened species or a population.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would directly remove 5.3 ha of Subtropical Coastal Floodplain Forest which is in a good ecological condition. There is potential for the project to alter habitat attributes of surrounding areas of Subtropical Coastal Floodplain Forest which would remain following the project through indirect impacts such as altering hydrological and nutrient regimes and creating edge effects. This could potentially result in increases in weed abundance, altered soil conditions and sedimentation. Changes to local hydrological regimes may result in water being contained for longer periods of time or lowering of the watertable, potentially resulting in

changes to understorey floristics and die-back in the canopy. Mitigation measures during construction and the implementation of specific design features into the proposed development are likely to minimise these indirect impacts.

Areas of this community would remain surrounding the project on the western side of the existing highway, as well as smaller occurrences that would remain on the eastern side of the project. Other occurrences of this community in the locality include areas to the north of the project surrounding Pheasants Creek, drainage lines to the south and east of the project footprint within Glenugie State Forest and private land.

The Comprehensive Regional Assessment Aerial Photographic Interpretation (CRAFTI) (Resource and Conservation Division 2001) has mapped about 2211 ha of vegetation with affinities to Subtropical Coastal Floodplain Forest within about a 10 km radius of the project footprint. The project would result in the removal of about 0.2 per cent of the local distribution of this community.

To mitigate the ecological impacts from the project an offset strategy is proposed to provide greater protection of *Eucalyptus tetrapleura* and habitat for other threatened flora and fauna, through placing an area of private land or state forest under conservation. Several options for the offset strategy are proposed, several of which include extending current conservation reserves in the area including Wells Crossing Flora Reserve, Yuraygir State Recreation Area and Glenugie Peak Flora Reserve. Areas of Subtropical Coastal Floodplain Forest are likely to be included in any offset area, considering that *Eucalyptus tetrapleura* was recorded throughout much of this community in the study area.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

Subtropical Coastal Floodplain Forest is not threatened species or a population.

How is the project likely to affect current disturbance regimes?

Current disturbance regimes in Subtropical Coastal Floodplain Forest mainly comprise weed invasion, grazing from introduced herbivores and impacts from too frequent fire regimes. The project would result in a larger fire break to wildfire approaching from the west of the existing highway, potentially resulting in the frequency of wildfire to be reduced in this community to the east of the project footprint. Considering this EEC is an area which should be generally excluded from fire, the potential of reduced frequency of fires would be ecologically advantageous for this EEC.

Vegetation clearing would potentially contribute to further invasion of *Lantana camara* and other exotic species particularly along the edges of the project footprint where there would be increased sunlight availability. Other indirect impacts include stormwater run-off potentially

increasing water and nutrient loads entering adjacent bushland areas, leading to the increased growth and spread of exotic species.

How is the project likely to affect habitat connectivity?

Areas of Subtropical Coastal floodplain Forest are currently fragmented by the existing highway and the project would widen the disturbance width further fragmenting habitats on the western side of the existing highway from habitats to the east.

However considering the high mobility of many pollinator species for the various plant species within this EEC (such as insects, birds and bats, and also wind and water dispersal of genetic material) some gene flow is expected to continue across the existing highway and the width of the project.

How is the project likely to affect critical habitat?

No critical habitat has been identified for this community.

B.3 Threatened fauna

The significance of impacts on the following subject species has been assessed. Species with similar morphological characteristics or ecological requirements have been assessed concurrently for example woodland birds and large forest owls.

Species / Groups	**Status**	
	Cwlth	**NSW**
Swift Parrot (*Lathamus discolour*)	E	E
Regent Honeyeater (*Xanthomyza phrygia*)	E	E
Grey-headed Flying-Fox (*Pteropus poliocephalus)*	V	V
Rufous Bettong (*Aepyprymnus rufescens)*		V
Spotted-tailed Quoll (*Dasyurus maculatus)*	E	V
Square-tailed Kite (*Lophoictinia isura)*		V
Brush-tailed Phascogale (*Phascogale tapoatafa)*		V
Glossy Black-Cockatoo (*Calyptorhynchus lathami)*		V
Koala (*Phascolarctos cinereus)*		V
Bush Stone-Curlew (*Burhinus grallarius*)		E
Woodland Birds		
Black-chinned Honeyeater (*Melithreptus gularis gularis)*		V
Brown Treecreeper (*Climacteris picumnus)*		V
Diamond Firetail (*Stagonopleura guttata)*		V
Grey-crowned Babbler (*Pomatostomus temporalis temporalis)*		V
Hooded Robin (*Melanodryas cucullata)*		V
Speckled Warbler (*Pyrrholaemus sagittatus)*		V
Cave-roosting Bats		
Eastern Bent-Wing Bat (*Miniopterus schreibersii oceanenis)*		V

Species / Groups	Status	
	Cwlth	NSW
Eastern Cave Bat (*Vespadelus troughtoni)*		V
Little Bentwing-Bat (*Miniopterus australis)*		V
Large-footed Myotis (*Myotis adversus)*		V
Large-eared Pied Bat (*Chalinolobus dwyeri*)		V
Tree-roosting Bats		
Eastern False Pipistrelle (*Falsistrellus tasmaniensis)*		V
Eastern Freetail-Bat (*Mormopterus norfolkensis)*		V
Eastern Long-Eared Bat (*Nyctophilus bifax)*		V
Greater Broad-Nosed Bat (*Scoteanax rueppellii)*		V
Yellow-bellied Sheathtail-Bat (*Saccolaimus flaviventris)*	V	V
Beccari's Freetail-Bat (*Mormopterus beccarii)*		V
Hoary Wattled Bat (*Chalinolobus nigrogriseus)*		V
Large Forest Owls		
Masked Owl (*Tyto novaehollandiae)*		V
Powerful Owl (*Ninox strenua)*		V

Swift Parrot and Regent Honeyeater

How is the project likely to affect the lifecycle of a threatened species and/or population?

The distribution of records for both species in the north coast of NSW has been consistently associated with lowland coastal forests dominated by Swamp Mahogany (*Eucalyptus robusta*) or drier forests and woodlands comprising a high density of Large-leaved Spotted Gum (*Corymbia henryi*) (Menkhorst 1999). Swamp Mahogany is not present in the study area, although the winter flowering Large-leaved Spotted Gum is abundant throughout the drier open forest. The association with these habitat types is a result of the presence of winter flowering eucalypts and the reliance by these nomadic species on the seasonally available winter food resources (nectar).

The study area would constitute non-breeding habitat for a proportion of the population of both species, however the study area is not considered a critical area for the regent honeyeater or swift parrot. The habitat is only marginal and higher value swamp forest communities supporting Swamp Mahogany occur elsewhere in the region. Records from the study area are relatively continuous extending over the last 30 years indicating that the region may constitute seasonally important foraging and refuge habitat for these species, particularly during inland droughts. The current potential for these species to occur based on the presence of potential foraging habitat is expected to remain after completion of the project such that foraging, movement and other life-cycle attributes would not be impacted.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

In considering the potential habitat of these two species in the study area, it is likely that the dry open forest habitats dominated by Large-leaved Spotted Gum, provide opportunities for foraging, although the habitat is not used for breeding. The project would remove up to 74.7 ha of dry open forest and 5.1 ha of woodland. This loss is considered low and of little significance to populations of the swift parrot and regent honeyeater. Large areas of high quality habitat are represented outside the road footprint in several regional State Forests, conservation reserves and rural properties. The potential for continued visitation to the region is expected following construction of the project.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The swift parrot extends from its summer breeding grounds in Tasmania, from where it disperses to over-winter in southeast mainland Australia. Some individuals range north to Queensland, but the majority over-winter in Victoria and central and eastern NSW (Saunders and Heinsohn 2008). The species returns to Tasmania in September. The study area constitutes a small percentage of the known distribution of the species and does not represent its geographical limit.

The regent honeyeater was formerly distributed in about 300 km of the eastern Australian coast from about 100 km north of Brisbane to Adelaide (Franklin *et al.* 1989); however, it is no longer found in South Australia (Franklin and Menkhorst 1988) or western Victoria (Franklin *et al.* 1987) and records from Queensland are uncommon. Sightings now centre on a few sites in north-eastern Victoria, along the western slopes of the Great Dividing Range to Tenterfield, the Warrumbungle Ranges and Parkes in the west, and the central coast of NSW. The total population is estimated at close to 1500 individuals (Webster and Menkhorst 1992).

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, examples include the loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient and sediment loads into aquatic habitats, and the presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes via additional vegetation clearing and altering of hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The

inclusion of these measures suggests minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Grey-headed Flying-fox

How is the project likely to affect the lifecycle of a threatened species and/or population?

The Grey-headed flying-fox is a habitat specialist that occurs widely throughout the Clarence Valley and surrounding areas. There were no camps or roost sites identified in the study area and the nearest known camp is at Susan Island in the Clarence River. The Grey-headed flying-fox inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. Camps are often located in gullies, typically close to water, in vegetation with a dense canopy.

The Grey-headed flying-fox feeds on nectar and pollen of native trees, in particular species form the plant genera *Eucalyptus, Melaleuca, Banksia* and *Ficus* and fruits of rainforest trees and vines. There are extensive areas of potential foraging habitat for the species throughout the region and the clearing of about 85 ha of potential foraging habitat for this species represents a relatively minor impact for this species in the locality. In relation to the available habitat in adjacent land surrounding areas, the project is not considered likely to affect this species at the local level. The proposed action would not result in the decrease in size of the population in the local area and would not impact on a known roost site.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

As stated, the clearing of about 85 ha of potential foraging habitat for this species represents a relatively minor impact for this wide-ranging and nomadic species in the regional area. In relation to the available habitat in adjacent land surrounding the highway, the project is not considered likely to affect this species at the regional level. The proposed action would not result in the decrease in size of the population in the local area and would not impact on a known roost site.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The grey-headed flying-fox has a large distribution in a range of 200 km from the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. The species is not at the limit of its distribution in the study area.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and

conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Yellow-bellied Glider

How is the project likely to affect the lifecycle of a threatened species and/or population?

Recorded from four locations during field surveys within the study area, all associated with or in proximity to riparian areas. Also reported from several locations throughout Glenugie SF (DPI 2008). It is evident that Glenugie State Forest supports a viable population.

The association with riparian habitat may be a factor of the higher density of tree hollows in these locations and indeed potential den trees were noted along Glenugie Creek. Evidence of sap feeding (feeding scars) was observed in Grey Box (*Eucalyptus moluccana*) and Orange Gum (*E. bancroftii*). The presence of these species in addition to Bloodwood (*Corymbia intermedia*) and Small-fruited Grey Gum (*E. propinqua*) (MU 3, 4 and 6) would constitute preferred habitat particularly where this occurs in proximity to Glenugie Creek and other distinctive riparian habitats.

Yellow-bellied Gliders were reported on both the eastern and western side of the existing Pacific Highway from this study and large areas of suitable habitat occur to the west of Glenugie Creek. The project is likely to remove a number of den trees and sap feed trees, particularly in riparian areas. Potential den sites also occur outside the road footprint particularly along riparian areas and the loss would be a percentage of the tree hollows available. The identified preferred feed tree species in the study area are also common and widespread, particularly Grey box, which occur throughout Glenugie State Forest.

The lifecycle activities of the local population rely on the presence of den trees (mostly located in riparian areas), the presence of feed trees and habitat connectivity to access these and for social interaction. The road would increase the degree of fragmentation between grouped occurring east and west of the footprint. It is likely that populations would remain stable in these locations given the extent of suitable habitat however it would be desirable to mitigate the effect of fragmentation from the project on this species through the addition of canopy crossing at appropriate locations. This measure has been included in the fauna mitigation strategy for the project.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project is likely to remove a portion of the home range territory of at 1-2 family groups of gliders including probable den trees. There is no specific data on the home range of this group or known den trees, so the extent of this impact is not known, although data on the species suggest home ranges can extend as large as 60 ha (Goldingay and Kavanagh 1991). The groups identified in the road corridor would be part of a larger population which extends into the surrounding state forest and possibly private lands and national park to the east and south. Individuals have also been recorded in Newfoundland State Forest in contiguous habitats to the east. Additionally the subject area is part of a larger east west corridor suggesting other populations are likely to occur to the west of the study area.

The long-term persistence of yellow-bellied gliders requires a landscape mosaic of old growth trees which meets both their foraging and sheltering needs. Such habitat is present throughout portions of Glenugie State Forest particularly in riparian areas. Clearing of riparian forest would be minimised during construction and hollow trees marked prior to clearing to protect these features wherever possible.

Yellow-bellied gliders need to occupy large home ranges as there food resources are seasonal and often widely dispersed. Therefore most of the habitats in the study area are likely to provide foraging habitat for yellow-bellied gliders. Therefore the project would remove up to 85 ha of potential habitat for this species in the region.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The yellow-bellied glider is found along the eastern seaboard to the western slopes of the Great Divide, from southern Queensland to Victoria (NPWS 2002) and is not at the limit of its distribution in the study area.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have

been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Koala

How is the project likely to affect the lifecycle of a threatened species and/or population?

Not recorded in the study area, presence inferred from a review of regional records and habitat assessment. No evidence of koalas was recorded in the study area despite extensive searches throughout suitable habitat. The presence of Forest Red Gum (*Eucalyptus tereticornis*) and Small-fruited Grey Gum (*E. propinqua*) in very low densities suggests that the habitat is suitable to support small populations of koalas or dispersing and transient individuals, however the study area is considered unsuitable to support a significant population long-term.

Important life-cycle activities for koalas include foraging, shelter and refuge, movements and breeding. The koala feeds predominantly on the foliage of certain species of eucalypts. Likely food trees in the study area include primary browse trees such as Forest Red Gum and Small-fruited Grey Gum. Occasional browse trees such as Red Mahogany (*E. resinifera*) also occur.

Breeding is seasonal with mating taking place during October to February and most births occurring between November and late March. Females become sexually mature at two to three years and males at around three to four years. The species appears to be polygamous with the ranges of dominant males overlapping the range of several females (Lee & Martin 1988; Mitchell 1990).

The project would remove a small amount of potential habitat for the species through the clearing of vegetation communities containing identified food tree species. The impact of this activity on the local population is likely to be minimal as suitable food resources are common and widespread in the region particularly to the north and east of the route and there is little evidence to suggest that koala populations or movements are centred on the proposed route.

The potential for east-west movements across the highway have been considered in the design and location of fauna underpass structures combined with fauna exclusion fencing to facilitate movements and minimise vehicle strike mortalities.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

In coastal northern NSW, populations have been estimated to range from one animal every 45ha to one every 4.5 ha (average one every 20-25 ha) (Austeco 1994). Most young disperse at two to three years of age and females remain in their natal area (Martin 1983). There are no data available on the size of local populations or the extent of potential habitat. The project would remove potential habitat for the species through the clearing of vegetation communities containing the identified food tree species. The impact of this activity on the local population is likely to be minimal as suitable food resources are common and widespread in the region particularly to the north and east of the route and there is little evidence to suggest that koala populations or movements are centred on the proposed route.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The koala occurs throughout eastern Australia through Queensland, NSW and Victoria and the study area is not the limit of distribution for this species.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Spotted-tailed Quoll

How is the project likely to affect the lifecycle of a threatened species and/or population?

Preferred habitat includes dry and moist sclerophyll forests where they den in rock caves, hollow logs or trees and will feed in nearby cleared areas (State Forests of NSW 1995a). Suitable habitat is well represented in the larger fragments of forest in the study area, particularly state forests, adjoining private properties and conservation reserves. The species was not recorded during this study however is expected to occur. The species is an opportunistic predator and will feed on a variety of prey including macropods, birds, reptiles, arboreal mammals and small terrestrial mammals (Mansergh 1983). The project would remove potential habitat for the species and its prey, leading to further fragmentation of habitat, a known threat to the species. Measures to conserve connectivity and movement avenues for terrestrial fauna have been incorporated into the project. Breeding, foraging and movement life-cycle opportunities would remain in the region and likely to sustain local populations.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

Preferred habitat includes dry and moist sclerophyll forests where they den in rock caves, hollow logs or trees and will feed in nearby cleared areas (State Forests of NSW 1995a). Suitable habitat is well represented in the larger fragments of forest in the study area, particularly state forests, adjoining private properties and conservation reserves. The project would remove potential habitat for the species and its prey, leading to further fragmentation of

habitat, a known threat to the species. The project would result in the removal of up to 85 ha for this species. The overall reduction of habitat is a small proportion of the available potential habitat.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The spotted-tailed quoll occurs throughout eastern Australia through Queensland, NSW, Victoria and Tasmania and the study area is not the limit of distribution for this species.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on

connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Brush-tailed Phascogale

How is the project likely to affect the lifecycle of a threatened species and/or population?

This was recorded from one location during the field survey, in Spotted Gum / Ironbark open forest heavily disturbed from logging and thinning although comprising abundant large logs, representing preferred habitat of this species. It is reported in a wide range of habitats including the open forest and woodland types which are well represented in the study area and indeed the wider Clarence Valley and adjoining escarpments along the Pillar Valley and Shark Creek ranges and Yuraygir NP.

The brush-tailed phascogale is largely arboreal, occupying a variety of habitats, particularly open dry sclerophyll forest with little groundcover (Cuttle 1982). The home range of the species is exclusive and densities are correspondingly low. Female brush-tailed phascogales occupy a home range of 37 ha, and males occupy 86 ha with their home ranges overlapping the female home range (Traill and Coates 1993; Soderquist and Ealey 1994). Evidence of local populations in the study area has not been identified, however suitable habitat is widespread and common and populations are considered to persist following development of the project.

The diet of this species consists mainly of arthropods, such as spiders and centipedes, as well as small invertebrates including cockroaches, beetles and bull ants (Cuttle 1982). Phascogales will also forage on the ground and eucalypt nectar is extensively utilised when trees are flowering (Traill and Coates 1993). The diet is not particularly specialised to a degree that clearing for the project would significantly affect foraging requirements.

The brush-tailed phascogale has a three week mating season which occurs mid May to early July. Following mating, the pair nests in tree hollows with narrow entrances. After forming the nest, the male will soon die through what is believed to be stress related illness induced by excessive copulative behaviour (Traill and Coates 1993). The project would remove hollow-bearing trees suitable as nesting sites for the species and lead to further fragmentation and reduction of mature forest from the region. Suitable habitat is widespread and common providing continued habitat for local populations.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The brush-tailed phascogale is largely arboreal, occupying a variety of habitats, particularly open dry sclerophyll forest with little groundcover (Cuttle 1982). Such habitats are particularly well represented in the region, particularly on ridges and low hills where clearing has been less severe than river flats. The project would result in the removal of up to 85 ha for this species. The overall reduction of habitat is a small proportion of the available potential habitat. Populations are considered to persist following development of the project.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The brush-tailed phascogale occurs throughout eastern Australia to the western slopes of the Great Divide from southern Queensland, NSW and Victoria (NPWS 2002) and the study area is not the limit of distribution for this species.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively

impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Glossy Black-Cockatoo

How is the project likely to affect the lifecycle of a threatened species and/or population?

The species was not recorded in the study area, although its presence is inferred from a review of regional records and habitat assessment. Numerous records noted in the eastern parts of Glenugie SF and throughout Yuraygir NP, although very few records in the actual study area. The species occurrence is widespread in the region and associated with open forest habitats where food resources (*Allocasuarina* spp) are present. Black She-oak (*Allocasuarina littorlais*) is a moderately common component of the Spotted Gum / Ironbark / Grey box open forests which make up the majority of the study area and potential habitat for this species is widespread in the locality. Despite this a search of over 30+ large Forest Oaks along the alignment did not detect any evidence of foraging use by this species. The size of the local population and importance of the study area is not known, although considered low based on this evidence. Large tree hollows (potential nest sites) are present in low abundance along the alignment.

The glossy black-cockatoo inhabits mountain forests, coastal woodlands, open forest, riparian vegetation and partially cleared areas from sea level to 1000 metres. This species distribution is linked to its reliance on their primary food source, the seeds of *Allocasuarina torulosa, A. verticillata* and *A. littoralis*.

Groups of this species (two to twenty individuals) are known to occupy an area permanently, though individuals and sub groups may move around in this area (Blakers *et al* 1984). It is generally unknown what size this area must be, but it is closely linked to the density of *Allocasuarina* species.

A hollow limb or hole, often is a tall dead tree in a forest clearing, is typically used for roosting (Forshaw and Cooper 1978). This species requires large cavities for nesting and breeding which occurs from March to August (Mount King Ecological Surveys 1993) however, the main breeding season is from April to June (Simpson and Day 1997).

The abundance of food resources and distributional range of the local population together with the high mobility of the species suggests there are several localised family groups in the region and that these are adapted to moving across modified landscapes to access food resources. The project is unlikely to significantly impact on this situation, despite the loss of food resources. There is potential to remove large hollow-bearing trees which may currently or potentially provide nest sites. These are an uncommon feature in the landscape as a result of the historical land uses. Where feasible these have been identified near the route and refinement of the design carried out to minimise their removal. Further surveys of habitat trees to identify potential nest sites are to be documented in the CEMP (and FFMP) which would be particularly important if construction commences between April and June.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

This species distribution in the study area is linked to the distribution of their primary food source, the seeds of *Allocasuarina littoralis* which is a common component of the extensive dry open forest communities. The project would clear up to 79.8 ha of open forest and woodland a small portion of which would provide potential habitat for this species. Nesting resources comprising larger tree hollows are scarce in this habitat type.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The species occurs throughout coastal eastern Australia through Queensland to the Victoria border.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed

management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Large Forest Owls (Powerful Owl and Masked Owl)

How is the project likely to affect the lifecycle of a threatened species and/or population?

Neither species was recorded in the study area, presence inferred from a review of regional records and habitat assessment.

Both species are widespread throughout the region recorded in a range of habitats including the open forest and riparian habitats typical of the study area.

Prey species for the Powerful Owl (typically arboreal mammals) are present although limited to Sugar Gliders (*Petaurus breviceps*), Brushtail Possum (*Trichosurus vulpecula*) and Yellow-bellied Glider (*P.australis*). Common ringtail possums (*Psedocheirus peregrinus*) are very scarce and their low density may negatively affect the availability of habitat for Powerful Owls. Prey species for the Masked Owl include small ground-dwelling fauna and smaller arboreal mammals.

Similarly large tree hollows required for nesting are uncommon and the habitat within the study area is unlikely to support a high density of Powerful Owls or Masked Owls or constitute regionally important habitat.

Whilst both species are known to occasionally roost by day in dense thickets of vegetation or foliage their nesting requirements are more specialised being totally dependent on suitably large tree-hollows generally found in the trunks of tall and mature trees. Their dependence on this specific habitat feature restricts the local distribution of the species at least for breeding life-cycle requirements and highlights their vulnerability to increased clearing and fragmentation. Generally foraging territory is more widespread and may occur throughout a variety of habitat types depending on the species, with the powerful owl ranging from swamp forest to wet and dry sclerophyll, preferably in wet gullies for roosting and the masked owl favouring the more open forest and woodland types for foraging, particularly on the edge of open lands such as agricultural lands.

Targeted searches were carried out at all times during the field surveys for the presence of suitable tree-hollows (potential nest sites) for these birds. These are considered very scarce along the route corridor and nesting opportunities are considered very limited. As the incidence of potential roost / nest hollows in the study area is minimal it is considered unlikely that the project would constitute a significant impact on local populations of these species. The removal of 85 ha of forest habitat would impact on the habitat of prey species for these owls and increase fragmentation which may have an impact on juvenile dispersal.

Further surveys of habitat trees to identify potential nest sites are to be documented in the CEMP (and FFMP) which would be particularly important if construction commences between May and July.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

As the incidence of potential roost / nest hollows in the study area is very minimal it is considered unlikely that the project would constitute a significant impact on local populations of these species. The removal of 85 ha of forest habitat would impact on the habitat of prey species for these owls and increase fragmentation which may have an impact on juvenile dispersal and establishment of new pairs.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

Both species occur throughout eastern Australia through Queensland, NSW and Victoria and the study area is not the limit of distribution for these species.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have

been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Square-tailed Kite

How is the project likely to affect the lifecycle of a threatened species and/or population?

Not recorded in the study area, presence inferred from a review of regional records and habitat assessment. The species is recorded in a wide range of habitats including the open forest types which dominate the study area and surrounding landscape. No nest sites were reported from a general traverse of the entire alignment.

The square-tailed kite prefers coastal and sub-coastal open forest and woodlands on fertile soils with abundant prey species being present (Debus *et al*. 1993; Marchant and Higgins 1993). A common feature of the kite's habitat is the presence of profuse eucalypt blossom and attendant nectivorous birds (Debus *et al*. 1993) on which the square-tailed kite preys. On the coast, the kite appears to prefer the drier forest types on the foothills and coastal plains. Records of the species appear to be associated with the extensive dry sclerophyll forest habitats on low hills.

No nest sites were located along the proposed alignment during the surveys nor have been reported in the vicinity of the route in the local State Forests. Further surveys are recommended immediately prior to construction. The project would not impact on breeding activities of local populations of the square-tailed kite. Potential habitat for foraging and roosting is very common and widespread for this species in the region and the impacts on this life-cycle activity is expected to be minimal.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The square-tailed kite prefers coastal and sub-coastal open forest and woodlands on fertile soils with abundant prey species (Debus *et al*. 1993; Marchant and Higgins 1993). Dry sclerophyll forest habitats are very common and widespread throughout the region particularly east of the study area in Glenugie ad Newfoundland State Forest. The project would remove up to 85 ha of open forest considered suitable for this species. This total is a small percentage of the habitat available in the region.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

It occurs throughout eastern and northern Australia. The study area is not the limit of distribution for this species.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have

been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Tree-roosting microchiropteran Bats

Eastern False Pipistrelle (*Falsistrellus tasmaniensis)*
Eastern Freetail-Bat (*Mormopterus norfolkensis)*
Eastern Long-Eared Bat (*Nyctophilus bifax)*
Greater Broad-Nosed Bat (*Scoteanax rueppellii)*
Yellow-bellied Sheathtail-Bat (*Saccolaimus flaviventris)*
Beccari's Freetail-Bat (*Mormopterus beccarii)*
Hoary Wattled Bat (*Chalinolobus nigrogriseus)*

How is the project likely to affect the lifecycle of a threatened species and/or population?

Vegetation in the study area provides potential foraging and roosting habitat for the assessed species. These bat species frequent a variety of habitat types ranging from rainforest to wet and dry sclerophyll forest, woodland and open modified landscapes.

Important life-cycle activities include roosting and breeding and both are typically associated with tree hollows as well as foraging for insect prey which occurs in a variety of habitat types. The size of local populations is not known, although expected to be moderately large given the expanses of suitable habitat and tree hollow densities, particularly small hollows which are preferred by bats. The project would remove about 85 ha of forest habitat which is potentially used by these species, this will include the removal of tree hollows. Comparable habitats are very well represented throughout the locality and regional area and it is unlikely that the project would have a significant impact on the foraging or roosting life-cycle events for local populations of these bat species and continued presence in the locality could be expected.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

Vegetation in the study area provides potential foraging and roosting habitat for the assessed species. The project would remove about 85 ha of forest habitat which is potentially used by these species, this would include the removal of tree hollows and potentially affect populations of insect prey. Comparable habitats are very well represented throughout the locality and regional area and it is unlikely that the loss of habitat would have a significant impact.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

None of these tree roosting threatened bat species are at the limit of their distribution in the study area. Dry and moist sclerophyll forest habitats are very common and widespread throughout the region particularly further west of the study area.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have

been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Cave-roosting microchiropteran Bats

Eastern Bent-Wing Bat (*Miniopterus schreibersii oceanenis)*
Eastern Cave Bat (*Vespadelus troughtoni)*
Little Bentwing-Bat (*Miniopterus australis)*
Large-footed Myotis (*Myotis adversus)*
Large-eared Pied Bat (Chalinolobus dwyeri)

How is the project likely to affect the lifecycle of a threatened species and/or population?

The study area provides known and potential foraging habitat for the assessed species. The Little Bentwing-bat in particular was recorded from trapping and call recording surveys at a number of locations widely dispersed along the proposed road alignment. These species are predominantly cave-roosting bats, although a small colony of Little Bentwing-bats has been observed roosting in a hollowed tree trunk (Schulz 1997) and Large-footed Myotis have been recorded roosting under old timber bridges. No timber bridges would need to be removed to accommodate the project. Similarly no caves or abandoned mine shafts have been recorded in the proposed route corridor and the project is not expected to impact on the roosting life-cycle activities of these species. The location of any roost sites for these species in the regional area is not known.

The project would remove about 85 ha of forest habitat and which provides known and potential foraging habitat. Comparable habitats are very well represented throughout the locality and regional area and it is unlikely that the project would have a significant impact on the foraging life-cycle events for a local population of these bat species and continued foraging over the site and adjacent lands could be expected. Large-footed Myotis hunt over water bodies for small fish and invertebrates and may frequent the creek habitats in the study area. Impacts on foraging habitat would result from the project however the overall magnitude of impact is small.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

Impacts on known or potential roosting habitat are not expected. The project would remove about 85 ha of forest habitat and which provides potential foraging habitat for the Bentwing-bats. Comparable habitats are very well represented throughout the locality and regional area

and it is unlikely that the project would have a significant impact on the foraging life-cycle events for a local population of these bat species and continued foraging over the site and adjacent lands could be expected. Large-footed Myotis hunt over water bodies for small fish and invertebrates and may frequent the creek habitats. Impacts on foraging habitat would result from the project however the overall magnitude of impact is small.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

None of these cave-roosting threatened bat species are at the limit of their distribution in the study area.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the

landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Rufous Bettong

How is the project likely to affect the lifecycle of a threatened species and/or population?

It was recorded from two locations during the field survey associated with riparian vegetation in the northern half of the study area near Nine Mile Creek and Pheasant Creek. The abundance of records reported throughout the northern half of Glenugie SF (DPI 2008) and other reports north of Eight Mile Lane into the Coldstream wetlands in addition to WIRES roadkill data for Eight Mile Lane suggest that the local population is largely centred in the far northern and eastern parts of the study area extending north into private properties along Eight Mile Lane through to Wooli Road. In proximity to the proposed road corridor Rufous Bettong records are mostly associated with Nine Mile Creek and also occur to the west of the existing Pacific Highway in this location. However, forestry ecologists from DPI have recorded this species widely in Glenugie state forest and from a wide variety of habitats (Brian Tolhurst; pers comm.).

The species is found in sparsely grassed, lightly timbered open forest and woodland, and favours open grassy understoreys and a high diversity of groundcover flora associated with its dietary needs. The association with riparian sites in the study area may be related to the groundcover flora diversity and density of logs or Blady Grass (*Imperata cylindrica*) for shelter and nesting.

The project would remove 74.7ha of open forest vegetation, 5.1 ha of woodland and 5.3ha of riparian vegetation. The loss would likely impact on the home range territory of a small number of animals, remove a percentage of the shelter and foraging resources for these animals and potentially disrupt a breeding season. The number of animals affected in relation to the size of local population is not known. Given the widespread occurrence of DPI and DECC Atlas of NSW Wildlife records for this species in the locality it could be reasonably expected the proportion the population impacted would be minor and not lead to a significant impact on the population as a whole.

Measures to mitigate the effects of fragmentation have been considered in the design and placement of fauna underpass structures aimed at facilitating crossing of the highway to access

available habitat and allow genetic exchange. Suitable habitat is widespread and common providing continued habitat for local populations.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The species is recorded in sparsely grassed, lightly timbered open forest and woodland and particularly favours open grassy understorey and a high diversity of groundcover flora associated with its dietary needs. The association with riparian areas in the study area may be related to the groundcover flora diversity and density of logs or Blady Grass (*Imperata cylindrica*) for shelter and nesting.

The project would remove 74.7ha of open forest vegetation, 5.1ha of woodland and 5.3ha of riparian vegetation, this would include the loss of foraging resources and habitat connectivity along Glenugie Creek and Nine Mile Creek. The overall reduction of habitat is a small proportion of the available potential habitat. Populations are considered to persist following construction of the project. Measures to mitigate the barrier effect of the road have been considered in the design and placement of underpass structures to maintain connectivity.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The Rufous Bettong is known from coastal and subcoastal NSW and QLD, from north of Newcastle to Cooktown. Its distribution extends south of Grafton into the lower north coast.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not

suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Bush Stone-Curlew

How is the project likely to affect the lifecycle of a threatened species and/or population?

Bush Stone-Curlews require sparsely grasses, lightly timbered, open forest or woodland. They persist where there is often a well-structured litter layer and fallen timber debris (Blakers *et al.* 1984). Not recorded from the field assessment on the study area however presence inferred from a review of regional records and habitat assessment. There is a least one historic record from the northern end of Glenugie SF. Potential habitat in the study area would be associated with Spotted Gum / Ironbark / Grey Box open forest which occupy the large majority of the landscape through Glenugie SF and surrounding areas. The project would remove 74.7 ha of open forest and 5.1 ha of woodland vegetation. The exact proportion of this which is preferred habitat for this species (i.e. open grassy understorey) has not been quantified although is expected to be in the order of up to 30 ha. There is no data to confirm the current presence or status of the species in Glenugie State Forest, nor the number of pairs. The loss of vegetation has potential, however, to remove shelter and foraging resources for the species.

The number of animals affected in relation to the size of local and regional populations is not known, however records are widespread and it could be reasonably expected that the proportion

of the population impacted would be minor and would not have a significant impact on the population as a whole. Potential habitat will remain in Glenugie State Forest outside of the project area and purpose built fauna crossing structures have been included in the project to minimise the barrier effect of the project for this species.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove 74.7 ha of open forest and 5.1 ha of woodland vegetation. The exact proportion of this which is preferred habitat for this species (i.e. open grassy understorey) has not been quantified although is expected to be in the order of up to 30 ha. There is no data to confirm the current presence or status of the species in Glenugie State Forest, nor the number of pairs. As a precautionary measure the loss of vegetation has potential to remove shelter and foraging resources for the species. The habitats suited to this species are well represented in the region, particularly to the east and south of the study area. The overall reduction of habitat is considered a small proportion of the available potential habitat. Populations are considered to persist following development of the project and purpose built fauna crossing structures have been included in the project to minimise the barrier effect of the project for this species.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution for the Bush Stone-Curlew.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have

resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Woodland Birds

Black-chinned Honeyeater (*Melithreptus gularis gularis)*
Brown Treecreeper (*Climacteris picumnus)*
Diamond Firetail (*Stagonopleura guttata)*
Grey-crowned Babbler (*Pomatostomus temporalis temporalis)*
Hooded Robin (*Melanodryas cucullata)*
Speckled Warbler (*Pyrrholaemus sagittatus)*

How is the project likely to affect the lifecycle of a threatened species and/or population?

The Black-chinned Honeyeater was recorded as uncommon and restricted in the study area from the field survey, and particularly associated with the Grey Box / Spotted Gum habitat types in the northern part of Glenugie SF and adjoining private properties along Eight Mile Lane where low densities were reported. No records directly along the route. Suitable habitat appears widespread although may be of reduced quality due to the widespread removal of mature tree cover and particularly ironbarks from logging). It prefers rough barked trees and decorticating bark, typically of Grey Box (*Eucalyptus moluccana*) trees. Optimum habitat is associated with the Grey Box dominated forest in the central northern part of the study area.

The Brown Treecreeper was recorded as common in restricted locations of the study area, particularly associated with the Grey Box dominated open forest in the central northern half of

the alignment and Ironbark dominated open forest in the southern portion of the study area, particularly east of the alignment along Franklins Road. Much of the habitat of this species and indeed reported locations appears to be east of the alignment and would be associated with a higher abundance of tree hollows (required for nesting) and rough-barked Eucalyptus preferred for foraging.

The remaining woodland birds were not recorded although may potentially occur and have been reported previously in Glenugie State Forest.

The project would remove 74.7 ha of open forest and 5.1 ha of woodland vegetation potentially suited to these species. The loss would likely impact on the home range territory of several pairs, remove a percentage of the shelter and foraging resources for these birds and potentially disrupt a breeding season. The number of animals affected in relation to the size of local population is not known, however records are widespread and it could be reasonably expected the proportion of the population impacted would be minor and not lead to a significant impact on the population as a whole.

How is the project likely to affect the habitat of a threatened species, population or ecological community?

The project would remove 74.7 ha of open forest and 5.1 ha of woodland potentially used by these species. This would result in the loss of foraging and breeding habitat and may have a short term impact on food resources. However the habitats suited to these species are particularly well represented in the region, particularly to the east and south of the study area. The overall reduction of habitat is considered a small proportion of the available potential habitat. Populations are considered to persist following development of the project.

Does the project affect any threatened species or populations that are at the limit of its known distribution?

The study area is not at the limit of distribution for any of these woodland bird species. Species such as the Speckled Warbler and Black-chinned Honeyeater approach the coast in northern NSW and southern Queensland, elsewhere there distribution is inland.

How is the project likely to affect current disturbance regimes?

A range of disturbance regimes currently exist and reflect the historical and current land-uses of the study area, such as loss of mature forest and tree hollows, weed invasion, inappropriate fire regimes, draining of swamps, increased nutrient loads in aquatic habitats, and presence of introduced predators. The introduction of a new road has the potential to further affect some of these disturbance regimes through vegetation clearing and altering hydrological regimes. The route selection process was designed to minimise the severity of disturbance regimes by appropriate placement of the corridor. Further measures to reduce the residual impacts include construction and operational management practices, drainage design and sediment control, weed

management and rehabilitation. The inclusions of these measures suggest minimal additional affect of the disturbance regimes beyond the current situation.

How is the project likely to affect habitat connectivity?

The landscape surrounding the study area supports several very large areas of habitat associated with the production forests of Glenugie State Forest, Newfoundland State Forest and conservation reserves such as Yuraygir National Park in addition to natural vegetation on private rural properties. This is a reflection of the low fertile soil types and terrain which is not suited to agriculture in contrast to the fertile soils on the Clarence River floodplain which have resulted in extensive clearing and fragmentation of vegetation. The habitat to the west of the project area becomes increasingly more fragmented in lower elevated lands and private property while Glenugie State Forest continues extensively to the east of the project area.

Impacts associated with the barrier effect of new roads are well documented. This factor has potential to impact on typical fauna movements in the vicinity of the road, in turn negatively impacting on important life-cycle events such as foraging, breeding and dispersal. The new road would contribute to the cumulative reduction in habitat connectivity similar to the existing Pacific Highway in this location and would have the greatest potential impact on ground-dwelling terrestrial fauna and species with large home-ranges such as the spotted-tailed quoll. More mobile species such as bats and birds have better opportunities to move across the landscape and access habitat fragmented by roads. Measures to reduce the impact on connectivity have been considered in the development of a biodiversity mitigation strategy and include the provision of dedicated fauna underpass structures and over pass structures (canopy ropes) as well as fauna exclusion fencing and revegetation of road verges. These features have been strategically located at important habitat areas and linkages in the landscape that reflect the habitat assessment data and predicted distribution of threatened fauna.

How is the project likely to affect critical habitat?

None of the habitats present in the study area are registered on the current list of recommended or declared critical habitat in NSW.

Appendix C Assessment of significance (EPBC Act)

C.1 Endangered species

Swift Parrot and Regent Honeyeater

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

Both species are occasional visitors to the region during peak flowering events of the dominant trees, particularly the winter flowering Large-leaved Spotted Gum (*Corymbia henryi*). There are no breeding records in the study area and the extent of habitat remaining in the study area would provide sufficient resources to sustain future visitation. The project would not reduce populations of either species.

Reduce the area of occupancy of the species;

Both species are occasional visitors to the region and there are no known permanent populations.

Fragment an existing population into two or more populations;

Both species are occasional visitors to the region and there are no known permanent populations within the study area.

Adversely affect habitat critical to the survival of a species;

Any use of the site habitats by these migratory and nomadic birds is likely to be sporadic and during peak flowering events of the dominant mature trees. The habitat within the study area is not recognised as a critical breeding or foraging area for these two species.

Disrupt the breeding cycle of a population;

There are no breeding records of Swift Parrot and Regent Honeyeater in the study area.

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

There are no permanent populations in the region and the study area is not known to contain important foraging or breeding habitat for these two species. The proposed removal of habitat for this project would not adversely affect the recovery or directly lead to further decline of these species.

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

There is potential for further small scale invasion of weeds and feral animals during the clearing and construction of the project. This risk would be managed during construction and it is

considered unlikely that any extensive degradation would result or that any invasive species would become established.

Introduce disease that may cause the species to decline; or

It is considered unlikely that the project would introduce any diseases.

Interfere with the recovery of the species.

Provided management measures are implemented to protect potential habitat as described in this assessment, it unlikely that the project would interfere with the recovery of these species.

Spotted-tailed Quoll

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

Suitable habitat for this species is well represented throughout the larger fragments of forest in the study area, particularly the state forests and adjoining private properties and Yuraygir National Park including the edges of open farmland. The species was not recorded during this study however is expected to occur and there are records within Glenugie State Forest. The species is an opportunistic predator and would feed on a variety of prey including macropods, birds, reptiles, arboreal mammals and small terrestrial mammals (Mansergh 1983). The project would remove potential habitat for the species and its prey, leading to further fragmentation of habitat, a known threat to the species. Measures to conserve fauna corridors and movement avenues for terrestrial fauna have been incorporated into the mitigation strategy for the project. There is no evidence to indicate that there is an important population in the study area.

Reduce the area of occupancy of an important population

The species typically has a large home range and occupies a diversity of habitat types. It is therefore difficult to identify the area of occupancy. Theoretically, Quolls could occur in any of the larger forest fragments of the study area. Preferred habitat includes dry and moist sclerophyll forests and may include adjacent modified patches of forest on farmland. Suitable habitat is well represented in the larger fragments of forest in the study area, particularly state forests and adjoining private properties and national park estate. The project would remove potential habitat for the species however the overall reduction of habitat is a small proportion of the available potential habitat.

Fragment an existing important population into two or more populations

The project would increase the fragmentation of habitat in the landscape by impacting on contiguous forest area associated with Glenugie State Forest and private forested land to the west of the study area. These areas provide potential habitat for spotted-tailed quoll largely because of their size and continuity. It is important to note however that all areas of habitat affected by the project have already been fragmented in the past by roads, and clearing for

forestry operations. The project would be contributing to this cumulative fragmentation of habitat in the landscape.

Measures to conserve fauna corridors and movement avenues for terrestrial fauna have been incorporated into the mitigation strategy for the project including placing fauna underpass structures in strategic locations.

Adversely affect habitat critical to the survival of the species

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

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

Some of the larger habitats represented in the study area are suitable for populations of spotted-tailed quoll however, they do not constitute habitat that is critical for the long-term maintenance of the species.

Disrupt the breeding cycle of an important population

Given the typically large home ranges of this species, potentially only a small number of individuals may be present in the lands surrounding the study area. While there are no cave sites present there may be suitably large hollow logs providing potential den sites for breeding. There is potential therefore to impact on the breeding cycle of a small proportion of the population.

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

Suitable habitat is well represented in the larger fragments of forest in the study area, particularly the state forests and adjoining private properties including the edges of open farmland. Given the large home ranges of this species, potentially only a small number of individuals may be present in the lands surrounding the study area.

The project would remove potential habitat for this small number of individuals, leading to further fragmentation of habitat. The impacts are not likely to cause the species to decline in the region. Measures to conserve fauna corridors and movement avenues for terrestrial fauna have been incorporated into the project.

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

The potential for weed invasion is considered possible with a project of this nature and appropriate controls are required during the construction and operation of the road to reduce this threat as it may have long term implication for the habitat of threatened species. The management of invasive species would be managed under the guidance of the CEMP and OEMP.

Introduce disease that may cause the species to decline

There are no known diseases issues affecting this species. The project is unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Interferes substantially with the recovery of the species

The project and proposed highway construction would not conflict with the recovery of this species. The route has been selected on the basis of avoiding high quality habitats for threatened fauna.

C.2 Vulnerable species

Eucalyptus tetrapleura

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

The major populations for *Eucalyptus tetrapleura* were recorded in the Glenugie area including the population in the project footprint. Large populations are predicted to be present to the east of Glenugie State Forest on private property adjoining Yuraygir State Conservation Area and Glenugie Peak Flora Reserve.

The population in the project footprint is estimated to occur over a 613 ha area supporting about 103,300 individual *Eucalyptus tetrapleura* from all age classes. Additionally there are nearby populations to the south and east not directly linked to the population in the project footprint on private land, in Glenugie State Forest, New Foundland State Forest, Wells Crossing Flora Reserve and Yuraygir State Recreation Area. The total individuals estimated to occur in these populations within about six kilomtetres of the project footprint is 147,000 over area of 1010 ha.

The 147,000 individuals within six kilomatres of the project footprint could be considered to be within a single population considering the high mobility of some pollinator species such as insects, birds and bats, and wind dispersal of pollen. The total population of *Eucalyptus tetrapleura* is known to occur between Glenreagh in the south to Casino in the north within a range of about 100 km north-south and 50 km east-west. The total population is estimated to be between 170,000 and 250,000 individuals based on recorded locations to date and regional records (DECC 2009) comprising 50 or more different sub-groups.

There are estimated to be about 6156 individuals within the project footprint which would potentially be removed comprising about 36 ha of habitat. This potential removal is estimated to constitute about 4.2 per cent of the local population and between 3.6 per cent and 2.5 per cent of the total known population. This would have impacts to the local distribution of the species, removing part of the local gene pool and 36 ha of known habitat for the species. Although about 95 per cent of the local population is estimated to remain following the proposed impact in the surrounding areas in conservations reserves, state forests and private lands, the project would result in the long-term decrease in the size of the local population.

The project is unlikely to significantly impact the local gene pool or lead to inbreeding depressions due to fragmentation. Habitat for pollinator species would be removed, however sufficient habitat for large populations of potential pollinator species would remain in surrounding areas. Considering the above the life cycle of *Eucalyptus tetrapleura* in the local area is unlikely to be significantly affected.

To mitigate the ecological impacts from the project an offset strategy is proposed to provide greater protection of *Eucalyptus tetrapleura* and habitat for other threatened flora and fauna, through placing an area of private land or state forest under conservation. Several options for the offset strategy are proposed, several of which include extending current conservation reserves in the area including Wells Crossing Flora Reserve, Yuraygir State Recreation Area and Glenugie Peak Flora Reserve.

Reduce the area of occupancy of an important population

The area of occupancy for *Eucalyptus tetrapleura* is not well defined and is not restricted to one particular vegetation association, landform, soil type or geology. Its occurrence was observed to be more associated with a number of physical features influencing soil moisture and groundwater levels, including soil texture, soil depth, slope, bedrock geology, subsoil permeability. The area of occupancy for the local population is estimated to be about 1010 ha based on field survey assessments and predicted distributions on private lands.

The project would result in the removal of up to 36 ha of known habitat for *Eucalyptus tetrapleura.* Therefore the known area of occupancy for *Eucalyptus tetrapleura* in the local area would be reduced by about 3.6 per cent.

Fragment an existing important population into two or more populations

The population is currently fragmented by the existing highway and the project would widen the existing disturbance width, further fragmenting habitats on the western side of the existing highway from populations to the east. However, considering the high mobility of some pollinator species such as insects, birds and bats, and wind dispersal of pollen, gene flow is expected to continue across the existing highway and the width of the project. There is estimated to be about 7,100 individuals on the western side of the existing highway, which is

likely to have a large enough gene pool in to continue to successfully reproduce in isolation without inbreeding depressions.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary:

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

The project would result in the removal of about 36 ha of known habitat for *Eucalyptus tetrapleura*. The total area of known habitat the local population of *Eucalyptus tetrapleura* occurs in is 1010 ha, which includes habitat for pollinator species. Although the habitat within the project area is critical to the survival of the species, it constitutes less than five per cent of the known habitat for the species in the local area. Therefore it is considered unlikely that the project would result in adverse impacts to habitat critical to the survival of the species, such that the genetic diversity and long-term evolutionary development would be impacted or that pollinator species would be significantly impacted.

Disrupt the breeding cycle of an important population

The life cycle of *Eucalyptus tetrapleura* is likely to be linked to a large range of factors, but several important components include:

- A wide range of potential pollinator species including insects, birds, bats and arboreal mammals.
- Fire regime including fire intensity, frequency and season.
- Available gene pool.
- Other disturbance regimes such as forestry activities, grazing.

The local abundance of the species varied considerably within each of the different populations. The density of trees was often dependant on the degree of recruitment, with some areas supporting a large number of juvenile trees and smaller saplings, whilst other areas supported more mature trees with fewer juveniles. The abundance of juveniles is dependent on several factors including fire history, understorey structure and other disturbances such as logging activities. Many of the State Forest areas supported a large number of juveniles possibly due to past disturbance from logging activities providing bare soil for germination. However certain fire regimes are likely to favour recruitment, such as a fire during the major fruiting period for *Eucalyptus tetrapleura*, providing bare surface substrates for germination of plant-stored seed.

Although there is potential for fire regimes to change following the project it is considered unlikely to significantly impact the life cycle of populations of *Eucalyptus tetrapleura*.

The project is unlikely to significantly impact the local gene pool or lead to inbreeding depressions due to fragmentation. Habitat for pollinator species would be removed, however sufficient habitat for large populations of potential pollinator species would remain in surrounding areas. Considering the above the life cycle of *Eucalyptus tetrapleura* in the local area is unlikely to be significantly affected.

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

The known area of occupancy for the local population is estimated to be about 1010 ha based on field survey assessments and predicted distributions on private lands. The potential area of habitat available to the species is likely to be much larger than this within the local area.

The project would result in the removal of up to 36 ha of known habitat for *Eucalyptus tetrapleura.* Therefore the known area of occupancy for *Eucalyptus tetrapleura* in the local area would be reduced by about 3.6 per cent. This removal of habitat for the local population is unlikely to be large enough to result in significant declines to the population through inbreeding depressions and habitat fragmentation.

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

Vegetation clearing would potentially contribute to further invasion of *Lantana camara* and other exotic species particularly along the edges of the project footprint where there would be increased sunlight availability. Other indirect impacts include stormwater run-off potentially increasing water and nutrient loads entering adjacent bushland areas, leading to the increased growth and spread of exotic species.

Mitigation measures would be implemented to minimise impacts from nutrient loads, sedimentation and altered hydrology regimes. Weed management should be implemented during the construction phase of the project to limit the spread of exotic weed species, including appropriate disposal of exotic vegetative material and propagules.

Introduce disease that may cause the species to decline

Diseases which may impact *Eucalyptus tetrapleura* include the introduction of Root Rot Fungus (*Phytophora cinnamomi*) and other plant pathogens. Provided machinery and personnel are excluded from areas where this species would be retained adjacent to the project, impacts from plant pathogens would be minimised. Monitoring and management actions for the retained populations as part of the mitigation measures of the project should be carried out in a way that minimises the risk of the spread of disease from plant pathogens.

Interferes substantially with the recovery of the species

The project would not significantly conflict with the recovery actions proposed for *Eucalyptus tetrapleura*. Some recovery actions could potentially be implemented for the individuals that are proposed to be retained surrounding the proposed development including protective fencing, ongoing monitoring of populations and weed control within habitat areas.

To mitigate the ecological impacts from the project an offset strategy is proposed to provide greater protection of *Eucalyptus tetrapleura* and habitat for other threatened flora and fauna, through placing an area of private land or state forest under conservation. Several options for the offset strategy are proposed, several of which include extending current conservation reserves in the area including Wells Crossing Flora Reserve, Yuraygir State Recreation Area and Glenugie Peak Flora Reserve. An offset supporting a large number of *Eucalyptus tetrapleura* would significantly contribute to the recovery of the species.

Grey-headed flying-fox

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

The project would remove about 85 ha of vegetation comprising dry open forests dominated by Large-leaved Spotted Gum (*Corymbia henryi*), with Grey Box (*Eucalyptus moluccana*) and Ironbark species (74.7 ha), woodland (5.1 ha) and riparian forest (5.3 ha).

Ongoing habitat removal, particularly in coastal areas is a continual threat to this species. Other threats include disturbance and modification of habitat near roosting camps and electrocution from contacting overhead wires. The nearest known roost camp for this species is at Susan Island in Grafton and there no roost sites were identified from the field survey of the study area and footprint. Foraging resources for the Grey-headed Flying-fox occur throughout all naturally vegetated areas of the study area and it is likely that the vegetation to be cleared provides a portion of the foraging range of a local population of Grey-headed Flying-foxes given the individual observed along the alignment and the scattering of previous records in Glenugie State Forest. The project removal of 85 ha is considered a sustainable loss of potential foraging habitat in the context of available habitat in the surrounding region, including Glenugie State Forest, several other state forests and conservation reserves and considering the broad foraging requirements of the species. The proposed action would not result in a decrease in the size of a local population and would not impact on a known roost site.

Reduce the area of occupancy of an important population

The project would remove about 85 ha of vegetation comprising dry open forests dominated by Large-leaved Spotted Gum, with Grey Box and Ironbark species (74.7 ha), woodland (5.1 h) and riparian forest (5.3 ha). This is a small percentage of the foraging habitat available throughout the distributional range of the Grey-headed Flying fox in Australia. The project is not expected to significantly impact on food resources available for local populations of the

grey-headed flying-fox. This species is wide ranging a capable of exploiting seasonally available and wide spread food resources.

Fragment an existing important population into two or more populations

The project would increase the fragmentation of habitat in the landscape by impacting on contiguous forest area associated with Glenugie State Forest and private forested land to the west of the study area. It is important to note however that all areas of habitat affected by the project have already been fragmented in the past by roads, and clearing for forestry operations. The project would be contributing to this cumulative fragmentation of habitat in the landscape.

Highly mobile species such as bats and birds are expected to be less impacted by fragmentation and the grey-headed flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. The project would not fragment an important population of the Grey-headed flying-fox.

Adversely affect habitat critical to the survival of the species

- Habitat critical to the survival of a species refers to areas that are necessary for activities such as:
    - Foraging, breeding, roosting, or dispersal.
    - For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators.
    - To maintain genetic diversity and long-term evolutionary development.
    - For the reintroduction of populations or recovery of the species.

The proposed area of disturbance represents a very small fraction of the potential foraging habitat for the grey-headed flying-fox in the mid north coast region. This species typically exhibits very large home ranges and grey-headed flying-fox are known to travel distances of at least 15 km from roost sites to access seasonal foraging resources (Tidemann 1995). No evidence of a roosting colony of the grey-headed flying-fox occurs in proximity to the study area. Habitat in the study area is not considered critical for this species.

Disrupt the breeding cycle of an important population

No evidence of a roosting colony of the grey-headed flying-fox occurs in proximity to the study area and the project would not impact on breeding cycles.

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

The project would remove about 85 ha of vegetation potentially used by this species for foraging. There would be a decrease in the availability of habitat in the region however this

decrease represents a very small fraction of the potential foraging habitat for the grey-headed flying-fox in the mid north coast region and is unlikely to lead to a decline in any local populations.

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

The potential for weed invasion is considered possible with a project of this nature and appropriate controls are required during the construction and operation of the road to reduce this threat as it may have long term implication for the habitat of threatened species. Grey-headed flying-fox forage on a very wide diversity of flora and are unlikely to be dependent on roadside verges. The management of invasive species would be managed under the guidance of the CEMP and OEMP.

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species. The project is unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Interferes substantially with the recovery of the species

The project and proposed highway construction would not conflict with the recovery of this species. The route has been selected on the basis of avoiding high quality habitats for threatened fauna.

Large-eared Pied Bat (*Chalinolobus dwyeri*)

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

The project would remove about 85 ha of vegetation comprising dry open forests dominated by Large-leaved Spotted Gum (*Corymbia henryi*), with Grey Box (*Eucalyptus moluccana*) and Ironbark species (74.7 ha), woodland (5.1 ha) and riparian forest (5.3 ha).

As the species roosts in caves and there are no caves present in the study area, the potential impact is represented by a loss of potential foraging habitat. The project removal of 85 ha is considered a sustainable loss of potential foraging habitat in the context of available habitat in the surrounding region, including Glenugie State Forest, several other state forests and conservation reserves and considering the broad foraging requirements of the species. The proposed action would not result in a decrease in the size of a local population and would not impact on a known roost site.

Reduce the area of occupancy of an important population

The project would remove about 85 ha of vegetation comprising dry open forests dominated Large-leaved Spotted Gum, with Grey Box and Ironbark species (74.7 ha), woodland (5.1 h) and riparian forest (5.3 ha). This is a small percentage of the foraging habitat available

throughout the distributional range of the species in Australia. The project is not expected to significantly impact on food resources available for local populations and would not impact on potential roosting habitat.

Fragment an existing important population into two or more populations

The project would increase the fragmentation of habitat in the landscape by impacting on contiguous forest area associated with Glenugie State Forest and private forested land to the west of the study area. It is important to note however that all areas of habitat affected by the project have already been fragmented in the past by roads, and clearing for forestry operations. The project would be contributing to this cumulative fragmentation of habitat in the landscape.

Highly mobile species such as bats and birds are expected to be less impacted by fragmentation.

Adversely affect habitat critical to the survival of the species

- Habitat critical to the survival of a species refers to areas that are necessary for activities such as:
  - Foraging, breeding, roosting, or dispersal.
  - For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators.
  - To maintain genetic diversity and long-term evolutionary development.
  - For the reintroduction of populations or recovery of the species.

The proposed area of disturbance represents a very small fraction of the potential foraging habitat for the large-eared pied bat. As the species is a cave-roosting bat and there are no caves in the study area, there would be no impact on potential roosting habitat.

Disrupt the breeding cycle of an important population

No evidence of a roosting colony of the large-eared pied bat occurs in proximity to the study area and the project would not impact on breeding cycles or potential breeding habitat.

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

The project would remove about 85 ha of vegetation potentially used by this species for foraging. There would be a decrease in the availability of habitat in the region however this decrease represents a very small fraction of the potential foraging habitat for the species. No potential roosting habitat will be impacted as the species roosts in caves, which are not present along the alignment.

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

The potential for weed invasion is considered possible with a project of this nature and appropriate controls are required during the construction and operation of the road to reduce this threat as it may have long term implication for the habitat of threatened species. The management of invasive species would be managed under the guidance of the CEMP and OEMP.

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species. The project is unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Interferes substantially with the recovery of the species

The project and proposed highway construction would not conflict with the recovery of this species. The route has been selected on the basis of avoiding high quality habitats for threatened fauna.

C.3 Migratory Species

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

No listed migratory bird species (EPBC Act) were identified from the field investigation; however two species the Regent Honeyeater (*Xanthomyza phrygia*) and White-throated Needletail (*Hirundapus caudacutus*) are considered to potentially occur based on the habitat assessment.

The White-throated Needletail is an aerial forager that is generally observed in the air and has no specific or documented habitat preferences. There is no evidence to suggest that an area of important habitat exists in the study area for this species.

In terms of the Regent Honeyeater, the species is only an occasional visitor to the region during peak flowering events of the dominant trees, particularly the winter flowering Large-leaved Spotted Gum (*Corymbia henryi*). There are no breeding records in the study area and the extent of habitat remaining in the study area would provide sufficient resources to sustain future visitation. The project would not reduce populations of either species nor substantially modify the extent of potential habitat in the region.

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

There is no evidence to suggest that an area of important habitat exists in the study area for any listed migratory species. Suitable measures would be incorporated into the project to control the spread of weeds during the construction and operation of the road.

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

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

Appendix D Flora list

KEY TO SYMBOLS USED IN APPENDIX D

ABBREVIATIONS:

* = introduced (i.e. not indigenous to Australia)
spp. = unidentified spp
? = unconfirmed species[4]
var. = variety
subsp. = subspecies

NOTES:

1. Recent 'synonyms' include misapplied names.
2. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring in any area, especially species that are only apparent in some seasons.
3. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material, etc.

SCIENTIFIC NAMES & AUTHORITIES:

Scientific names & families are those used in the *Flora of NSW* as maintained by the Royal Botanic Gardens (http://.plantnet.rbgsyd.gov.au).

Orders and higher taxa are based on Angiosperm Phylogeny Group (2003).

For sake of simplicity, scientific names in this list do not include authorities. These can be found in the *Flora of NSW.*

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Pteridophytes																					
Adiantaceae		*Adiantum aethiopicum*	Common Maidenhair Fern							X											
Adiantaceae		*Adiantum hispidulum*	Rough Maidenhair																		X
Blechnaceae		*Doodia caudata*	Small Rasp-fern																		X
Dennstaedtiaceae		*Pteridium esculentum*	Bracken																		X
Lindsaeaceae		*Lindsaea microphylla*	Lacy Wedge Fern																		X
Sinopteridaceae		*Cheilanthes sieberi* subsp. *sieberi*	Rock Fern	X	X	X		X	X	X	X	X					X	X	X		
Conifers																					
Pinaceae		*Pinus elliottii*	Slash Pine																		X
Dicotyledons																					
Acanthaceae		*Brunoniella australis*	Blue Trumpet, Blue Yam													X		X			
Acanthaceae		*Brunoniella pumilio*	Dwarf Blue Trumpet	X	X					X	X				X	X					
Acanthaceae		*Pseuderanthemum variable*	Pastel Flower																		X
Amygdalaceae		*Prunus spp.*																			
Apiaceae		*Centella asiatica*	Pennywort				X			X			X	X		X		X			
Apiaceae		*Hydrocotyle laxiflora*	Stinking Pennywort				X											X			
Apiaceae		*Hydrocotyle peduncularis*	Hairy Pennywort																		X
Apiaceae		*Platysace ericoides*																		X	
Apocynaceae	*	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush				X				X										
Apocynaceae		*Marsdenia fraseri*														X					
Apocynaceae		*Parsonsia straminea*	Common Silkpod, Monkey Rope							X											
Asteraceae		*Ambrosia spp.*	Ragweed																		X
Asteraceae		*Bidens pilosa*	Cobblers Peg																		X
Asteraceae		*Brachycome microcarpa*											X								
Asteraceae		*Brachycome* sp.											X								

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Asteraceae		*Calotis cuneifolia*	Purple Burr-daisy																		X
Asteraceae		*Chrysocephalum apiculatum*	Common Everlasting, Yellow Buttons	X	X																
Asteraceae	*	*Conyza spp.*	Fleabane																		X
Asteraceae		*Epaltes australis*	Spreading Nut-heads									X					X				
Asteraceae	*	*Gamochaeta spicata*	Cudweed																		X
Asteraceae		*Glossogyne tannensis*	Cobbler's Tack										X		X						
Asteraceae		*Gnaphalium spp.*																			X
Asteraceae		*Lagenophora gracilis*		X	X	X	X	X	X	X	X	X	X		X		X	X	X		
Asteraceae		*Ozothamnus diosmifolius*	Tall Paperdaisy																		X
Asteraceae	*	*Senecio madagascariensis*	Fireweed, Madagascar Ragwort								X						X				
Asteraceae		*Vernonia cinerea*		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	
Bignoniaceae		*Jacaranda mimosifolia*	Jacaranda																		X
Brassicaceae	*	*Lepidium* sp.					X														
Casuarinaceae		*Allocasuarina littoralis*	Black She-Oak	X		X		X	X		X			X				X	X	X	
Casuarinaceae		*Allocasuarina torulosa*	Forest She-Oak																		X
Clusiaceae		*Hypericum gramineum*	Small St Johns-wort	X	X	X	X						X					X	X		
Convolvulaceae		*Convolvulus erubescens*	Native Bindweed, Blushing Bindweed											X	X						
Convolvulaceae		*Dichondra repens*	Kidney-weed, Mercury Bay Weed				X			X	X		X	X	X	X	X				
Convolvulaceae		*Polymeria calycina*																			X
Dilleniaceae		*Hibbertia linearis*	Guinea-flower		X																
Dilleniaceae		*Hibbertia serpyllifolia*				X	X					X						X		X	
Dioscoreaceae		*Dioscorea transversa*	Native Yam																		X
Droseraceae		*Drosera peltata*	Pale Sundew			X													X	X	
Ericaceae - Styphelioideae		*Agiortia ? pleiosperma*																			X
Ericaceae -		*Leucopogon* sp.	Beard-heath	X				X	X											X	

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Styphelioideae																					
Ericaceae - Styphelioideae		*Leucopogon juniperinus*	Juniper Beard-heath																		X
Ericaceae - Styphelioideae		*Leucopogon lanceolatus var. lanceolatus*	Lance-leaf Beard-heath																		X
Ericaceae - Styphelioideae		*Melichrus procumbens*	Jam Tarts																		X
Ericaceae - Styphelioideae		*Montoca scoparia*																			X
Euphorbiaceae		*Breynia oblongifolia*	Coffee Bush				X							X				X			
Euphorbiaceae		*Glochidion ferdinandi*	Cheese Tree				X														
Euphorbiaceae		*Phyllanthus gunnii*		X	X	X			X			X	X						X		
Euphorbiaceae		*Phyllanthus hirtellus*	Thyme Spurge			X		X	X									X	X	X	
Euphorbiaceae		*Phyllanthus virgatus*		X	X	X				X	X		X				X				
Euphorbiaceae		*Poranthera microphylla*	Small Poranthera															X			
Fabaceae Faboideae		*Bossiaea prostrata*																			X
Fabaceae Faboideae		*Daviesia ulicifolia*	Gorse Bitter-pea																	X	
Fabaceae Faboideae		*Desmodium brachypodum*	Large Tick-trefoil																		X
Fabaceae Faboideae		*Desmodium gunnii*	Slender Tick-trefoil											X		X		X			
Fabaceae Faboideae		*Desmodium rhytidophyllum*	Tick-trefoil								X				X	X	X				
Fabaceae Faboideae		*Desmodium varians*	Slender Tick-trefoil	X	X					X	X										
Fabaceae Faboideae	*	*Erythrina sykesii*	Coral Tree																		X
Fabaceae Faboideae		*Glycine clandestina*	Twining Glycine		X	X		X	X	X	X	X					X		X		
Fabaceae Faboideae		*Glycine tabacina*	Variable Glycine	X	X						X		X	X	X	X					
Fabaceae Faboideae		*Gompholobium pinnatum*	Pinnate Wedge Pea																	X	
Fabaceae Faboideae		*Hardenbergia violacea*	False Sarsaparilla									X			X						
Fabaceae Faboideae		*Jacksonia scoparia*	Dogwood																		X
Fabaceae Faboideae		*Kennedia rubicunda*	Dusky Coral Pea																		X

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Fabaceae Faboideae	*	*Macroptilium atropurpureum*	Siratro																		X
Fabaceae Faboideae		*Pultanaea euchila*	Pale Bush-pea																		X
Fabaceae Faboideae		*Pultenaea paleacea*	Narrow-leaf Bush-pea																		X
Fabaceae Faboideae		*Pultenaea spinosa*	Whorled Bush-pea																		X
Fabaceae Mimosoideae		*Acacia concurrens*	Curracabah	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Fabaceae Mimosoideae		*Acacia falcata*																			X
Fabaceae Mimosoideae		*Acacia irrorata*																			X
Geraniaceae		*Geranium solanderi var. solanderi*	Native Cranesbill																		X
Goodeniaceae		*Goodenia heterophylla*					X	X	X			X			X		X	X		X	
Goodeniaceae		*Velleia spathulata*		X		X		X	X		X						X		X	X	
Haemadoraceae		*Haemodorum planifolium*	Bloodroot																		X
Haloragaceae		*Gonocarpus micranthus* subsp. *micranthus*	Creeping Raspwort				X		X												
Haloragaceae		*Gonocarpus tetragynus*																		X	
Lamiaceae		*Ajuga australis*	Native Bugle, Australian Bugle								X										
Lamiaceae		*Mentha diemenica*	Slender Mint	X							X			X							
Lamiaceae		*Mentha satureioides*	Creeping Mint																		X
Lamiaceae		*Plectranthus parviflorus*									X										
Lauraceae		*Cassytha pubescens*	Devils Twine																		X
Lauraceae	*	*Cinnamonum camphora*	Camphor laurel																		X
Lobeliaceae		*Lobelia gracilis*	Trailing Lobelia						X									X			
Lobeliaceae		*Pratia purpurascens*	Whiteroot	X	X	X	X			X	X	X	X	X	X	X	X	X	X		
Loganiaceae		*Logania albiflora*	Logania																		X
Loganiaceae		*Mitrasacme polymorpha*	Mitre Weed																		X
Loranthaceae		*Amyema congener*																			X

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Loranthaceae		*Amyema pendulum*																			X
Malaceae	*	*Cotoneaster glaucophyllus*	Cotoneaster																		X
Malvaceae	*	*Sida rhombifolia*	Paddy's Lucerne										X	X		X					
Menispermaceae		*Stephania japonica*	Snake Vine																		X
Myoporaceae		*Eremophila debilis*	Winter Apple, Amulla								X				X	X					
Myrsinaceae		*Rapanaea variabilis*	Variable Muttonwood																		X
Myrtaceae		*Angophora subvelutina*	Broad-leaved Apple								X										
Myrtaceae		*Angophora woodsiana*																			X
Myrtaceae		*Callistemon salignus*	White Bottlebrush, Pink-tips				X		X								X				
Myrtaceae		*Corymbia henryi*	Large-leaved Spotted Gum	X	X	X	X	X		X	X	X	X		X	X	X			X	
Myrtaceae		*Corymbia intermedia*	Pink Bloodwood	X					X	X	X			X							
Myrtaceae		*Eucalyptus bancroftii*	Orange Gum																X	X	
Myrtaceae		*Eucalyptus crebra*	Narrow-leaved Ironbark											X	X						
Myrtaceae		*Eucalyptus fibrosa*	Broad-leaved Red Ironbark									X					X			X	
Myrtaceae		*Eucalyptus moluccana*	Grey Box	X							X		X	X	X		X				
Myrtaceae		*Eucalyptus propinqua*	Small-fruited Grey Gum											X							
Myrtaceae		*Eucalyptus resinifera* subsp. *resinifera*	Red Mahogany				X											X			
Myrtaceae		*Eucalyptus seeana*	Narrow-leaved Red Gum				X	X	X	X								X	X		
Myrtaceae		*Eucalyptus siderophloia*	Grey Ironbark								X					X					
Myrtaceae		*Eucalyptus signata*	Scribbly Gum																		X
Myrtaceae		*Eucalyptus tereticornis*	Forest Red Gum										X	X		X					
Myrtaceae		*Eucalyptus tetrapleura*		X	X	X	X	X		X							X		X		
Myrtaceae		*Leptospermum polygalifolium*	Yellow Tea-tree, Tantoon Tea-Tree															X			
Myrtaceae		*Leptospermum trinervium*	Paperbark Tea-tree																	X	
Myrtaceae		*Lophostemon suaveolens*	Swamp Box, Swamp Turpentine				X		X	X								X	X		

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Myrtaceae		*Melaleuca alternifolia*					X			X								X			
Myrtaceae		*Melaleuca irbyana*	Weeping Paperbark																		
Myrtaceae		*Melaleuca nodosa*	Ball Honey-myrtle	X	X	X	X	X	X	X		X					X		X	X	
Myrtaceae		*Melaleuca sieberi*					X	X	X											X	
Myrtaceae		*Sannantha similis*																			X
Oleaceae		*Jasminum suavissimum*																			X
Oleaceae		*Notelaea longifolia*	Mock-olive										X								
Oxalidaceae		*Oxalis perennans*	Oxalis	X	X	X	X	X		X	X			X				X	X		
Pittosporaceae		*Billardiera scandens*	Apple-berry																		
Plantaginaceae		*Plantago gaudichaudii*	Narrow Plantain																		X
Plantaginaceae		*Plantago varia*	Variable Plantain	X							X		X	X							
Proteaceae		*Banksia oblongifolia*																			X
Proteaceae		*Hakea florulenta*				X	X	X	X									X		X	
Proteaceae		*Lomatia silaifolia*	Crinkle Bush																		X
Proteaceae		*Persoonia stradbrokensis*																			X
Ranunculaceae		*Clematis glycinoides*																			X
Ranunculaceae		*Ranunculus* sp.					X														
Rhamnaceae		*Alphitonia excelsa*	Red Ash, Soap Tree				X			X	X			X		X		X			
Rubiaceae		*Morinda jasminoides*	Morinda							X											
Rubiaceae		*Opercularia diphylla*	Stinkweed	X	X	X		X	X	X		X			X	X	X	X	X	X	
Rubiaceae		*Pomax umbellata*	Pomax																		X
Rubiaceae		*Richardia brasiliensis*	Mexican Clover																		X
Rubiaceae		*Richardia stellaris*																			X
Rutaceae		*Boronia polygalifolia*					X						X								
Scrophulariaceae		*Veronica plebeia*	Creeping Speedwell							X	X										
Solanaceae	*	*Physalis ixocarpa*	Ground Cherry																		X

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Solanaceae	*	*Solanum nigrum*																			X
Thymelaeaceae		*Pimelea linifolia*	Rice Flower			X											X		X	X	
Verbenaceae		*Clerodendrum tomentosum*	Hairy Clerodendrum																		X
Verbenaceae	*	*Lantana camara*	Lantana				X			X				X		X					
Verbenaceae		*Vernbena rigida*	Veined Verbena																		X
Violaceae		*Hybanthus monopetalus*																			X
Violaceae		*Hybanthus stellarioides*					X				X	X	X		X	X	X				
Vitaceae		*Cayratia clematidea*	Native Grape																		X
Monocotyledons																					
Anthericaceae		*Arthropodium milleflorum*	Vanilla Lily									X			X	X					
Anthericaceae		*Laxmannia gracilis*	Slender Wire Lily		X	X		X	X								X		X		
Commelinaceae		*Murdannia graminea*		X	X	X	X			X	X		X		X		X				
Cyperaceae		*Abildgaardia ovata*					X					X								X	
Cyperaceae		*Baumea articulata*	Jointed Twig-rush																		X
Cyperaceae		*Baumea juncea*																			X
Cyperaceae		*Carex inversa*	Knob Sedge					X					X		X	X	X		X	X	
Cyperaceae		*Cyperus gracilis*	Slender Sedge													X					
Cyperaceae		*Eleocharis spp.*	Spike-rush																		X
Cyperaceae		*Eleocharis gracillis*	Spike-rush																		X
Cyperaceae		*Eleocharis philippinensis*	Spike-rush																		X
Cyperaceae		*Fimbristylis dichotoma*				X	X												X		
Cyperaceae		*Gahnia aspera*	Rough-leaved Saw-sedge	X	X	X		X	X	X		X	X	X			X	X	X	X	
Cyperaceae		*Isolepis* sp.	Club-rush				X											X			
Cyperaceae		*Lepidosperma laterale*	Variable Sword-sedge		X	X	X	X	X	X		X					X	X	X	X	
Cyperaceae		*Scleria mackaviensis*													X	X					
Hypoxidaceae		*Hypoxis hygrometrica*	Golden Star, Golden		X		X			X			X				X		X		

Family	Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
		Weather-glass																		
Juncaceae	*Juncus continuus*	Sand Rush																		X
Juncaceae	*Juncus planifolius*	Broadleaf Rush																		X
Juncaceae	*Juncus usitatus*	Common Rush																		X
Juncaginaceae	*Triglochin procerum*	Water Ribbons															X			
Lomandraceae	*Lomandra elongata*			X				X		X	X	X	X							
Lomandraceae	*Lomandra filiformis* subsp. *coriacea*	Wattle Mat-rush	X						X	X	X			X	X	X	X	X	X	
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush			X													X		
Lomandraceae	*Lomandra longifolia*	Honey Reed, Spike Mat-rush		X	X		X	X			X			X		X	X		X	
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush		X					X					X	X	X		X		
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry							X	X		X	X	X	X	X	X			
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily																		X
Orchidaceae	(Orchidaceae genus unknown)							X												
Orchidaceae	*Acianthus sp.*	Gnat Orchid							X											
Orchidaceae	*Caladenia catenata*	Pink Fingers			X															
Orchidaceae	*Chiloglottis diphylla*					X	X		X											
Orchidaceae	*Eriochilus cucullatus*	Parson's Bands																		X
Orchidaceae	*Pterostylis baptistii*	King Greenhood															X			
Orchidaceae	*Pterostylis concinna*	Trim Greenhood																		X
Orchidaceae	*Pterostylis nutans*	Nodding Greenhood				X											X			
Orchidaceae	*Pterostylis* sp.	Greenhood Orchid				X	X													
Philydraceae	*Philydrum lanuginosum*	Frogsmouth																		X
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		X	X								X							
Phormiaceae	*Dianella longifolia*	Smooth Flax-lily													X					
Phormiaceae	*Dianella revoluta*	Blue Flax-lily, Spreading Flax-lily		X	X															

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Poaceae		*Andropogon virginicus*	Whisky Grass																		X
Poaceae		*Alloteropsis semialata*	Cockatoo Grass		X																
Poaceae		*Aristida benthamii*	Wiregrass		X	X		X	X											X	
Poaceae		*Aristida ramosa*	Purple Wiregrass	X							X		X		X	X					
Poaceae		*Aristida vagans*	Threeawn Speargrass	X	X	X	X	X	X	X	X	X			X	X	X	X	X		
Poaceae		*Aristida warburgii*	Wiregrass	X	X	X		X	X		X	X							X	X	
Poaceae		*Austrodanthonia fulva*	Wallaby Grass												X	X					
Poaceae		*Austrostipa* sp.	Speargrass						X												
Poaceae	*	*Axonopus fissifolius*	Narrow-leaved Carpet Grass	X		X								X				X			
Poaceae		*Bothriochloa macra*	Red-leg Grass	X							X		X	X	X						
Poaceae		*Capillipedium spicigerum*	Scented-top Grass				X				X				X	X					
Poaceae	*	*Chloris gayana*	Rhodes Grass																		X
Poaceae		*Chloris ventricosa*	Tall Windmill Grass											X							
Poaceae		*Chloris virgata*	Feathertop Rhodes Grass																		X
Poaceae		*Cymbopogon refractus*	Barbed Wire Grass	X	X	X				X	X		X	X	X	X		X	X	X	
Poaceae		*Dichelachne micrantha*	Shorthair Plumegrass	X									X								
Poaceae		*Dichelachne rara*																			X
Poaceae		*Dichamtheum sericeum subsp. sericeum*	Queensland Bluegrass																		X
Poaceae		*Digitaria parviflora*	Smallflower Finger Grass	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		
Poaceae		*Echinopogon caespitosus*	Tufted Hedgehog Grass	X		X	X			X	X			X			X	X			
Poaceae		*Echinopogon ovatus*	Forest Hedgehog Grass		X		X				X			X			X		X		
Poaceae		*Entolasia marginata*	Bordered Panic				X		X	X											
Poaceae		*Entolasia stricta*	Wiry Panic	X	X	X	X	X	X	X		X			X	X	X	X	X	X	
Poaceae		*Eragrostis brownii*	Brown's Lovegrass	X	X	X						X	X		X		X	X	X	X	
Poaceae		*Eragrostis curvula*	African Lovegrass																		X
Poaceae		*Eragrostis leptostachya*	Paddock Lovegrass	X		X	X	X	X		X		X				X	X			

Family		Species	Common name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Extra
Poaceae		*Hyparrhenia hirta*	Coolatai Grass																		X
Poaceae		*Imperata cylindrica*	Blady Grass		X		X			X	X	X	X	X	X	X	X	X			
Poaceae	*	*Melinis repens*	Red Natal Grass																		X
Poaceae		*Microlaena stipoides*	Meadow Rice-grass, Weeping Grass	X	X	X	X	X	X	X	X		X	X	X	X	X	X			
Poaceae		*Oplismenus aemulus*	Broad-leaved Basket Grass				X				X			X	X	X					
Poaceae		*Oplismenus imbecillis*	Narrow-leaf Beard-grass																		
Poaceae		*Ottochloa gracillima*		X			X			X								X			
Poaceae		*Panicum effusum*	Hairy Panic			X	X		X			X	X	X					X		
Poaceae		*Panicum simile*	Two-colour Panic	X		X	X	X	X		X			X	X	X	X		X	X	
Poaceae		*Paspalidium criniforme*	Paspalidium					X													
Poaceae		*Paspalidium distans*	Spreading Panicgrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	
Poaceae		*Paspalum dilatatum*	Paspalum																		X
Poaceae		*Paspalum orbiculare*	Ditch Millet										X								
Poaceae		*Paspalum urvillei*	Vasey Grass																		X
Poaceae		*Phragmites australis*	Common Reed																		X
Poaceae	*	*Setaria gracilis*	Slender Pigeon Grass							X											
Poaceae	*	*Sporobolus africanus*	Parramatta Grass								X										
Poaceae		*Sporobolus elongatus*	Slender Rat's-tail Grass	X	X								X	X							
Poaceae		*Themeda australis*	Kangaroo Grass	X		X						X			X					X	
Restionaceae		*Lepyrodia scariosa*	Scale-rush						X												
Smilaceae		*Smilax australis*	Lawyer Vine																		X
Xanthorrhoeaceae		*Xanthorrhoea fulva*	Swamp Grasstree			X		X	X	X								X	X	X	
Xyridaceae		*Xyris gracilis*																	X		

Appendix E Fauna list

KEY TO SYMBOLS USED IN APPENDIX E

	HABITAT
DOF	Dry Open Sclerophyll Forest (Spotted Gum / Ironbark / Grey Box / Grey Gum) on clay soils
SW	Shrubby Woodland (Narrow-leaved Redgum - Paperbark Woodland)
Riparian	Swamp Turpentine - Paperbark Riparian Forest
Aquatic	Creeks and small soaks

	STATUS
VC	Very Common
C	Common
O	Occasional
R	Rare
RS	Regionally signficant
NV	Nationally vulnerable species (EPBC Act)
NE	Nationally Endangered species (EPBC Act)
V	Vulnerable species (NSW TSC Act)
E	Endangered species (NSW TSC Act)
EP	Endangered Population (NSW TSC Act)
M	Migratory listed species (EPBC Act)

BIRDS

FAMILY/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Expected
Phasianidae						
Coturnix pectoralis	Stubble Quail					■
Coturnix ypsilophora	Brown Quail					■
Phalacrocoracidae						
Phalacrocorax melanoleucos	Little Pied Cormorant					■
Ardeidae						
Egretta novaehollandiae	White-faced Heron					■
Accipitridae						
Accipiter novaehollandiae	Grey Goshawk					■
Accipiter fasciatus	Brown Goshawk					■
Accipiter cirrocephalus	Collared Sparrowhawk					■
Haliastur sphenurus	Whistling Kite					■
Lophoictinia isura	Square-tailed Kite	V				■
Falconidae						
Falco longipennis	Australian Hobby					■
Burhinidae						
Burhinus grallarius	Bush Stone-curlew	E				■
Columbidae						
Geopelia placida	Peaceful Dove	O	■	■		
Geopelia humeralis	Bar-shouldered Dove	O	■			
Phaps chalcoptera	Common Bronzewing	O	■			
Cacatuidae						
Calyptorhynchus lathami	Glossy Black-Cockatoo	R, V				■
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	O	■			
Cacatua galerita	Sulphur-crested Cockatoo	O	■			
Eolophus roseicapillus	Galah	O	■			
Psittacidae						
Trichoglossus haematodus	Rainbow Lorikeet	C	■	■	■	
Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	VC	■	■	■	
Glossopsitta concinna	Musk Lorikeet					■
Glossopsitta pusilla	Little Lorikeet	O	■			
Alisterus scapularis	Australian King-Parrot	O	■	■		
Platycercus adscitus eximius	Eastern Rosella	O	■	■		
Lathamus discolor	Swift Parrot	NE, E				■
Cuculidae						
Cacomantis flabelliformis	Fan-tailed Cuckoo	O	■	■		
Cacomantis variolosus	Brush Cuckoo	O	■	■		
Chalcites basalis	Horsfield's Bronze-Cuckoo					■
Chalcites lucidus	Shining Bronze-Cuckoo	R	■			
Eudynamys orientalis	Pacific Koel					■
Scythrops novaehollandiae	Channel-billed Cuckoo					■
Centropodidae						
Centropus phasianinus	Pheasant Coucal					■

FAMILY/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Expected
Strigidae						
Ninox boobook	Southern Boobook	O		■		
Ninox strenua	Powerful Owl	R, V				■
Tytonidae						
Tyto novaehollandiae	Masked Owl	V				■
Podargidae						
Podargus strigoides	Tawny Frogmouth	O	■	■		
Aegothelidae						
Aegotheles cristatus	Australian Owlet-nightjar	O	■			
Caprimulgidae						
Eurostopodus mystacalis	White-throated Nightjar	O	■			
Apodidae						
Hirundapus caudacutus	White-throated Needletail	M				■
Alcedinidae						
Dacelo novaeguineae	Laughing Kookaburra	C	■	■	■	
Todiramphus macleayii	Forest Kingfisher					■
Todiramphus sanctus	Sacred Kingfisher	O			■	
Coraciidae						
Eurystomus orientalis	Dollarbird					■
Climacteridae						
Climacteris picumnus	Brown Treecreeper	O, V	■	■		
Cormobates leucophaea	White-throated Treecreeper					■
Maluridae						
Malurus cyaneus	Superb Fairy-wren	O	■		■	
Malurus lamberti	Variegated Fairy-wren	O	■			
Malurus melanocephalus	Red-backed Fairy-wren					■
Pardalotidae						
Pardalotus punctatus	Spotted Pardalote	C	■	■	■	
Pardalotus striatus	Striated Pardalote	C	■	■	■	
Acanthizidae						
Gerygone olivacea	White-throated Gerygone	O			■	
Gerygone mouki	Brown Gerygone					■
Smicrornis brevirostris	Weebill					■
Acanthiza lineata	Striated Thornbill	O	■			
Acanthiza pusilla	Brown Thornbill	O		■		
Sericornis frontalis	White-browed Scrubwren	O			■	
Pyrrholaemus saggitatus	Speckled Warbler	V				■
Meliphagidae						
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	O, V	■			
Lichmera indistincta	Brown Honeyeater	C	■	■		
Xanthomyza phrygia	Regent Honeyeater	NE, E				■
Meliphaga lewinii	Lewin's Honeyeater	O			■	
Lichenostomus fuscus	Fuscous Honeyeater	C	■	■		
Lichenostomus chrysops	Yellow-faced Honeyeater	VC	■	■	■	
Lichenostomus penicillatus	White-plumed Honeyeater	C	■			

FAMILY/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Expected
Manorina melanocephala	Noisy Miner	C	■	■	■	
Anthochaera chrysoptera	Little Wattlebird	C	■	■	■	
Anthochaera carunculata	Red Wattlebird	O	■	■		
Entomyzon cyanotis	Blue-faced Honeyeater	O	■			
Philemon corniculatus	Noisy Friarbird	O	■			
Philemon citreogularis	Little Friarbird	O	■			
Petroicidae						
Microeca fascinans	Jacky Winter	O		■		
Petroica boodang	Scarlet Robin	O		■		
Eopsaltria australis	Eastern Yellow Robin	C	■	■	■	
Pomatostomidae						
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern ssp)	V				■
Eupetidae						
Psophodes olivaceus	Eastern Whipbird					■
Neosittidae						
Daphoenositta chrysoptera	Varied Sittella	O	■			
Pachycephalidae						
Pachycephala pectoralis	Golden Whistler	C	■	■	■	
Pachycephala rufiventris	Rufous Whistler	O		■		
Colluricincla harmonica	Grey Shrike-thrush	C	■	■	■	
Dicruridae						
Rhipidura albiscapa	Grey Fantail	C	■	■		
Rhipidura leucophrys	Willie Wagtail	O	■	■		
Myiagra rubecula	Leaden Flycatcher	O	■		■	
Grallina cyanoleuca	Magpie-lark	C	■		■	
Dicrurus bracteatus	Spangled Drongo					■
Campephagidae						
Coracina novaehollandiae	Black-faced Cuckoo-shrike	O	■	■		
Coracina papuensis	White-bellied Cuckoo-shrike	C	■	■		
Oriolidae						
Oriolus sagittatus	Olive-backed Oriole	O	■	■	■	
Sphecotheres vieilloti	Australasian Figbird	O	■		■	
Artamidae						
Strepera graculina	Pied Currawong	O	■			
Cracticus nigrogularis	Pied Butcherbird	O	■	■		
Cracticus torquatus	Grey Butcherbird	C	■	■		
Gymnorhina tibicen	Australian Magpie	C	■	■	■	
Corvidae						
Corvus orro	Torresian Crow	C	■	■	■	
Corcoracidae						
Corcorax melanorhamphos	White-winged Chough					■
Estrildidae						
Stagonopleura guttata	Diamond Firetail	V				■
Taeniopygia bichenovii	Double-barred Finch					■
Neochmia temporalis	Red-browed Finch	O	■		■	

FAMILY/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Expected
Dicaeidae						
Dicaeum hirundinaceum	Mistletoebird	C	■	■	■	
Hirundinidae						
Hirundo neoxena	Welcome Swallow					■
Petrochelidon nigricans	Tree Martin	O	■			
Petrochelidon ariel	Fairy Martin					■
Zosteropidae						
Zosterops lateralis	Silvereye	C	■	■	■	

MAMMALS

FAMILY/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Expected
Tachyglossidae						
Tachyglossus aculeatus	Short-beaked Echidna	O	■			
Dasyuridae						
Dasyurus maculatus	Spotted-tailed Quoll	NV, V				■
Phascogale tapoatafa	Brush-tailed Phascogale	R, V	■			
Antechinus flavipes	Yellow-footed Antechinus	VC	■	■		
Sminthopsis murina	Common Dunnart					■
Antechinus stuartii	Brown Antechinus					■
Peramelidae						
Isoodon macrourus	Northern Brown Bandicoot	O		■	■	
Perameles nasuta	Long-nosed Bandicoot	C	■	■	■	
Phascolarctidae						
Phascolarctos cinereus	Koala	V				■
Petauridae						
Petaurus australis	Yellow-bellied Glider	O, V	■		■	
Petaurus breviceps	Sugar Glider	C	■	■	■	
Pseudocheiridae						
Pseudocheirus peregrinus	Common Ringtail Possum	R			■	
Petauroides volans	Greater Glider					■
Acrobatidae						
Acrobates pygmaeus	Feathertail Glider	C	■	■		
Phalangeridae						
Trichosurus vulpecula	Common Brushtail Possum	C	■	■	■	
Potoroidae						
Aepyprymnus rufescens	Rufous Bettong	O, V	■		■	
Macropodidae						
Wallabia bicolor	Swamp Wallaby	O	■		■	
Macropus rufogriseus	Red-necked Wallaby	C	■	■	■	
Macropus giganteus	Eastern Grey Kangaroo	O	■			
Pteropodidae						
Pteropus poliocephalus	Grey-headed Flying-fox	O, V	■	■	■	
Pteropus alecto	Black Flying-fox	V				■
Rhinolophidae						
Rhinolophus megaphyllus	Eastern Horseshoe-bat					■
Emballonuridae						
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V				■
Molossidae						
Tadarida australis	White-striped Freetail-bat	O	■	■		
Mormopterus norfolkensis	Eastern Freetail-bat	V				■
Mormopterus beccarii	Beccari's Freetail-bat	V				■
Vespertilionidae						
Vespadelus darlingtoni	Large Forest Bat					■

FAMILY/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Expected
Nyctophilus gouldi	Gould's Long-eared Bat	O	■			
Nyctophilus geoffroyi	Lesser Long-eared Bat	O	■			
Nyctophilus bifax	Eastern Long-eared Bat	V				■
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat					■
Miniopterus australis	Little Bentwing-bat	C, V	■	■		
Chalinolobus gouldii	Gould's Wattled Bat	O	■			
Chalinolobus morio	Chocolate Wattled Bat	O	■			
Chalinolobus dwyeri	Large-eared Pied Bat	V				■
Chalinolobus nigrogriseus	Hoary Wattled Bat	V				■
Myotis adversus	Large-footed Myotis	V				■
Scoteanax rueppellii	Greater Broad-nosed Bat	V				■
Scotorepens greyii	Little Broad-nosed Bat					■
Scotorepens orion	Eastern Broad-nosed Bat	C	■			
Falsistrellus tasmaniensis	Eastern False Pipistrelle	R, V				■
Vespadelus pumilus	Eastern Forest Bat	C	■			■
Vespadelus vulturnus	Little Forest Bat					■
Muridae						
Rattus fuscipes	Bush Rat	O	■		■	
Rattus lutreolus	Swamp Rat					■
Rattus tunneyi	Pale Field-rat					■
Pseudomys novaehollandiae	New Holland Mouse					■
INTRODUCED						
Canidae						
Canis lupus	Dingo, domestic dog	O	■			
Vulpes vulpes	Fox	C	■	■	■	
Felidae						
Felis catus	Cat					■
Leporidae						
Oryctolagus cuniculus	Rabbit					■
Lepus capensis	Brown Hare					■
Muridae						
Rattus rattus	Black Rat	O	■	■		
Mus musculus	House Mouse					■
Equidae						
Equus caballus	Wild Horse	O	■	■		
Suidae						
Sus scrofa	Feral Pig					■

REPTILES

Family/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Aquatic	Expected
Chelidae							
Chelodina longicollis	Eastern Snake-necked Turtle	O				■	
Gekkonidae							
Diplodactylus vittatus	Wood Gecko						■
Gehyra dubia	Dubious Dtella						■
Gehyra variegata	Tree Dtella						■
Gehyra robusta	Robust Dtella						■
Heteronotia binoei	Bynoe's Gecko						■
Oedura lesueurii	Lesueur's Velvet Gecko						■
Oedura robusta	Robust Velvet Gecko						■
Saltuarius swaini	Southern Leaf-tailed Gecko						■
Underwoodisaurus milii	Thick-tailed Gecko						■
Pygopodidae							
Lialis burtonis	Burton's Snake-lizard	O	■				

Family/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Aquatic	Expected
Pygopus lepidopodus	Common Scaly-foot						■
Agamidae							
Pogona barbata	Bearded Dragon	O	■	■			
Amphibolurus muricatus	Jacky Lizard	O			■		
Physignathus lesueurii	Eastern Water Dragon	C			■	■	
Varanidae							
Varanus gouldii	Gould's Goanna						■
Varanus varius	Lace Monitor	C	■	■			
Scincidae							
Calyptotis ruficauda	Red-tailed Calyptotis						■
Anomalopus leuckartii	Two-clawed Worm-skink						■
Anomalopus swansoni	Punctate Worm-skink						■
Anomalopus verreauxii	Three-clawed Worm-skink						■
Lygisaurus foliorum	Tree-base Litter-skink	O	■				
Carlia vivax	Tussock Rainbow-skink	C	■	■			
Cryptoblepharus virgatus	Cream-striped Shinning-skink	C	■	■			
Ctenotus robustus	Robust Ctenotus	O	■	■			
Ctenotus taeniolatus	Copper-tailed Skink						■
Egernia striolata	Tree Skink	O	■				■
Lampropholis delicata	Dark-flecked Garden Sunskink	VC	■	■	■		
Lampropholis guichenoti	Pale-flecked Garden Sunskink						■
Saproscincus mustelinus	Weasel Skink						■
Morethia boulengeri	South-eastern Morethia Skink						■
Saiphos equalis	Three-toed Skink						■
Eulamprus quoyii	Eastern Water-skink						■
Eulamprus tenuis	Barred-sided Skink						■
Tiliqua scincoides	Eastern Blue-tongue	O	■	■			
Typhlopidae							
Ramphotyphlops nigrescens	Blackish Blind Snake						■
Ramphotyphlops proximus	Proximus Blind Snake						■
Ramphotyphlops wiedii	Brown-snouted Blind Snake						■
Boidae							
Morelia spilota	Carpet & Diamond Pythons						■
Colubridae							
Boiga irregularis	Brown Tree Snake						■
Dendrelaphis punctulatus	Common Tree Snake	O		■			
Elapidae							
Acanthophis antarcticus	Common Death Adder						■
Cryptophis nigrescens	Eastern Small-eyed Snake						■
Demansia psammophis	Yellow-faced Whip Snake						■
Furina diadema	Red-naped Snake						■
Hemiaspis signata	Black-bellied Swamp Snake	O			■		
Pseudechis porphyriacus	Red-bellied Black Snake	C			■		
Pseudonaja textilis	Eastern Brown Snake						■

FROGS

Family/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Aquatic	Expected
Myobatrachidae							
Uperoleia fusca	Dusky Toadlet						■
Limnodynastes peronii	Brown-striped Frog	O			■	■	

Family/ Scientific Name	Common Name	Status	DOF	SW	Riparian	Aquatic	Expected
Limnodynastes tasmaniensis	Spotted Grass Frog	O	■		■	■	
Pseudophryne bibroni	Brown Toadlet	C	■		■	■	
Crinia parinsignifera	Eastern Sign-bearing Froglet	C			■	■	
Crinia signifera	Common Eastern Froglet	C			■	■	
Uperoleia laevigata	Smooth Toadlet						■
Hylidae							
Litoria caerulea	Green Tree Frog						■
Litoria dentata	Bleating Tree Frog						■
Litoria fallax	Eastern Dwarf Tree Frog	O	■		■	■	
Litoria gracilenta	Dainty Green Tree Frog						■
Litoria latopalmata	Broad-palmed Frog	O			■		
Litoria nasuta	Rocket Frog						■
Litoria peronii	Peron's Tree Frog						■
Litoria revelata	Whirring Tree Frog	O			■	■	
Litoria tyleri	Tyler's Tree Frog						■
Litoria lesueuri	Lesueur's Frog						■

Appendix F Macroinvertebrate results

F.1 AusRivAS Modelling Output

Site	Site 1	Site 2	Site 3	Site 4
NTE50	11.8	10.54	11.8	11.8
NTP50	16	14	16	16
NTC50	10	11	9	6
OE50	0.85	1.04	0.76	0.51
E50Signal	4.1	4.17	4.1	4.1
O50Signal	3.9	4.09	4.44	4.17
OE50Signal	0.95	0.98	1.09	1.02
E0Signal	3.98	4.12	3.98	3.98
O0Signal	4.04	3.9	3.64	3.88
OE0Signal	1.01	0.94	0.91	0.98
SIGNAL2	3.261905	3.62069	4.03125	3.68
Total	23	26	17	12
Band	A	A	B	B

F.2 Macroinvertebrate Taxa List

ORDER	FAMILY	SIGNAL SCORE	Site 1	Site 2	Site 3	Site 4
Acarina	*Acarina*	6	0	4	5	2
Aranae	*Aranae*	-	0	2	0	0
Cladocera	*Cladocera*	-	10	1	1	0
Coleoptera	*Dytiscidae*	2	3	7	2	0
Coleoptera	*Gyrinidae*	4	0	5	0	0
Coleoptera	*Hydraenidae*	3	1	8	4	7
Coleoptera	*Hydrochidae*	4	0	0	1	2
Coleoptera	*Hydrophilidae*	2	1	2	0	0
Coleoptera	*Scirtidae*	6	0	4	7	0
Collembola	*Collembola*	1	0	1	1	0
Copepoda	*Copepoda*	-	14	4	0	2
Decapoda	*Atyidae*	3	19	15	7	14
Diptera	*Culcidae*	1	0	0	3	0
Diptera	*s-f Chironominae*	3	6	11	0	0
Diptera	*s-f Tanypodinae*	4	3	0	0	0
Ephemeroptera	*Baetidae*	5	2	0	0	0
Ephemeroptera	*Caenidae*	4	1	0	0	0
Ephemeroptera	*Leptophlebiidae*	8	1	7	5	0
Gastropoda	*Ancylidae*	4	0	1	1	0
Gastropoda	*Hydrobiidae*	4	1	0	0	0
Gastropoda	*Planorbidae*	2	6	4	1	2
Hemiptera	*Belostomatidae*	1	4	1	0	0
Hemiptera	*Corixidae*	2	4	5	0	1
Hemiptera	*Gelastocoridae*	5	0	1	0	0

ORDER	FAMILY	SIGNAL SCORE	Site 1	Site 2	Site 3	Site 4
Hemiptera	*Gerridae*	4	0	0	0	3
Hemiptera	*Hydrometridae*	3	0	11	2	0
Hemiptera	*Nepidae*	3	0	1	0	0
Hemiptera	*Notonectidae*	1	0	2	1	0
Hemiptera	*Veliidae*	3	2	6	17	19
Hirudinea	*Glossiphoniidae*	1	2	0	0	0
Odonata	*Aeshnidae*	4	2	0	0	0
Odonata	*Coenagrionidae*	2	27	15	2	0
Odonata	*Gomphidae*	5	1	4	0	0
Odonata	*Isostictidae*	3	0	9	0	3
Odonata	*Megapodagrionidae*	5	0	1	0	0
Odonata	*UL Family Complex*	4	1	0	0	0
Oligochaeta	*Oligochaeta*	2	4	2	0	0
Ostracoda	*Ostracoda*	-	6	1	0	0
Trichoptera	*Calamoceratidae*	7	1	0	0	0
Trichoptera	*Hydroptilidae*	4	0	0	0	1
Trichoptera	*Leptoceridae*	6	10	29	23	5
Turbellaria	*Temnocephala*	5	4	2	1	6

F.3 Comparison of AusRivAS SIGNAL Scores