4. Threatened biodiversity and migratory species

4.1 Threatened ecological communities

Seventeen Threatened ecological communities listed under the TSC Act and/or EPBC Act have been identified as having potential to occur within the Hunter/Central Rivers Catchment Management Area Hunter subregion (Table 4-1). No Threatened ecological communities listed under the FM Act occur within the locality.

One Threatened ecological community listed under TSC Act was recorded within the study area (Table 4-1): Central Hunter Ironbark – Spotted Gum – Grey Box Forest (Figure 3-1).

No Threatened ecological community listed under the EPBC Act or FM Act is present within the study area.

Table 4-1 Threatened ecological communities listed predicted to occur in the locality

Threatened ecological community	TSC Act	EPBC Act	Occurs within the study area?
Central Hunter Grey Box Ironbark Woodland in the NSW North Coast and Sydney Basin bioregions	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Central Hunter Ironbark – Spotted Gum – Grey Box Forest in the NSW North Coast and Sydney Basin bioregions	**E**		**Yes, mapped as occurring within the site and confirmed during site surveys**
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Freshwater Wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections
Hunter Valley vine thicket in the NSW North Coast and Sydney Basin bioregions	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Hunter Valley Weeping Myall Woodland of the Sydney Basin bioregion	E	CE[*1]	No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Kurri Sand Swamp Woodland in the Sydney Basin bioregion	E		No. Site is outside the range of this community.
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections.

Threatened ecological community	TSC Act	EPBC Act	Occurs within the study area?
Littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions*	E*	CE*2	No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin bioregion	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Swamp Oak Floodplain forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions	**E**		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	**E**		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Sydney Freshwater Wetlands in the Sydney Basin bioregions	**E**		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Warkworth Sands Woodland in the Sydney Basin bioregion	E		No. Not identified within the site either in vegetation mapping of the region or during site inspections.
White Box-Yellow Box-Blakely's Red gum Grassy Woodland and Derived Native Grassland*	E*	CE*3	No. Not identified within the site either in vegetation mapping of the region or during site inspections.
Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley		CE	No. Not identified within the site either in vegetation mapping of the region or during site inspections.

Notes: *There are significant similarities in these TSC and EPBC Act listed communities, however, not all occurrences will fit both listings. Under the EPBC Act, these communities are listed as:
1) Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley.
2) Littoral Rainforest and Coastal Vine Thickets of Eastern Australia.
3) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

4.2 Endangered populations

Four Endangered populations listed under the TSC Act have been identified as occurring in the Hunter/Central Rivers CMA, Hunter sub-catchment (Table 4-2). The preferred habitats of these species are provided in Appendix C (flora) and Appendix D (fauna).

No Endangered populations listed under the FM Act occur within the locality.

No Endangered populations occur within the study area (Table 4-2).

Table 4-2 Endangered populations predicted to occur in the Hunter/Central Rivers CMA, Hunter sub-catchment

Endangered population	Occurs within the study area?
Emu population in the NSW North Coast Bioregion and Port Stephens LGA	No. Site is not within the NSW North Coast Bioregion or Port Stephens LGA
Leionema lamprophyllum ssp. *obovatum* population in the Hunter Catchment	No. *Leionema lamprophyllum* ssp. *obovatum* was not recorded within the study area. The known distribution of this species is to the west of Maitland near Pokolbin in the Hunter Valley, approximately 40 km to the south of the study area.
Eucalyptus camaldulensis (River Red Gum) population in the Hunter Catchment	No. Neither *Eucalyptus camaldulensis* nor its habitat recorded within the study area.
Acacia pendula (Weeping Myall) population in the Hunter Catchment	No. *Acacia pendula* is not a cryptic species and was not recorded within the study area.

Source: (Department of Environment Climate Change and Water 2010b).

4.3 Threatened species

4.3.1 Flora

A total of 39 Threatened flora species listed under the TSC Act and/or EPBC Act are known or predicted to occur in the locality (Appendix C). A further three species are listed as Endangered populations in the region (see Section 4.2). Two Threatened species of plant are considered moderately likely to occur based on the presence of potential habitat. These are:

- *Diuris tricolor* (Pine Donkey Orchid or Tricolour Donkey Orchid) is listed as Vulnerable under the TSC Act.
- *Bothriochloa biloba* (Lobed Blue-grass) is listed as Vulnerable under the EPBC Act.

Other Threatened species known or predicted to occur in the locality are considered unlikely to occur in the study area (Appendix C) for one or more of the following reasons:

- preferred habitat not present
- outside known range of the species and habitat marginal
- species is not cryptic and based on survey effort, would have been recorded if present.

4.3.2 Fauna

A total of 67 Threatened species of animal listed under the TSC Act, FM Act and/or the EPBC Act has been recorded, or are predicted to have habitat in the locality (Appendix D). Four Threatened species of animal, Squirrel Glider, Grey-headed Flying Fox, Grey-crowned Babbler and Little Lorikeet, were recorded in the study area during field surveys (Figure 4-1).

It is not likely, however, that all 67 species would be affected by the project. Thirty-three Threatened species are considered to have a low likelihood of occurrence based on the availability of habitat. Full details of species requirements and reasons for not considering impacts of the Project further are provided in Appendix D.

Significance assessments required under the TSC Act and/or the EPBC Act, have been completed for the remaining 34 species (Section 7 and Appendix E). Although the subject site may provide potential foraging or roosting habitat, albeit poor quality, it is not likely that these species (or any other species) would be significantly affected by the project.

4.4 Migratory species

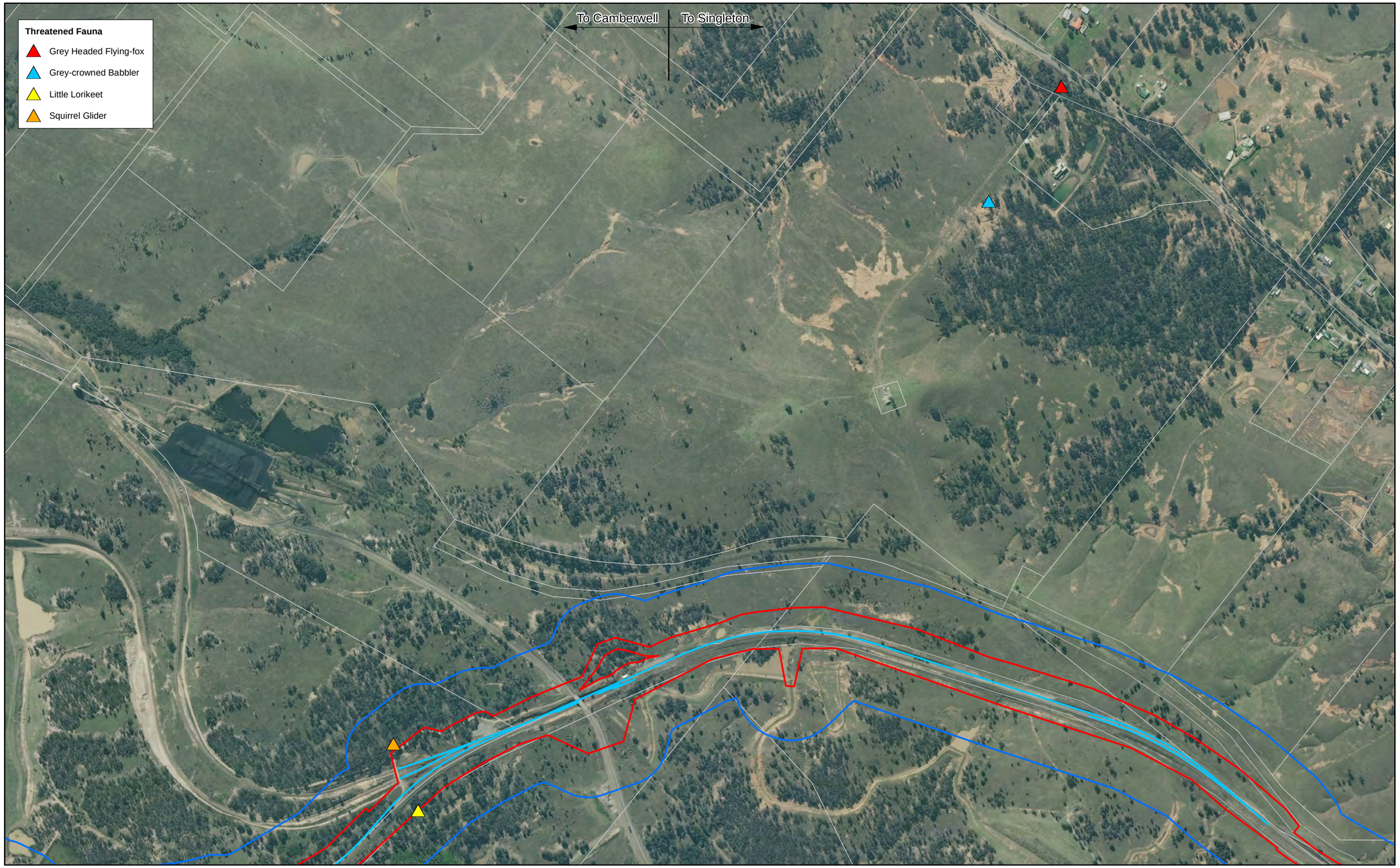
Migratory species are protected under the international agreements to which Australia are a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered Matters of National Environmental Significance and are protected under the EPBC Act.

One species of Migratory bird, Eastern Great Egret, was recorded in the study area during field surveys (Appendix B). A further 14 Migratory species have the potential to occur in the project locality (10 km radius) based on previous reports in the study area, EPBC Protected Matters search, other database searches and experience and knowledge of the area (Appendix D). Of these 6 have a moderate or greater likelihood of occurrence within the study area.

Under the EPBC Act, an action is likely to have a significant impact on a Migratory species if it substantially modifies, destroys or isolates an area of important habitat for the species (Department of the Environment and Heritage 2006). For 7 species of Migratory bird considered likely to occur, including the Eastern Great Egret recorded during field surveys, the study area is not considered to comprise important habitat as it does not contain:

- habitat used by a Migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat that is of critical importance to the species at particular life-cycle stages
- habitat used by a Migratory species that is at the limit of the species' range
- habitat within an area where the species is declining (Department of the Environment Water Heritage and the Arts 2009b).

As such, impacts of the project on Migratory species are not considered further.



A3 Original

0 75 150 300

Meters

GDA 1994 MGA Zone 56

Proposed Third Track Alignment

Study Area

Subject Site

Cadastre

ARTC
Nundah Bank
Proposed Third Track

Job Number	2110501A
Revision	A1
Date	16.02.2011
Scale	1:8,000

Location of Threatened Species Figure 4-1

\\Auncifl\2110501a\NB - Nundah Bank\DE_Design\DE06_Design_Doc\Phase_2\Drafting\GIS\Projects\ESRI\2110501A_GIS_F036_A2.mxd

5. Impacts from the proposal

The project will have both direct and indirect impacts on biodiversity during both the construction and operation phases (Table 5-1). These impacts are described in more detail below.

Table 5-1 Potential impacts of the project on biodiversity

Impacts of the project on biodiversity	Construction	Operation
Vegetation/habitat clearing	•	
Migratory species	•	•
Fragmentation and connectivity	•	
Noise impacts on fauna	•	•
Weed invasion	•	•
Increase in edge effects	•	
Hydrological changes	•	
Aquatic disturbance	•	
Increase in fauna mortality	•	•
Increase in Key Threatening Processes	•	•

5.1 Vegetation and habitat clearing

Clearing of native vegetation is listed as a Key Threatening Process under both the NSW TSC Act and the Commonwealth EPBC Act. Under the TSC Act, native vegetation is made up of plant communities, comprising primarily indigenous species. Clearing is defined as the destruction of a sufficient proportion of one or more strata layers within a stand or stands of native vegetation so as to result in the loss, or long-term modification, of the structure, composition and ecological function of a stand or stands (NSW Scientific Committee 2001).

Construction of the proposal will require the clearing of vegetation and habitats as summarised in Table 5-2. This includes loss of habitat features including tree hollows.

The estimates of vegetation clearing presented below are based on a broad corridor assessment and represent a worst case scenario for impacts to biodiversity. The impacts would be substantially reduced as a result of detailed design.

Table 5-2 Potential loss of vegetation within the subject site

Vegetation community/Fauna habitat	Extent within study area (ha)	Vegetation clearing (ha)
Vegetation		
Central Hunter Spotted Gum – Ironbark – Grey Box Forest[1]	45.24	8.75
Central Hunter Spotted Gum – Ironbark – Grey Box[2] Derived grassland[1]	84.9	13.37
Weed dominated areas	102.53	40.99
Aquatic vegetation along drainage lines and dams	6.29	0.26
Plantation	17.57	0.64
Total area of EEC clearing	**130.14**	**22.12**
Fauna habitats		
Dry open forest[2]	63.39	9.5
Aquatic habitat	6.29	0.26
Cleared land[3]	187.44	54.36

Notes: 1 - Endangered Ecological Community as listed under the *Threatened Species Conservation Act 1995*; 2 – includes plantation and forest; 3 – includes derived grassland and weed dominated vegetation.

5.2 Fragmentation and connectivity

Habitat fragmentation through the clearing of vegetation can increase the isolation of remnant vegetation and create barriers to the movements of small and sedentary fauna such as ground dwelling mammals, reptiles and amphibians. Furthermore, habitat fragmentation can create barriers to the movement of pollinator vectors, such as insects, and thereby affect the life cycle of both common and Threatened flora.

One Threatened species recorded in the study area that may be affected by fragmentation is the Squirrel Glider. A study of the effects of clearing and habitat fragmentation on Squirrel Gliders in the Wyong Local Government Area (Smith 2002a, 2002b) suggests that there is a strong relationship between Squirrel Glider numbers and density and the distance to the nearest remnant. Squirrel Gliders were found to be abundant in remnants isolated by gaps of up to 100 m, but scarce in remnants isolated by gaps of more than 250 m. The study further classified the remnant isolation as follows (Figure 5-1):

- Class 1 – remnants connected to other remnants by a narrow corridor (up to 250 m wide).
- Class 2 – remnants separated from other remnants by a cleared gap (e.g. road or clearing) up to 100 m wide, but with a broad area of contact, including native vegetation on both sides of the gaps for a width of at least 250 m.
- Class 3 – as in Class 2 (above), but with a narrow width of contact is narrow (less than 250 m wide).
- Class 4 – remnants separated from other remnants by cleared areas of 100–400 m in rural environments or 100–200 m in urban environments.

- Class 5 – remnants separated by more than 200 m of urban habitat or 400 m of cleared habitat.

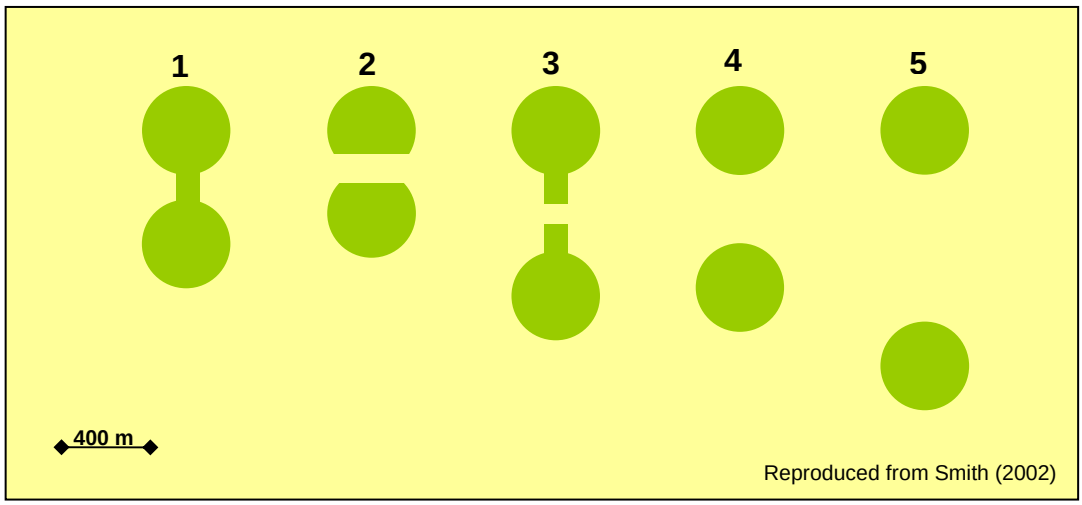


Figure 5-1 Remnant isolation classes

The project would result in the removal of approximately 8.87 ha (including Spotted Gum - Grey Box Forest 8.75 ha and Swamp oak 0.12 ha)of forest occurring in the subject site. Due to the linear nature of the project, the subject site would essentially encroach on vegetation at the interface of existing clearings and easements.

Vegetation in the study area is already isolated/fragmented by existing rail infrastructure, coal mine operations and agriculture developments. This remnant isolation would largely be consistent with Class 4, and over the full extent of the subject site, the project is not likely to further fragment or isolate vegetation anymore than that currently occurring in the study area; given its location adjacent to already disturbed areas.

However, in habitat where the Threatened Squirrel Glider was recorded (Figure 4-1); vegetation is more consistent with Class 2 (Figure 5-1). The project would increase remnant isolation from Class 2 to Class 4 over an approximate 300 m distance (near Integra Coal rail loop), which may effectively inhibit this species from accessing vegetation occurring to the south. While the Squirrel Glider may still access such vegetation (i.e. vegetation near Flora quadrat F, Figure 2-1B) the increased separation distance of up to 75 m is likely to hinder this dispersal.

5.3 Noise impacts on fauna

While the construction phases of the proposal (along with its ancillary activities) may cause temporary disturbance to animals, the impacts from noise emissions are likely to be localised close to the project (up to100 m) and are not likely to have a significant, long-term, impact on wildlife populations. Noise in the subject site would occur during day time hours, and most species that have potential to be disturbed are nocturnal in their habits. Furthermore, it is considered likely that most animal species will habituate to periodic noise disturbance from regular maintenance activities (Forman *et al.* 2000; Larkin 2005) and it is likely that surrounding mining operations and existing rail operations would already have an impact on background levels of noise due to 24 hour operations.

5.4 Weeds

The proposal has the potential to further disperse weeds into areas of native vegetation within the study area, particularly adjacent to cleared areas. The existing rail corridor has a high level of weed invasion, particularly exotic grasses.

The study area also includes four weed species listed under *the Noxious Weeds Act 1993* (see Section 3.3): *Romulea rosea*, Opuntia stricta*, Opuntia aurantiac** and *Lantana camara*.* The latter is also recognised as a Weed of National Significance.

The invasion of exotic perennial grasses, such as *Chloris gayana*, Melinis repens*, Hyparrhenia hirta** that were recorded abundantly within the existing rail corridor, is recognised as a Key Threatening Process under the TSC Act.

The most likely causes of weed dispersal associated with the project would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery.

Existing disturbed vegetation within the study area, however, has considerable weed growth already; therefore, the overall extent of weed invasion is not likely to increase significantly.

5.5 Edge effects

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed and/or temperature) occurring along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different vegetation types and allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. Edge effects have mainly been recorded adjacent to roads and at distances greater than 1,000 m from the road surface (Forman *et al.* 2000). However, Bali (2005), in a comparison of edge effects in a variety of different habitat types, estimated that average edge effects generally occur up to 50 m away from the road edge.

The study area has been extensively cleared. Immediately adjacent to the subject site is an existing railway line. The surrounding area consists of open cut coal mining as well as areas of stock grazing. Forest vegetation occurs as small patches of regenerating woodland fragmented by the existing railway line, derived grassland, open cut coal mining, access tracks and mining roads. Due to the small size of native vegetation patches, the majority are likely to be completed subject to edge effects. As such the project is unlikely to result in a significant increase in edge effects.

5.6 Hydrological changes

Waterway crossings could modify the natural hydrology of creeks in the study area, which could ultimately affect the aquatic assemblages that use the area (Fairfull & Witheridge 2003). Impacts from waterway crossings may include:

- excessive flow velocities, which could erode creek banks and lead to changes in water quality, as well as acting as a barrier to any fish movements in the creek

- modified water depths of the creek or river, which could act as a barrier to fish movement and cause loss of interconnectivity between pools
- increased water turbulence, which could lead to the avoidance of the area by various aquatic organisms.

While a number of dams occurred in the study area, most drainage lines have been modified as a result of coal mine operations, agricultural practices and existing rail infrastructure. However, Station Creek, which (in the study area) runs perpendicular to Middle Falbrook Road, has the potential to be affected by the proposal. It is proposed that the existing bridge over Station Creek would require works to be completed to ensure loads associated with construction traffic can cross Station Creek. Any such works will require erosion and sediment control measures.

5.7 Aquatic disturbance and impacts on fish passage

The proposal would require works to be completed at the location of the small wooden bridge in Middle Falbrook Road to ensure loads associated with construction traffic can cross Station Creek. However, little aquatic disturbance in the study area is expected once construction of any waterway crossing is complete; provided that crossings are designed according to NSW Department of Industry and Investment (Fisheries) guidelines on fish passage (Fairfull & Witheridge 2003), and damage to any aquatic habitat and riparian vegetation during construction is minimised.

Areas of riparian vegetation likely to be damaged or removed during construction should be replanted on completion of works. In addition, appropriate erosion and sediment control measures should be put in place around any proposed waterway crossing prior to construction, to ensure minimal change in water quality due to run-off.

During construction, run-off from disturbed surfaces could potentially affect water quality in local creeks and dams due to sedimentation. In addition, there is the potential for accidental spillage/leakage of rail construction materials including fuels, lubricants and hydraulic oils from construction equipment.

Best practice erosion and sediment controls should be implemented in accordance with Volume 2D of *Managing Urban Stormwater: soils and construction* (Department of Environment and Climate Change 2008a).

5.8 Direct fauna mortality

Fauna injury or death could occur as a result of the project's construction phase, when vegetation and habitats are being cleared. They also have the potential to occur during operation of the rail corridor as a result of collision with survey/maintenance vehicles and through increased rail movements.

While some mobile species, such as birds, have the potential to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, may have difficulty moving over relatively large distances. Threatened species that may be affected by vegetation clearing include Squirrel Gliders, microchiropteran bats and woodland birds.

The proposal would increase the width of an existing linear rail corridor that effectively traverses a modified landscape. This would increase the distance and area for animals to cross and negotiate, increasing the extent of vehicle strikes. Threatened fauna that may be affected by the vehicle strikes include the Squirrel Glider (Claridge & van der Ree 2004) and woodland species of bird such as the Grey-crowned Babbler (Davidson & Robinson 1992; Robinson *et al.* 2001).

It is likely that the proposal would have the greatest impacts near Integra Coal's rail loop, where regrowth/remnant vegetation borders the subject site.

5.9 Key threatening processes

Key Threatening Processes are listed under Schedule 3 of the NSW TSC Act, NSW FM Act and also under the Commonwealth EPBC Act. Key Threatening Processes relevant to this proposal are listed in Table 5-3.

Table 5-3 Key Threatening Processes relevant to the proposal

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Pest species			
Competition and grazing by the feral European rabbit	Competition and land degradation by rabbits		No. Project unlikely to increase this threat anymore than that currently occurring in the study area
Competition and habitat degradation by feral goats	Competition and land degradation by unmanaged goats		No. Feral Goats were not recorded in the study area
Invasion and establishment of the Cane Toad	The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*)		No. Project unlikely to result in invasion or establishment of the Cane Toad
Predation by the European Red Fox	Predation by European red fox		No. Project unlikely to increase this threat anymore than that currently occurring in the study area
Importation of red imported fire ants into NSW	The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant)		No. Project unlikely to result in the importation of red fire ants
Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*)	Predation, habitat degradation, competition and disease transmission by feral pigs		No. This species was not recorded in the study area and the project is unlikely to increase this threat

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Invasion of the yellow crazy ant (*Anoplolepis gracilipes*)	Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean		No. Project unlikely to result in the invasion of the yellow crazy ant
Introduction of the large earth bumblebee (*Bombus terrestris*)			Unlikely. Species not recorded in study area
Predation and hybridisation by feral Dogs (*Canis lupus familiaris*)			Unlikely. Species not recorded in study area
Predation by the Plague Minnow (*Gambusia holbrooki*)			**Possible. Plague Minnow was recorded in one dam in the study area**
Predation by the ship rat (*Rattus rattus*) on Lord Howe Island			No
Predation by feral cats			No. Project unlikely to increase predation by feral cats
Competition from feral honeybees			No. Project is unlikely to increase competition
Herbivory and environmental degradation caused by feral deer			No. Species not recorded in study area
	Predation by exotic rats on Australian offshore islands of less than 1000 km^2 (100,000 ha)		No
Weeds			
Invasion and establishment of exotic vines and scramblers	-		Unlikely. Exotic vines and scramblers not recorded within study area
Invasion, establishment and spread of *Lantana camara**	**-**		**Possible. Lantana recorded within the study area, however, only rarely and in low abundance**
Invasion of native plant communities by bitou bush & boneseed (*Chrysanthemoides monilifera**)	-		Unlikely. Species not recorded within the area

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Invasion of native plant communities by exotic perennial grasses	**-**		**Yes, rail corridor is dominated by exotic perennial grasses and project has potential to spread these to other areas**
	Invasion of northern Australia by Gamba Grass and other introduced grasses		No. Site is not within northern Australia
	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants		Unlikely. Project does not include garden plants
Habitat loss or change			
Clearing of native vegetation[1]	**Land clearance**		**Yes. See Section 5.1**
Human-caused climate change	**Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases**	**Human-caused climate change**	**Unlikely. The alternative is transport using trucks**
Loss of hollow-bearing trees			**Possible. While hollow trees were recorded in the study area, the majority were not located in the subject site**
Removal of dead wood and dead trees			No. the majority of the subject site occurred as an existing maintained easement
Bush rock removal			No. Bush rock was recorded outside the subject site and occurred as deeply imbedded material
Ecological consequences of high frequency fires	-		No. Project unlikely to increase frequency of fires
Loss and/or degradation of sites used for hill-topping by butterflies			No
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners			Unlikely. Project is unlikely to affect the abundance of psyllids or Bell Miners
Alteration of habitat following subsidence due to longwall mining			No. project does not include long wall mining

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Alternation to the natural flow regimes of rivers and streams and their floodplains and wetlands	-		No. Although the There are no natural streams
Disease			
Infection by Psittacine circoviral (beak & feather) disease affecting endangered psittacine species	Disease affecting endangered psittacine species		No. Project unlikely to increase frequency
Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis	Infection of amphibians with chytrid fungus resulting in chytridiomycosis		Unlikely. Project is unlikely to spread chytrid fungus
Infection of native plants by *Phytophthora cinnamomi*[2]	Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)		Unlikely. No evidence of Phytophthora within the study area
Threats to marine species and habitats			
	Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South		No. Project will not impact marine species or areas
	Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations		No. Project will not impact marine species or areas
Death or injury to marine species following capture in shark control programs on ocean beaches		Current shark meshing program in NSW waters	No. Project will not impact marine species or areas
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments	Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris		No. Project will not impact marine species or areas
		Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales	No. Project will not impact marine species or areas

Listed Key Threatening Process			Proposal would increase threat?
TSC Act	**EPBC Act**	**FM Act**	
Impacts to riparian habitats and species			
		The degradation of native riparian vegetation along New South Wales water courses	**The project will require the extension of culverts under existing rail lines to accommodate the new line. There will be some encroachment upon man-made dams/impoundments, but these small impacts are not likely to significantly impact downstream water courses, due to the containment of effects within these water bodies**
		Hook and line fishing in areas important for the survival of threatened fish species	No. Project will not include fishing
		The introduction of fish to fresh waters within a river catchment outside their natural range	No. Project will not include introduction of fish
		The removal of large woody debris from NSW rivers and streams	No. The project will not impact rivers or streams
		Instream structures and other mechanisms that alter natural flow	No. There are no natural streams or rivers that would be impacted by the project

6. Mitigation

The general principle to minimise impacts to biodiversity, should in order of consideration, endeavour to:

- avoid impacts on habitat, through the planning process
- minimise impacts on habitat, through the planning process
- mitigate impacts on habitat, though the use of a range of mitigation measures.

The avoidance of impacts can be achieved through the planning process. This process involves a preliminary examination of a number of possible route options and their potential impacts on the environment and other factors (for example, economic and social considerations). Those potential routes that best fit the environmental, social and economic criteria are then short-listed. This was conducted for the project through the early examination of options prior to selection of the preferred option(SKM 2009a & SKM 2009b).

Minimising impacts involves reducing the loss of habitat or significant species as far as practicable. Through detailed surveys, it is usually possible to fine-tune the final alignment and the width of the footprint to minimise loss of important vegetation communities or habitats and avoid significant plant species or habitat features. The final alignment and footprint are also subject to engineering constraints and safety standards.

The project has undertaken this process through suitable siting of works compounds and access tracks in disturbed areas, avoiding native forest vegetation. The area of impact will also be reviewed throughout the detailed design stage and where possible be reduced. It has been necessary to survey and assess a larger area of impact in this study to provide flexibility for alterations in the design process although it is unlikely that the entire area will need to be disturbed.

Residual impacts that cannot be avoided or minimised are mitigated wherever possible. Depending on vegetation and project type, mitigation measures generally employed during construction can include the following:

- fauna exclusion fencing
- landscaping and revegetation
- site rehabilitation.

In order to address the potential impacts of the proposal on biodiversity, the following mitigation measures are recommended (Table 6-1).

Table 6-1 Proposed mitigation measures

Impact	Mitigation
General	▪ Ensure all workers are provided an environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity and penalties for breaches. ▪ Prepare a flora and fauna management plan as part of the CEMP.
Vegetation and habitat loss	▪ Limit disturbance of vegetation to the minimum necessary to construct works. ▪ Where appropriate mark the limits of clearing and install fencing around the construction footprint area prior to the commencement of construction activities to avoid unnecessary vegetation and habitat removal. ▪ Install nest boxes to offset affected hollow trees where the Threatened Squirrel Glider was located (Figure 4-1). ▪ Implement clearing protocols, including: ▸ marking trees to be removed and preparing an inventory of trees and hollows to be removed ▸ checking hollow-bearing trees for the presence of bird nests and arboreal mammals, such as possum, gliders and bats, prior to felling ▸ animals found to be occupying trees should be safely removed before the clearing of trees and relocated into nearby woodlands ▸ nest boxes or salvaged tree hollows should be provided in nearby woodland for each relocated animal. ▪ Restrict equipment storage and stockpiling of resources to designated areas in cleared land.
Weeds	▪ Develop weed management actions to manage weeds during the construction phase of the proposal. This will include the management of exotic perennial grasses, such as *Chloris gayana*, Melinis repens*, Hyparrhenia hirta** that were recorded abundantly within the existing rail corridor and the four noxious weeds of *Romulea rosea*, Opuntia stricta*, Opuntia aurantiaca** and *Lantana camara** as per the *Noxious Weeds Act 1993*. ▪ Vehicles and other equipment to be used in clearing within the construction zone and general construction equipment (such as excavators, graders etc) are to be cleaned so that they are completely free of soil, seeds and plant material before entering the site to prevent the introduction of further exotic plant species and pathogens.
Direct fauna mortality	▪ Design all drainage structures to incorporate fauna movement capability by ensuring dry status under normal conditions apart from existing box drainage structures under the Camberwell junction. ▪ Reduce the median width to the minimum necessary for safe operation of the project in potential fauna crossing zones.
Fragmentation and connectivity	▪ During design include a crossing zone (with multiple gliding poles) in the area of the Integra Coal loop rail loop, to aid Squirrel Glider movement.

Impact	Mitigation
Aquatic disturbance	▪ Best practice erosion and sediment controls should be implemented in accordance with Volume 2D of *Managing Urban Stormwater: soils and construction* (Department of Environment and Climate Change 2008a). Design temporary scour protection and energy dissipation measures to protect receiving environments from erosion. ▪ Design and construct waterway crossings in accordance with the DPI's *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull & Witheridge 2003). ▪ All water discharge into streams would be guided by the ANZECC Water Quality Guidelines (2000).
Residual impacts	▪ Develop offset strategies to mitigate the residual impacts. This will fulfil the need to improve or maintain as required under *Part 3A of the EP&A Act* 1979.

7. Impact assessment

This chapter summarises the assessment of significance of the potential impacts following the requirements of the EP&A Act 1979 (draft *Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act 1979*) and the EPBC Act.

7.1 Impacts to Threatened biodiversity

Projects assessed under Part 3A of the EP&A Act 1979 do not require assessments of significance under Section 5A of the Act (the Seven Part Test). Instead the assessment is based against heads of consideration detailed in the draft *Guidelines for Threatened Species Assessment*, indicating the significance of the impacts relative to the conservation importance of the habitat, individuals and populations likely to be affected.

Impacts are considered more significant if:

- areas of high conservation value are affected
- individual animals and/or plants and/or subpopulations that are likely to be affected by a Project play an important role in maintaining the long-term viability of the species, population or ecological community
- habitat features are likely to be affected by a Project play an important role in maintaining the long-term viability of the species, population or ecological community
- the impacts were likely to be long-term in duration
- impacts are likely to be permanent and irreversible.

One Threatened ecological community and four Threatened species of animal listed under the TSC Act and/or the EPBC Act, were recorded in the study area. This included:

- Central Hunter Ironbark – Spotted Gum – Grey Box Forest.
- Squirrel Glider.
- Grey-headed Flying-fox.
- Grey-crowned babbler.
- Little Lorikeet.

A further 32 Threatened fauna species have the potential to use the study area as foraging habitat, two Threatened species of flora have potential habitat in the study area and three Endangered Ecological Communities occur within the study area (Table 7-1).

Significance assessments for species recorded or with a moderate or higher likelihood of occurrence were completed (Appendix E). The impacts to Threatened biodiversity are summarised in Table 7-1. This assessment is based on a broad corridor assessment and as such overestimates the area of vegetation and habitats to be cleared. The development footprint would be reduced as a result of ongoing detailed design. Significance assessments for these Threatened ecological communities and Threatened species concluded that the proposal is not likely to result in any significant impact due to the small area (22.12) of native vegetation communities likely to be affected and the existing disturbed nature of the subject site.

Table 7-1 Summary of likely impacts to Threatened biodiversity

Threatened biodiversity		TSC Act[1]	EPBC Act[2]	Recorded?	Impacts						
					Habitat clearing	Fragmentation	Affect the lifecycle	Weeds/pests/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	**Common name**										
Threatened ecological communities											
Central Hunter Ironbark - Spotted Gum – Grey Box Forest		E	-	Yes, dominant community within study area	Yes. 22.12 ha would be cleared (including 8.75 ha of forest and 13.37 ha of derived grassland). No critical habitat would be cleared.	Unlikely. Study area already highly fragmented. Project unlikely to increase fragmentation.	N/A	Potential impact, however, mitigation measures will likelihood of weed spread.	N/A	No	No
Flora											
Bothriochloa biloba			V	No	Yes, 22.12 ha potential habitat would be cleared. No critical habitat would be cleared.	Unlikely. Study area already highly fragmented. Project unlikely to increase fragmentation.	No	Potential impact, however, mitigation measures will likelihood of weed spread.	N/A	No	No
Diuris tricolor	Pine Donkey Orchid	V		No	Yes, 22.12 ha potential habitat would be cleared. No critical habitat would be cleared.	Unlikely. Study area already highly fragmented. Project unlikely to increase fragmentation.	No	Potential impact, however, mitigation measures will likelihood of weed spread.	N/A	No	No
Fauna											
Squirrel Glider		V	-	Yes	Yes, 8.75 ha of known habitat would be cleared.	Yes. Although study area is highly fragmented, proposal would increase fragmentation where species was recorded.		No	No	No	No
Brush-tailed Phascogale		V	-	No	Yes, 8.75 ha of potential habitat would be cleared.	Yes. Although study area is highly fragmented, proposal would potentially increase fragmentation of potential habitats for the species.	No	No	No	No	No
Threatened woodland birds (Brown Treecreeper, Hooded Robin, Scarlet Robin, Flame Robin, Grey-crowned Babbler, Speckled Warbler, Diamond Firetail, Painted Honeyeater and Black-chinned Honeyeater)		V	-	Yes. Grey-crowned Babbler only	Yes, 8.75 ha of potential habitat would be cleared.	Yes. Although study area is highly fragmented, proposal would increase fragmentation for these species.	No	No	No	No	No
Threatened aquatic birds (Black-necked Stork, Blue-billed Duck and Freckled Duck)		V	-	No	Yes, 0.26 ha of potential habitat would be cleared.	No	No	No	No	No	No
Threatened raptors (Little Eagle, Spotted Harrier and Square-tailed Kite)		V	-	No	Yes, 64.14 ha of potential habitat would be cleared.	No	No	No	No	No	No
Threatened owls (Barking Owl, Powerful Owl and Masked Owl)		V	-	No	Yes, 8.75 ha of potential habitat would be cleared.	No	No	No	No	No	No
Threatened opportunistic blossom nomads (Regent Honeyeater, Swift Parrot, Little Lorikeet and Grey-headed Flying-fox)		V	E/V	Yes. Little Lorikeet and Grey-headed Flying-fox	Yes, 9.4 ha (Ironbark, plantation) of known/potential habitat would be cleared.	No	No	No	No	No	No

Threatened biodiversity		TSC Act[1]	EPBC Act[2]	Recorded?	Impacts						
					Habitat clearing	Fragmentation	Affect the lifecycle	Weeds/pests/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name										
Microchiropteran bats (Eastern False Pipistrelle, Eastern Free-tail bat, South-eastern Long-eared Bat, Yellow-bellied Sheathtail Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Little Bent-wing Bat, Eastern Bent-wing Bat, Large-footed Myotis, Eastern Cave Bat)		V	V	No	Yes, 64.14 ha of potential habitat would be cleared.	No	No	No	No	No	No

Notes:
1) TSC Act - *Threatened Species and Conservation Act 1995*. CE = Critically Endangered, E1 = Endangered V = Vulnerable E2= Endangered Population.
2) EPBC Act - *Environmental Protection and Biodiversity Conservation Act 1999*. CE = Critically Endangered, E = Endangered V = Vulnerable.

7.2 Assessment against the Part 3A criteria

Under the draft *Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act 1979*, the objective of the biodiversity assessment process is to provide information to enable decision-makers to ensure that developments deliver the environmental outcomes outlined and discussed in Sections 7.1.1 to 7.1.5.

7.2.1 Improve or maintain biodiversity values

The term 'improve or maintain' is defined in the draft *Guidelines for Threatened Species Assessment under Part 3A of the EP&A Act* 1979 as 'no net impact on threatened species or native vegetation'. Given that the Project would result in clearing of native vegetation, including an Endangered Ecological Community and habitat for Threatened species, it would be necessary to develop offset strategies to fulfil this outcome.

7.2.2 Conserve biological diversity and promote ecologically sustainable development

The Project maintains vegetation in the study area (where practicable) by locating access roads, stockpiles and construction compounds in disturbed and cleared areas and locating the additional track adjacent to existing tracks. Recommendations have also been provided in Section 6 to mitigate potential effects on biodiversity.

7.2.3 Protect areas of high conservation value (including areas of critical habitat)

There is no critical habitat as defined under the TSC Act within the Project locality. Although much of the vegetation within the study area is consistent with an Endangered ecological community (Central Hunter Ironbark – Spotted Gum – Grey Box Forest, listed under the TSC Act), this vegetation has been previously cleared, occurs as small fragmented patches and is in poor to moderate condition. As such it is not considered to be of high conservation value. Mitigation measures have been included to further minimise impacts on Threatened biodiversity (Section 6).

7.2.4 Protect the long-term viability of local populations of a species, population or ecological community

The vegetation and habitats within the study area are disturbed and fragmented by existing mining, rail, tracks and cleared grazing land. Clearing for the project has been minimised by avoiding native vegetation and habitats where practical. Mitigation measures have been recommended in this assessment (Section 6) to further minimise impacts to local biodiversity. As a result, the long-term viability of biodiversity would be protected. The project is unlikely to significantly impact any Threatened species, populations or communities or affect their long-term viability.

7.2.5 Protect aspects of the environment that are matters of National Environmental Significance

Matters of national environmental significance are listed under the EPBC Act and include:

- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Ramsar wetlands of international importance.
- The Commonwealth marine environment.
- World Heritage properties.
- National Heritage places.
- Great Barrier Reef Marine Park.
- Nuclear actions.

The study area includes habitat (or potential habitat) for one Threatened species of plant and five Threatened species of animal listed under the EPBC Act. Significance assessments for these Threatened species (Appendix E) concluded that the proposal is not likely to result in any significant impact due to the small area (22.12 ha) of native vegetation communities and fauna habitats (64.14 ha) likely to be affected and the existing disturbed nature of the subject site.

No other Matters of National Environmental Significance occur within the study area.

8. Offsets

8.1 Is an offset required?

The need for biodiversity offsets is founded in the theory of 'avoid, minimise, mitigate' the impacts of proposals. The accepted approach to environmental mitigation require that, in the first instance, environmental impacts are avoided or minimised as far as possible and subsequently reduced to acceptable levels through appropriate mitigation techniques. Where measures to avoid and mitigate impacts are not feasible or cost effective, then offset strategies can be used to compensate the residual impacts of the development on biodiversity. Ideally offsets should be undertaken prior to development to provide certainty that the offsets are effective and to ensure that there would be no net loss in biodiversity (Department of Environment and Conservation 2005).

Under Part 3A of the EP&A Act 1979 there is a requirement for 'no net impact on threatened species or native vegetation'. Furthermore, the Director-General's requirements include consideration of the Principles for the use of biodiversity offsets in NSW (Department of Environment and Climate Change 2008b). These principles outline how to develop biodiversity offsets in situations where a loss of biodiversity is expected.

More requirements on offsets were provided by DECCW. The Department require the EA to '*detail the actions that will be taken to ….**compensate or offset for unavoidable impacts of the project on threatened species, populations, ecological communities and their habitats**'.*

Given that the Project would result in clearing of native vegetation, including an Endangered Ecological Community and habitat for Threatened species, it would be necessary to develop offset strategies to fulfil the requirements of 'maintain and improve' requirements of the Part 3A assessment and the Director General's and DECCW's requirements.

8.2 Offsets for the project

Potential offsets for the project are being investigated. These would be developed in accordance with the Principles for the use of biodiversity offsets in NSW (Department of Environment and Climate Change 2008b) provided below in Table 8-1.

Table 8-1 Assessment of Biodiversity Offset Strategy against DECCW Offsets requirement

DECCW principles for offsets (Department of Environment and Climate Change 2008)	Response
Impacts must be avoided first by using prevention and mitigation measures.	A general principle of environmental management is to, in order of preference: ▪ avoid environmental impacts ▪ minimise impacts ▪ mitigate the impacts. Where impacts cannot be avoided or minimised, compensate for the residual impacts using other mitigation measures such as offsets. These principles have been followed, where possible, for the Project.
All regulatory requirements must be met.	These have been followed, where possible, for the Project. DECCW have identified the projects offsets should meet the quantum of offsets determined by the BioBanking credit calculator.
Offsets must never reward ongoing poor performance.	ARTC is not known to have a history of poor performance. The existing operation of the rail infrastructure has been satisfactory to all regulatory authorities.
Offsets will complement other government programs.	The offsets proposed consider the landscape and assessment requirements for determining offsets requirements under the NSW BioBanking Assessment Scheme.
Offsets must be underpinned by sound ecological principles.	The offsets strategy has been developed in accordance with the following broad ecological principles: ▪ Distance from proposal. ▪ Presence of Threatened biodiversity. ▪ Current condition and potential for improvement. ▪ Connectivity. ▪ Management issues. ▪ 'Like for Like'. ▪ Improve or Maintain.
Offsets should aim to result in a net improvement in biodiversity over time.	The biodiversity offsets strategy will aim to result in a net improvement in biodiversity over time.
Offsets must be enduring and they must offset the impact of the development for the period that the impact occurs.	It is proposed the Offset strategy will be designated for conservation with binding title agreements attached to the properties in-perpetuity.
Offsets should be agreed prior to the impact occurring.	The Offset Strategy is currently being developed and commitment to an appropriate offset suitable for agencies approval is likely to be finalised prior to the approval of the Project.

DECCW principles for offsets (Department of Environment and Climate Change 2008)	Response
Offsets must be quantifiable (the impacts and benefits must be reliably estimated).	The ecological characteristics, including areas of remnant vegetation and rehabilitation will be calculated using the best available information and incorporate the BioBanking assessment methodology. It is likely that further ground truthing and surveys of the final offsets site will be completed prior to finalisation of the strategy.
Offsets must be targeted.	The offsets will meet the 'like for like' or better criteria of similar condition, size and conservation significance, including the Threatened Central Hunter Spotted Gum Ironbark-GreyBox Forest ;and/or other suitable vegetation types as identified in the BioBanking assessment, namely, Broad-leaved Stringybark- Blakely's Red Gum grassy woodlands of the gorges and upper Hunter Valley, north coast (HU517); or, Spotted Gum- Broad – leaved ironbark grassy open forest of dry hills of the lower Hunter Valley, Sydney Basin (HU629).
Offsets must be located appropriately.	All of the proposed offsets will be located within Hunter CMA boundary in accordance with the NSW BioBanking Assessment Scheme.
Offsets must be supplementary.	The Projects offsets will be supplementary to a range of strategies including ongoing mitigation and management activities, changes in land management, restoration rehabilitation.
Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	It is proposed the Offset strategy will be designated for conservation with binding title agreements attached to the properties in-perpetuity.

Options being considered include combining offsets with the approved Maitland to Minimbah Third Track – Environmental Assessment (Hunt8r Alliance 2010) and BioBanking Scheme.

9. Conclusion

This report provides a worst case scenario for impacts of the project on biodiversity as it provides a broad corridor assessment. The area of vegetation and habitats to be cleared would be reduced as a result of ongoing detailed design.

The proposal will include the removal of 22.12 ha of native vegetation, including 8.75 ha of Central Hunter Ironbark – Spotted Gum – Grey Box Forest, which is listed as a Threatened ecological community under the TSC Act.

No Threatened ecological community listed under the EPBC Act was recorded in the study area.

No Endangered Population listed under the TSC Act and/or the EPBC Act was identified or was considered likely to occur in the study area.

No Threatened species of plant listed under the TSC Act or the EPBC Act was identified in the study area. However, significance assessments were completed on two Threatened plant species, *Diuris tricolor* (Vulnerable under the TSC Act) and *Bothriochloa biloba* (Vulnerable under the EPBC Act), based on the presence of potential habitat. These assessments concluded that the proposal was unlikely to have a significant impact on these species due to the small area (22.12 ha) of potential habitat likely to be affected, its disturbed and fragmented nature and ongoing disturbance.

Four Threatened species of animal listed under the TSC Act and/or the EPBC Act were recorded in the study area including, Squirrel Glider, Grey-crowned Babbler, Little Lorikeet and Grey-headed Flying-fox. Significance assessments were also completed on a further 36 Threatened species of animal, based on the presence of suitable habitat. Significance assessments completed for these species (Table 7-1 and Appendix E) concluded that the proposal was not likely to have a significant impact for one or more of the following reasons:

- The subject site essentially followed disturbed easements with no preferred habitat recorded therein.
- The study area existed as highly fragmented and isolated regrowth/remnant vegetation.
- The subject site lacked important microhabitat elements such as roosting and breeding habitat (i.e. large tree hollows).
- The species' were highly mobile and while the subject site potentially occurred as part of a larger home range, the species would use larger tracts of vegetation/habitat in the locality and not the study area exclusively.

Therefore, the proposal is not likely to have a significant impact on the ecological features of the local area. Although the impacts to threatened biodiversity are not considered to be significant, given that the Project would result in clearing of native vegetation, including an Endangered Ecological Community and habitat for Threatened species, it would be necessary to develop offset strategies to fulfil the requirements of 'maintain and improve' requirements of the Part 3A assessment and the Director General's and DECCW's requirements.

Offsets are discussed further in the *Nundah Bank rail upgrade – Offsets discussion paper* {Parsons Brinckerhoff, 2010 #3211}.

10. References

Australian Government 2004, *Australian code of practice for the care and use of animals for scientific purposes 7th Edition 2004*, endorsed by the NHMRC, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australian Research Council (ARC) and the Australian Vice-Chancellor's Committee (AV-CC). Canberra.

Bali, R 2005, *Discussion Paper - Compensating for Edge Effects*, Ecosense Consulting for the NSW Roads and Traffic Authority, Sydney.

Brooker, MIH, Slee, AV, Connors, JR & Duffy, SM 2002, *Euclid: Eucalypts of Southern Australia*, CSIRO Publishing, Collingwood.

Claridge, AW & van der Ree, R 2004, 'Recovering endangered populations in fragmented landscapes: the squirrel glider *Petaurus norfolcensis* on the south-west slopes of New South Wales', in D Lunney (ed.), *Conservation of Australia's Forest Fauna (second edition)*, Royal Zoological Society of New South Wales, Mosman, pp. 678–87.

Cropper, SC 1993, *Management of Endangered Plants*, CSIRO Australia, Melbourne.

Davidson, I & Robinson, D 1992, *Grey-crowned Babbler Action Statement No 34* Department of Sustainability and Environment, Victoria.

Debus, SJS 1995, 'Surveys of large forest owls in Northern New South Wales: methodology, calling behaviour and owls responses', *Corella*, vol. 19, no. 2, pp. 38-50.

Department of Environment and Climate Change 2007a, *Introducing the NSW threatened species priorities action statement (PAS)*, Department of Environment and Climate Change,, Sydney South NSW.

Department of Environment and Climate Change 2007b, *Threatened species assessment guidelines. The assessment of significance*, Department of Environment and Climate Change, Hurstville.

Department of Environment and Climate Change 2008a, *Managing Urban Stormwater: soils and construction, Vol 2D: main road construction*, Department of Environment and Climate Change NSW, South Sydney.

Department of Environment and Climate Change 2008b, *Principles for the use of biodiversity offsets in NSW*, <http://www.environment.nsw.gov.au/biocertification/offsets.htm>.

Department of Environment and Conservation 2004, *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft)*, Department of Environment and Conservation, Hurstville.

Department of Environment and Conservation & Department of Primary Industries 2005, *Draft guidelines for Threatened species assessment under Part 3A*, Department of Environment and Conservation, Hurstville.

Department of Environment Climate Change and Water 2010a, *Atlas of NSW Wildlife*, Department of Environment Climate Change and Water, <http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp>.

Department of Environment Climate Change and Water 2010b, *Threatened species, populations and communities database* Department of Environment, Climate Change and Water, <http://www.threatenedspecies.environment.nsw.gov.au/>.

Department of the Environment and Heritage 2006, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*, Department of the Environment and Heritage, Canberra.

Department of the Environment Water Heritage and the Arts 2009a, *Census of Australian Vertebrates*, Department of Environment, Water, Heritage and the Arts, <http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/index.html>.

Department of the Environment Water Heritage and the Arts 2009b, *EPBC Act Policy Statement 1.1 Matters of National Environmental Significance, Significant Impact Guidelines*, Department of the Environment Water Heritage and the Arts, Canberra.

Department of the Environment Water Heritage and the Arts 2010a, *Protected Matters Search Tool*, Department of the Environment, Water, Heritage and the Arts, <http://www.deh.gov.au/erin/ert/epbc/index.html >.

Department of the Environment Water Heritage and the Arts 2010b, *Survey guidelines for Australia's Threatened frogs*, Department of the Environment, Water, Heritage and the Arts, Canberra.

ERM 2009, *Integra underground coal project: flora and fauna assessment*, Thornton.

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

Forman, RTT, Sperling, D, Bissonette, JA, Clevenger, AP, Cutshall, CD, Dale, VH, Fahrig, L, France, R, Goldman, CR, Heanue, K, Jones, JA, Swamson, FJ, Turrentine, T & Winter, TC 2000, *Road Ecology. Science and Solutions.*, Island Press, Washington.

Goldingay, RL 2009, 'Characteristics of tree hollows used by Australian birds and bats', *Wildlife Research*, no. 36, pp. 394-409.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1 (Revised Edition)*, University of New South Wales Press Ltd., Kensington.

Harden, G 2002, *Flora of New South Wales Volume 2 (Revised Edition)*, 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

Kavanagh, RP & Debus, SJS 1994, 'The Powerful Owl *Ninox strenua* in New South Wales', *Australian Birds*, vol. 28, supplement 21-38.

Keith, D 2004, *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT* Department of Environment and Conservation, Hurstville.

Larkin, RP 2005, *Effect of Military Noise on Wildlife*, viewed 11/12/2009 2009, <http://www.aerohabitat.org/link/2005/09-06-2005%20-%20Larkin,%20Effect%20military%20noise%20and%20wildlife%20(0.4MB).pdf>.

NSW Department of Environment and Conservation 2005, *BioMetric - Version 1.8*, NSW Department of Environment and Conservation, Hurstville.

NSW Department of Environment and Conservation 2007, *Field Data Sheets for BioMetric (Version 1.8)*, NSW Department of Environment and Conservation, Hurstville.

NSW Department of Environment, CCaW 2009, *Threatened Species survey and assessment guidelines: field survey and methods for fauna- Amphibians.*

NSW Department of Natural Resources 2005, *Native Vegetation Regulation 2005 Environmental Outcomes Assessment Methodology*, NSW Government, Sydney.

NSW National Parks and Wildlife Service 2001, *Hygiene protocol for the control of disease in frogs. Information Circular Number 6*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002, *Landscapes (Mitchell) of NSW*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003, *The Bioregions of New South Wales: their biodiversity, conservation and history*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2001, *Final determination to list the clearing of native vegetation as a key threatening process*, NSW National Parks and Wildlife Service, Hurstville.

Peake, TC 2005, *The Vegetation of the Central Hunter Valley, New South Wales. A report on the findings of the Hunter remnant vegetation project. Final Draft Version 1*, Hunter - Central Rivers Catchment Management Authority, Paterson.

Pennay, M, Law, B & Reinhold, L 2004, *Bat calls of NSW. Region based guide to the echolocation calls of microchiropteran bats*, New South Wales Department of Environment and Conservation and State Forests of New South Wales, Sydney.

Robinson, D, Davidson, I & Tzaros, C 2001, *Biology and conservation of the Grey-crowned Babbler in Victoria*, Department of Natural Resources and Environment, East Melbourne.

Royal Botanic Gardens 2006, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <http://plantnet.rbgsyd.nsw.gov.au/>.

Royal Botanic Gardens 2010, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <http://plantnet.rbgsyd.nsw.gov.au/>.

Seidel, J & Briggs, S 2008, *Biobanking Operation Manual* NSW Department of Environment and Climate Change, Sydney.

SKM 2009a, *Nundah Bank concept assessment report*, Newcastle West.

SKM 2009b, *Nundah project preliminary environmental assessment*, Newcastle West.

Smith, A 2002a, *Effects of Clearing and Fragmentation on the Squirrel glider (Petaurus norfolcensis: Petauridae).* A report to Wyong Shire Council by Austeco Environmental Consultants, Armidale.

Appendix A

Flora recorded

Table A.1 Species of plant recorded

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
Acanthaceae	*Brunoniella australis*	Blue Trumpet		Y	Y				2	1	2		1	2
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair						Y						
	Cheilanthes distans	Bristly Cloak Fern		Y		Y							1	
	Cheilanthes sieberi	Mulga Fern		Y	Y	Y		Y	2	2	2	2	2	3
Alliaceae	*Nothoscordum borbonicum*	Onion Weed	*					Y						
Anthericaceae	*Arthropodium minus*	Small Vanilla Lily						Y						
	Laxmannia gracilis			**Y**										
Apiaceae	*Apium prostratum*			Y								1		1
	Foeniculum vulgare	Fennel	*			Y		Y						
	Hydrocotyle peduncularis							Y						
	Unknown sp.			Y	Y				2	1		2		
	Platysace tridentata			Y									1	
Asclepiadaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	*	Y	Y	Y		Y	1					
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*	Y		Y		Y		1		1		
Asteraceae	*Brachyscome multifida*			Y										
	Calotis cuneifolia			**Y**							**3**		**3**	
	Calotis hispidula	Bogan Flea						Y						
	Calotis lappulacea			Y							1			

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Calotis sp.							Y						
	Cassinia aculeata	Dolly Bush						Y						
	Chondrilla juncea	Skeleton Weed	*	Y				Y						
	Chrysocephalum apiculatum	**Common Everlasting**		**Y**	Y			**Y**	**3**	**1**	**2**			**1**
	Cirsium vulgare	Spear Thistle	*	Y		Y		Y		1		1	1	
	Conyza bonariensis	Flaxleaf Fleabane	*	Y		Y		Y						
	Cymbonotus australis			Y	Y				2	2		3		
	Hypochaeris radicata	Catsear	*	Y	Y	Y		Y	2					
	Lactuca serriola		*			Y								
	Onopordum acanthium		*			Y		Y						
	Onopordum acanthium ssp. acanthium	Scotch Thistle	*					Y						
	Ozothamnus diosmifolius			Y						1				
	Senecio madagascariensis	Fireweed	*	Y	Y	Y		Y	2		2	2	2	1
	Senecio sp. 1			Y							1			
	Senecio sp. ?lautus			Y				Y			2			
	Senecio sp. 2			Y									1	
	Sonchus oleraceus	Common Sowthistle	*	Y	Y	Y		Y	1		1	1		1
	Tagetes minuta	Stinking Roger	*					Y						
	Taraxacum officinale	Dandelion	*	Y		Y		Y		1				2

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Vernonia cinerea var. cinerea			Y										
	Vittadinia cuneata			Y							2			
	Vittadinia gracilis							Y						
	Xanthium occidentale	"Noogoora Burr, Cockle Burr"	*					Y						
Azollaceae	*Azolla filiculoides*							Y						
Basellaceae	*Anredera cordifolia*	Madeira Vine	*					Y						
Boraginaceae	*Echium plantagineum*	Patterson's Curse	*					Y						
	Echium sp.		*					Y						
Brassicaceae	*Brassica juncea*	Indian Mustard	*			Y		Y						
	Capsella bursa-pastoris	Shepherd's Purse	*			Y		Y						
Cactaceae	*Opuntia aurantiaca*	Tiger Pear	*	Y		Y		Y						
	Opuntia humifusa	Creeping Pear	*					Y						
	Opuntia stricta var. stricta	Common Prickly Pear	*	Y	Y	Y		Y	1		1		1	1
Campanulaceae	***Wahlenbergia gracilis***	**Sprawling or Australian Bluebell**		**Y**		**Y**		**Y**		**1**				
	Wahlenbergia stricta	Tall Bluebell		Y	Y	Y		Y	1					
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak		Y	Y	Y		Y	1	1				2
	Casuarina cunninghamiana ssp. cunninghamiana	"River Oak, River Sheoak"						Y						
	Casuarina glauca	Swamp Oak				Y		Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Einadia hastata	Berry Saltbush						Y						
	Einadia nutans ssp. linifolia			Y		Y		Y				1	1	
	Einadia sp.							Y						
	Enchylaena tomentosa	Ruby Saltbush		Y				Y			1			
	Maireana enchylaenoides	Wingless Bluebush		Y										
	Maireana microphylla			Y				Y						
Clusiaceae	*Hypericum gramineum*			Y	Y				2			2		3
Commelinaceae	*Commelina cyanea*	Native Wandering Jew						Y						
	Tradescantia fluminensis	Wandering Jew	*					Y						
Convolvulaceae	*Convolvulus erubescens*					Y		Y						
	Dichondra repens	Kidney Weed		Y	Y	Y		Y	2	3		3	3	3
Crassulaceae	*Crassula sp.*							Y						
Cucurbitaceae	*Citrullus lanatus var. lanatus*	"Wild Melon, Camel Melon,Bitter"	*					Y						
	Carex sp			Y										2
	Cyperus bifax						Y	Y						
	Cyperus brevifolius		*				Y	Y						
	Cyperus exaltatus						Y	Y						
	Cyperus iria							Y						
	Cyperus sp.			Y		Y	Y	Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Schoenoplectus mucronatus						Y	Y						
Dilleniaceae	*Hibbertia obtusifolia*			Y										1
	Hibbertia sp.			Y						1				
Droseraceae	***Drosera pygmaea***	**Pygmy Sundew**												
Epacridaceae	***Lissanthe strigosa***			**Y**										**1**
	Euphorbia peplus	Petty Spurge	*			Y		Y						
	Phyllanthus sp.							Y						
	Ricinus communis	Castor Oil Plant	*			Y		Y						
Fabaceae (Faboideae)	*Bossieae prostrata*			Y						1				1
	Daviesia genistifolia	Broom Bitter Pea		Y		Y		Y						
	Daviesia ulicifolia	Gorse Bitter Pea		Y				Y		1	3	1	2	
	Daviesia ulicifolia ssp. ulicifolia							**Y**						
	Desmodium varians	Slender Tick-trefoil						Y						
	Glycine clandestina			**Y**		**Y**		**Y**		**2**	**1**	1		
	Glycine microphylla			Y	Y	Y		Y	2		1			
	Glycine sp.							Y						
	Glycine tabacina			**Y**				**Y**					**1**	**1**
	Hardenbergia violaceae			Y						1	1			
	Pultenaea retusa							Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Templetonia stenophylla			Y						2				
	Trifolium sp.		*			Y		Y						
Fabaceae (Mimosoideae)	*Acacia amblygona*	Fan Wattle		Y	Y	Y		Y	1	1	3		3	
	Acacia concurrens	Curracabah						Y						
	Acacia falcata			**Y**		**Y**		**Y**				2	**1**	
	Acacia parvipinnula	**Silver-stemmed Wattle**						**Y**						
	Acacia decora			Y									1	
	Acacia ulicifolia			Y							2			
Geraniaceae	*Geranium solanderi*	Native Geranium		Y		Y		Y						
Goodeniaceae	*Goodenia bellidifolia*							Y						
	Goodenia cycloptera			Y							1			2
	Goodenia sp.			Y										2
Hydrocharitaceae	*Ottelia ovalifolia*	Swamp Lily						Y						
Iridaceae	*Romulea rosea*		*	Y	Y	Y								
Juncaceae	*Juncus acutus ssp. acutus*	Sharp Rush	*			Y	Y	Y						
	Juncus cognatus		*				Y	Y						
	Juncus subsecundus							Y						
	Juncus usitatus							Y						
Lamiaceae	*Ajuga australis*	Austral Bugle		Y							1	2	2	1

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Marrubium vulgare	Horehound	*	Y	Y	Y		Y	2					
Lobeliaceae	*Pratia purpurascens*	Whiteroot		Y				Y		2		3	1	3
Loganiaceae	***Mitrasacme alsinoides***													
Lomandraceae	*Lomandra confertifolia*	Mat-rush						Y						
	Lomandra longifolia	Spiny-headed Mat-rush		Y				Y					2	
	Lomandra multiflora ssp. multiflora	**Many-flowered Mat-rush**		**Y**	Y			**Y**	**2**	**2**	**2**	2		**2**
Malvaceae	*Lagunaria patersonia*	Norfolk Island Hibiscus						Y						
	Malva parviflora	Small-flowered Mallow	*	Y		Y		Y						
	Sida rhombifolia	Paddy's Lucerne	*	Y		Y		Y						
Meliaceae	*Melia azedarach*	White Cedar						Y						
Myoporaceae	*Eremophila debilis*	Amulla		Y				Y		1	1	1	1	1
	Myoporum montanum	Western Boobialla		Y				Y				1		
Myrtaceae	*Angophora costata*	Sydney Red/Rusty Gum						Y						
	Angophora floribunda	Rough-barked Apple		Y		Y		Y						3
	Callistemon salignus	Willow Bottlebrush						Y						
	Corymbia maculata			**Y**				**Y**		**3**	**1**		**1**	
	Eucalyptus blakelyi	**Blakely's Red Gum**		**Y**				**Y**						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Eucalyptus crebra	**Narrow-leaved Ironbark**		**Y**	Y	**Y**		**Y**	**2**	**3**	**1**			
	Eucalyptus fibrosa	Red Ironbark		Y				Y						
	Eucalyptus melliodora	Yellow Box						Y						
	Eucalyptus moluccana	**Grey Box**		**Y**	Y			**Y**	**1**				**3**	
	Eucalyptus punctata	Grey Gum		Y				Y						
	Eucalyptus tereticornis	Forest Red Gum		Y				Y					1	
	Melaleuca armillaris							Y						
	Melaleuca hypericifolia							Y						
	Melaleuca styphelioides	Prickly-leaved Tea Tree						Y						
	Melaleuca thymifolia							Y						
	Notelaea microcarpa var. microcarpa	Native Olive		Y						1				
Onagraceae	*Epilobium billardiereanum ssp. cinereum*							Y						
	Ludwigia peploides			Y				Y					2	
	Oenothera sp.							Y						
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*					Y						
	Oxalis perennans			Y				Y		1				1
Oxalidaceae	***Oxalis rubens***			**Y**										
	Oxalis sp.							Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
Phormiaceae	*Dianella prunina*			Y				Y						
	Dianella revoluta var. revoluta	**Blue Flax-lily**		**Y**						3	2	3	2	1
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush						Y						
Phytolacaceae	*Phytolacca octandra*		*			Y								
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		Y									1	1
Pittosporaceae	***Bursaria spinosa***	**Native Blackthorn**						**Y**						
Plantaginaceae	*Plantago cunninghamii*			Y	Y			Y			2	2	1	2
	Plantago lanceolata	Lamb's Tongues	*	Y	Y			Y	2	2		2		
Poaceae	***Aristida lignosa***													
	Aristida ramosa							**Y**						
	Aristida vagans	**Threeawn Speargrass**		**Y**	Y			**Y**	**3**		**3**	3	**3**	**3**
	Austrodanthonia bipartita	Wallaby Grass		Y				Y						
	Austrodanthonia sp.			Y				Y		2	2		2	2
	Austrostipa ?wakoolika			Y										2
	Austrostipa aristiglumis			Y	Y									
	Austrostipa scabra			Y	Y									
	Austrostipa sp.	Spear Grass		Y	Y			Y	3	3				
	Austrostipa verticillata			Y				Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Axonopus affinis	Narrow-leaved Carpet Grass	*			Y	Y	Y						
	Bothriochloa decipiens	Red Grass		Y	Y			Y	3		2	2	2	
	Bothriochloa macra	Red Grass						Y						
	Bromus catharticus	Prairie Grass	*					Y						
	Chloris gayana	Rhodes Grass	*	Y		Y	Y	Y					2	
	Chloris truncata	Windmill Grass		Y	Y			Y	2		2	1	1	
	Chloris ventricosa			Y										
	Cymbopogon refractus	**Barbed Wire Grass**		**Y**	Y			**Y**	**2**	**3**	**3**	3	**3**	
	Cynodon dactylon	Common Couch		Y	Y			Y	2	1	1	1	1	
	Dichanthium sericeum	Queensland Bluegrass			Y			Y	3					
	Dichelachne micrantha	Shorthair Plumegrass		Y				Y			3		1	
	Digitaria divaricatissima	Umbrella Grass						Y						
	Echinopogon caespitosus			Y								1	1	
	Ehrharta erecta	Panic Veldtgrass	*			Y	Y	Y						
	Entolasia stricta	**Wiry Panic**		**Y**				**Y**			**2**			**2**
	Eragrostis brownii	Brown's Lovegrass		Y	Y			Y			3	2	1	2
	Eragrostis cilianensis	Stinkgrass	*			Y		Y						
	Eragrostis leptocarpa			**Y**										
	Hyparrhenia hirta	*		Y						2				

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
	Imperata cylindrica			Y						2				
	Melinis repens	Red Natal Grass	*	Y		Y		Y		1			1	
	Microlaena stipoides			**Y**	**Y**					**2**			**2**	**2**
	Panicum simile	Two-colour Panic		Y	Y			Y		2			2	2
	Panicum sp.							Y						
	Paspalum dilatatum	Paspalum	*			Y		Y						
	Pennisetum clandestinum	Kikuyu Grass	*			Y		Y						
	Pennisetum setaceum	Fountain Grass	*			Y		Y						
	Poa annua	Winter Grass	*					Y						
	Setaria gracilis		*	Y	Y	Y							1	
	Sporobolus creber	Slender Rat's Tail Grass		Y				Y			3			
	Sporobolus indicus var. capensis	Parramatta Grass	*					Y						
	Sporobolus sp.							Y						
	Stipa sp.							Y						
	Themeda australis			Y	Y					3	3		2	2
	Zoysia macrantha	Prickly Couch						Y						
Polygonaceae	*Acetosa sagittata*	Rambling Dock	*			Y	Y	Y						
	Persicaria decipiens	Slender Knotweed						Y						
	Rumex brownii	Swamp Dock					Y	Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
Primulaceae	*Anagallis arvensis*	Scarlet/Blue Pimpernel	*	Y	Y	Y	Y	Y	2		1	2	1	2
Proteaceae	*Hakea decurrens*							Y						
	Hakea sp.							Y						
	Helicia glabriflora							Y						
Rosaceae	*Rubus discolor*	Blackberry	*					Y						
Rubiaceae	*Galium aparine*			Y							2	1	1	
	Richardia humistrata	*		Y							2		1	
Salicaceae	*Salix babylonica*	Weeping Willow	*					Y						
Sapindaceae	*Dodonaea viscosa*			Y				Y			1			
Scrophulariaceae	*Veronica plebeia*	Trailing Speedwell		Y	Y			Y	1					
Solanaceae	*Cestrum parqui*	Green Cestrum	*			Y		Y						
	Lycium ferocissimum	African Boxthorn	*					Y						
	Solanum cinereum	Narrawa Burr						Y						
	Solanum nigrum	Black-berry Nightshade	*	Y		Y		Y				1		1
	Solanum papaverifolium													
	Solanum prinophyllum	Forest Nightshade		Y				Y				2		1
	Solanum pungetium	Eastern Nightshade		Y				Y						
	Solanum sp.							Y						
Thelypteridaceae	*Christella dentata*							Y						

Family	*Scientific name*[A]	Common Name	Exotic species	Spotted Gum-Ironbark-Grey Box		Weed dominated	Aquatic vegetation	Literature[C]	Quadrat[D]					
				Forest	Derived grassland				A	B	C	D	E	F
Thymelaceae	*Pimelea curviflora var. sericea*			Y									1	
Typhaceae	*Typha domingensis*	Narrow-leaved Cumbungi					Y	Y						
	Typha orientalis	Broad-leaved Cumbungi						Y						
Verbenaceae	*Verbena bonariensis*	Purpletop	*	Y		Y	Y	Y						
Native species		167		100	29	18	6	118	22	32	37	26	39	32
Total species count		226		122	39	56	15	172	30	38	41	33	46	38

Notes: A) * indicates an exotic species
B) Bold indicates a positive or constant diagnostic species for Central Hunter Spotted Gum- Ironbark-Grey Box Forest according to Peake {, 2005 #575}
C) Recorded in assessments undertaken in the study area (see Section
D) Cover abundance scores:

1. 5%- rare or few individuals
2. <5% common
3. 5-25%
4. 25-50%
5. 50-75%
6. 75-100%

Appendix B

Fauna recorded

Table B-1 Species of animal recorded

Family Name	Common Name	Scientific Name	TSC Act[1]	EPBC Act[2]	Dry open forest[3]	Aquatic habitat[3]	Cleared land[3]
Amphibians							
Hylidae	Broad-palmed Frog	*Litoria latopalmata*			-	T	-
Hylidae	Eastern Dwarf Tree Frog	*Litoria fallax*			-	T	-
Hylidae	Peron's Tree Frog	*Litoria peronii*			-	W	-
Hylidae	Verreaux's Tree Frog	*Litoria verreauxii*			-	W	-
Myobatrachidae	Common Eastern Froglet	*Crinia signifera*			-	T	-
Myobatrachidae	Spotted Grass Frog	*Limnodynastes tasmaniensis*			-	T	-
Reptiles							
Chelidae	Eastern Long-necked Tortoise	*Chelodina longicollis*			-	K	-
Elapidae	Eastern Brown Snake	*Pseudonaja textilis*			I	-	-
Varanidae	Lace Monitor	*Varanus varius*			O	-	-
Native Birds							
Accipitridae	Black-shouldered Kite	*Elanus axillaris*				-	O
Accipitridae	Brown Goshawk	*Accipiter fasciatus*			O	-	-
Accipitridae	Wedge-tailed Eagle	*Aquila audax*			O	-	O
Aegothelidae	Australian Owlet-nightjar	*Aegotheles cristatus*			W	-	-
Anatidae	Australian Wood Duck	*Chenonetta jubata*			-	O	-
Anatidae	Black Swan	*Cygnus atratus*			-	O	-
Anatidae	Grey Teal	*Anas gracilis*			-	O	-
Anatidae	Pacific Black Duck	*Anas superciliosa*			-	O	-
Ardeidae	Eastern Great Egret	*Ardea modesta*		M	-	O	-

Family Name	Common Name	Scientific Name	TSC Act[1]	EPBC Act[2]	Dry open forest[3]	Aquatic habitat[3]	Cleared land[3]
Ardeidae	White-faced Heron	*Egretta novaehollandiae*			-	O	-
Artamidae	Australian Magpie	*Gymnorhina tibicen*			O	-	O
Artamidae	Grey Butcherbird	*Cracticus torquatus*			O	-	O
Artamidae	Pied Currawong	*Strepera graculina*			O	-	O
Cacatuidae	Galah	*Cacatua roseicapilla*			O	-	O
Cacatuidae	Little Corella	*Cacatua sanguinea*			O	-	O
Charadriidae	Black-fronted Dotterel	*Elseyornis melanops*			-	-	O
Charadriidae	Masked Lapwing	*Vanellus miles*			-	-	O
Columbidae	Crested Pigeon	*Ocyphaps lophotes*			-	-	O
Corcoracidae	White-winged Chough	*Corcorax melanorhamphos*			O	-	O
Corvidae	Australian Raven	*Corvus coronoides*			O	-	O
Dicaeidae	Mistletoebird	*Dicaeum hirundinaceum*			O	-	-
Dicruridae	Grey Fantail	*Rhipidura fuliginosa*			O	-	-
Dicruridae	Magpie-lark	*Grallina cyanoleuca*			O	-	O
Dicruridae	Willie Wagtail	*Rhipidura leucophrys*			O	-	-
Falconidae	Australian Hobby	*Falco longipennis*			-	-	O
Falconidae	Brown Falcon	*Falco berigora*			O	-	O
Falconidae	Nankeen Kestrel	*Falco cenchroides*			-	-	O
Halcyonidae	Laughing Kookaburra	*Dacelo novaeguineae*			O	-	-
Hirundinidae	Welcome Swallow	*Hirundo neoxena*			O	O	O
Maluridae	Superb Fairy-wren	*Malurus cyaneus*			O	-	-
Meliphagidae	Brown-headed Honeyeater	*Melithreptus brevirostris*			O	-	-
Meliphagidae	Noisy Friarbird	*Philemon corniculatus*			O	-	-

Family Name	Common Name	Scientific Name	TSC Act[1]	EPBC Act[2]	Dry open forest[3]	Aquatic habitat[3]	Cleared land[3]
Meliphagidae	Noisy Miner	*Manorina melanocephala*			O	-	-
Meliphagidae	White-plumed Honeyeater	*Lichenostomus penicillatus*			O	O	-
Meliphagidae	Yellow-faced Honeyeater	*Lichenostomus chrysops*			O	-	-
Motacillidae	Richard's Pipit	*Anthus novaeseelandiae*			-	-	O
Pachycephalidae	Golden Whistler	*Pachycephala pectoralis*			O	-	-
Pachycephalidae	Rufous Whistler	*Pachycephala rufiventris*			O	-	-
Pardalotidae	Spotted Pardalote	*Pardalotus punctatus*			O	-	-
Pardalotidae	Striated Pardalote	*Pardalotus striatus*			O	-	-
Pardalotidae	Weebill	*Smicrornis brevirostris*			O	-	-
Pardalotidae	Yellow Thornbill	*Acanthiza nana*			O	-	-
Pardalotidae	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*			O	-	-
Passeridae	Double-barred Finch	*Taeniopygia bichenovii*			O	-	-
Passeridae	Red-browed Finch	*Neochmia temporalis*			O	-	-
Phalacrocoracidae	Pied Cormorant	*Phalacrocorax varius*			-	-	O
Podicipedidae	Australasian Grebe	*Tachybaptus novaehollandiae*			-	-	O
Pomatostomidae	Grey-crowned Babbler	*Pomatostomus temporalis*	V		O	-	-
Psittacidae	Australian King-Parrot	*Alisterus scapularis*			O	-	-
Psittacidae	Eastern Rosella	*Platycercus eximius*			O	-	-
Psittacidae	Little Lorikeet	*Glossopsitta pusilla*	V		O	-	-
Psittacidae	Rainbow Lorikeet	*Trichoglossus haematodus*			O	-	-
Rallidae	Dusky Moorhen	*Gallinula tenebrosa*			-	-	O
Rallidae	Purple Swamphen	*Porphyrio porphyrio*			-	-	O
Strigidae	Southern Boobook	*Ninox novaeseelandiae*			O	-	-

Family Name	Common Name	Scientific Name	TSC Act[1]	EPBC Act[2]	Dry open forest[3]	Aquatic habitat[3]	Cleared land[3]
Introduced Birds							
Sturnidae	Common Myna	*Acridotheres tristis*	U		-	-	O
Native Mammals							
Macropodidae	Eastern Grey Kangaroo	*Macropus giganteus*			O	-	O
Molossidae	Southern freetail Bat	*Mormopterus* sp 4.			W	-	-
Molossidae	White-striped freetail bat	*Austronomus australis*			-	W	W
Petauridae	Squirrel Glider	*Petaurus norfolcensis*	V		O	-	-
Petauridae	Sugar Glider	*Petaurus breviceps*			O	-	-
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*			O	-	-
Pteropodidae	Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	W	-	-
Vespertilionidae	Chocolate Wattled Bat	*Chalinolobus morio*			W	-	-
Vespertilionidae	Inland Broad-nosed Bat	*Scotorepens balstoni*			W	-	-
Vespertilionidae	Little Forest Bat	*Vespadelus vulturnus*			-	-	T
Vespertilionidae	Unidentified Eptesicus	*Vespadelus* sp.			W	-	-
Introduced Mammals							
Leporidae	Brown Hare	*Lepus capensis*	U		O	-	O
Leporidae	Rabbit	*Oryctolagus cuniculus*	U		O	-	O
Fish							
Poeciliidae	Mosquito fish	*Gambusia holbrooki*			-	O	-

Note:

1: V = Vulnerable, U = unprotected (*Threatened Species Conservation Act 1995*).

2: V = Vulnerable, M = Migratory (*Environment Protection and Biodiversity Conservation Act 1999*).

3: O = Observed, W = Heard Call, K = Dead; T= trapped.

Appendix C

Threatened species and populations of plant

Table C.1 Threatened species of plant predicted to occur within the locality

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Asclepiadaceae	*Cynanchum elegans*	White-flowered Wax Plant	E1	E	3Ei	Occurs from the Gloucester district to the Wollongong area and inland to Mt Dangar where it grows in rainforest gullies, scrub and scree slopes (Harden 1992). This species typically occurs at the ecotone between dry subtropical forest/woodland communities (James 1997; NSW National Parks and Wildlife Service 2002).	Yes	Low. Preferred habitat not present
Asteraceae	*Ozothamnus tesselatus*		V	V	V-	Grows in eucalypt woodland in the area north of Rylstone (Department of Environment Climate Change and Water 2010).	Yes	Low. Preferred habitat not present.
Asteraceae	*Rutidosis heterogama*	Heath Wrinklewort	V	V	2Va	Occurs in coastal districts from Maclean to the Hunter Valley and inland to the Torrington region. Grows in heath on sandy soils and moist areas in open forest, and has been recorded along disturbed roadsides (Department of Environment and Conservation 2005b; Royal Botanic Gardens 2005).	Yes	Low. Preferred habitat not present
Brassicaceae	*Lepidium hyssopifolium*	Aromatic Peppercress	E1	E	3Ei	In NSW, there is a population consisting of 6 plants near Bathurst, a population near Bungendore and Crookwell both on the Southern Tablelands. The species was also recorded near Armidale in 1945 and 1958 however it is not known whether it remains in this area. A specimen collected in the Cooma area about 100 years ago may also be Aromatic Peppercress. The species occurs in a variety of habitats including woodland with a grassy understorey and grassland (Department of Environment and Conservation 2005b).	Yes	Low. Preferred habitat not present
Euphorbiaceae	*Chamaesyce psammogeton*	Sand Spurge	E1			Occurs in coastal regions of NSW where it grows on sand dunes near the sea (Harden 2000). Grows on fore-dunes and exposed headlands, often with Spinifex (Spinifex sericeus) (Department of Environment and Conservation 2005b).	Yes	Low. Preferred habitat not present
Fabaceae (Faboideae)	*Pultenaea maritima*	Coastal Bush Pea	V			It occurs in New South Wales and Queensland and is restricted to grasslands on exposed coastal headlands. Within NSW, the species has been recorded from Newcastle north to Byron Bay.	Yes	Low, preferred habitat not present

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Fabaceae (Mimosoideae)	*Acacia bynoeana*	Bynoe's Wattle	E1	V	3V	Occurs south of Dora Creek-Morisset area to Berrima and the Illawarra region and west to the Blue Mountains. It grows mainly in heath and dry sclerophyll forest on sandy soils (Harden 2002). Seems to prefer open, sometimes disturbed sites such as trail margins and recently burnt areas. Typically occurs in association with *Corymbia gummifera, Eucalyptus haemastoma, E. gummifera, E. parramattensis, E. sclerophylla, Banksia serrata* and *Angophora bakeri* (NSW National Parks and Wildlife Service 1999a).	No	Low. Preferred habitat not present
Fabaceae (Mimosoideae)	*Acacia pendula*	Boree	E2			Within the Hunter catchment the species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations. This population is known to occur naturally as far east as Warkworth, and extends northwest to Muswellbrook and to the west of Muswellbrook at Wybong. It has only been recorded at six locations: Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. The stand at Jerrys Plains is part of the Weeping Myall - Coobah - Scrub Wilga Shrubland of the Hunter Valley, listed under EPBC Act as a Critically Endangered Ecological Community (Department of Environment Climate Change and Water 2010).	Yes	Low. Preferred habitat not present
Goodeniaceae	*Goodenia macbarronii*	Narrow Goodenia	-	-	3V	Occurs south from Guyra and Inverell districts where it grows in damp sandy soils (Royal Botanic Gardens 2004). The species is usually found in shaded, seasonally damp sites in clay-loam, sandy-loam and sandy soils. Habitats in NSW include a recently graded roadside drain adjacent to *Eucalyptus crebra* and *Callitris glaucophylla* woodland, dry eucalypt forest with low shrubby undergrowth in sandy soil, damp sandy patches in bushland areas, along roadsides, near water in a shallow excavation which has exposed the clay subsoil, on the banks of a sandy creek and in *Eucalyptus blakelyi* and *Angophora floribunda* woodland. Sites often have some form of recent disturbance. Other sites include grazed paddocks and clearings with a large proportion of weed and exotic species, (Department of Environment and Conservation 2005b).	No	**Moderate,** although not recorded, surveys were undertaken outside suitable survey period and study area contains potential habitat.

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP [3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Juncaginaceae	*Maundia triglochinoides*	-	V			Occurs north from Sydney. Grows in swamps, creeks or shallow freshwater 30 to 60 cm deep on heavy clay, low nutrients. Associated with wetland species such as *Triglochin procerum* (Harden 1993).	No	Low, wetland areas were artificial and highly disturbed.
Lamiaceae	*Prostanthera cineolifera*	Singleton Mint Bush	V	V	2K	Thought to occur in north coast and central coast botanical subdivisions. The distribution of this taxon is uncertain (Royal Botanic Gardens 2004). It grows in open woodlands on exposed sandstone ridges, usually found in association with shallow or skeletal sands (Department of Environment Climate Change and Water 2010).	Yes	Low. Preferred habitat not present
Lamiaceae	*Prostanthera cryptandroides ssp. cryptandroides*	Wollemi Mint Bush	V		2R	Range extends from Lithgow to Queensland, however occurrence is disjunct within this range. Habitat is specific at each location, for example: Open forest dominated by *Eucalyptus fibrosa* at Glen Davis; variety of communities along rocky ridgelines on Narrabeen group Sandstones at Denman-Gungal and Widden-Baerami Valley such as rocky heath, Acacia woodland, exposed woodland, open heathland of *Calytrix tetragona, Leptospermum parviflorum* and *Isopogon dawsonii*, and open scrubland of *Eucalyptus dwyeri, Baeckea densifolia, Dillwynia floribunda, Aotus ericoides* and *Hemigenia cunefolia* (Department of Environment and Climate Change 2008).	Yes	Low. Preferred habitat not present
Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V		Restricted to the Charmhaven - Wyee area where it grows in open dry sclerophyll woodland of *Eucalyptus haemastoma* and *Corymbia gummifera* with a dense shrub understorey. Occurs on deep white sandy soils over sandstone, often with some gravelly laterite (Harden 2002; NSW Scientific Committee 1998a).	Yes	Low. Preferred habitat not present

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Myrtaceae	*Callistemon linearifolius*	Netted Bottle Brush	V		2Ri	Occurs chiefly from Georges to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland or woodland on sandstone. Found in damp places, usually in gullies (Fairley & Moore 2002; Harden 2002; Robinson 1994). Within the Sydney region, recent records are limited to the Hornsby Plateau area near the Hawkesbury River (NSW Scientific Committee 1999a).	No	Low. Outside known range of species and preferred habitat not present
Myrtaceae	*Eucalyptus camaldulensis*	River Red Gum	E2			Occurs in the western slopes, western plains,far western plains and in the North Coast (Hunter Catchment). It is typically dominant, occurring within grassy woodland or forest on deep rich alluvial soils adjacent to large permanent water bodies (Harden 2002). In the Hunter it may occur with *Eucalyptus tereticornis, Eucalyptus melliodora, Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda* (NSW Scientific Committee 2005).	Yes	Low. Not recorded, and preferred habitat not present
Myrtaceae	*Eucalyptus camfieldii*	Heart-leaved Stringybark	V	V	2Vi	Restricted distribution in a narrow band with the most northerly records in the the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park (Department of Environment and Climate Change). Occurs within poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of *E. oblonga, E. capitellata* and *E. haemastoma* (Department of Environment and Climate Change).	Yes	Low. Preferred habitat not present

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP [3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Myrtaceae	*Eucalyptus castrensis*	Singleton Mallee	E1			Known only from a single dense stand of about 10 ha (near Broken Back repeater station in Singleton Training Area), and a number of smaller outlying stands over a 2.5 km range, near Singleton in the lower Hunter Valley in the North Coast bioregion (NSW Scientific Committee 2004).	Yes	Low. Preferred habitat not present
Myrtaceae	*Eucalyptus fracta*	Broken Back Ironbark	V			Known only from State Forests on parts of the northern escarpment of the Broken Back Range, near Cessnock, where it is locally frequent. It is restricted to shallow soils along the upper escarpment of a steep sandstone range (Harden 2002; NSW Scientific Committee 1999b).	Yes	Low. Preferred habitat not present
Myrtaceae	*Eucalyptus glaucina*	Slaty Red Gum	V	V	3Va	Occurs from Taree to Broke where it is locally frequent but very sporadic and grows in grassy woodland on deep, moderately fertile and well-watered soil (Harden 2002). Endemic on low coastal ranges and tablelands of central NSW, Taree to Broke, also near Casino (Brooker & Kleinig 1999).		Low. Preferred habitat not present
Myrtaceae	*Eucalyptus parramattensis ssp. decadens*	Parramatta Red Gum	V	V	2V	Locally frequent, grows in dry sclerophyll woodland on sandy soils in low, often wet sites (Harden 2002).		Low. Preferred habitat not present
Myrtaceae	*Eucalyptus pumila*	Pokolbin Mallee	V	V	2Vi	Now only known from a single stand near Pokolbin where it grows in sclerophyll shrubland on skeletal soil on sloping sandstone (Harden 2002). Previously recorded from Muswellbrook and Wyong (Brooker & Kleinig 1999).		Low. Preferred habitat not present
Myrtaceae	*Melaleuca groveana*	Grove's Paperbark	V		3R	Occurs in coastal districts north from Port Stephens and at Torrington (Harden 2002). Grove's Paperbark grows in heath and shrubland, often in exposed sites, at high elevations, on rocky outcrops and cliffs. It also occurs in dry woodlands (Department of Environment and Climate Change).		Low. Preferred habitat not present

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E1	V	3Ri	Occurs between Buladelah and St Georges Basin where it grows in subtropical and littoral rainforest on sandy soils or stabilized dunes near the sea (Harden 2002). On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities (Department of Environment and Climate Change 2008).		Low. Preferred habitat not present
Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue Orchid	V	V	3V	Occurs south from the Gibraltar Range, chiefly in coastal districts but also extends on to tablelands. Grows in swamp-heath and drier forest on sandy soils on granite & sandstone. Occurs in small, localised colonies most often on the flat plains close to the coast but also known from some mountainous areas growing in moist depressions and swampy habitats (Harden 1993; NSW National Parks and Wildlife Service 1999c).	No	Low. Preferred habitat not present
Orchidaceae	*Cymbidium canaliculatum*	Tiger Orchid	E2			In the Hunter Catchment, the endangered population of this species grows singularly or in clumps in tree hollows, commonly between two to six metres above the ground. Found in woodlands and dry sclerophyll forests dominated by *Eucalyptus albens*, and less commonly found on E. *dawsonii, E. crebra, E. moluccana, Angophora floribunda* and *Acacia salicina*. Scattered, non-endangered populations of this species exist across northern Australia, from NSW to Western Australia (NSW Scientific Committee 2006).		Low, although potential habitat occurs within the study area this species was not recorded. It has been recorded 10km to the north, 10km to west and 20km to the south east.

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Orchidaceae	*Diuris pedunculata*	Small Snake Orchid	E1	E	2E	Occurs chiefly from Port Jackson to Tenterfield where it grows in moist grassy areas in sclerophyll forest (Harden 1993). It typically occurs on stony soils on low ridges or moist flats (Bishop 2000), often on peaty soils in moist areas but also on shale and trap soils, on fine granite, and among boulders (Department of Environment and Conservation 2005b).	No	Low. Preferred habitat not present
Orchidaceae	*Diuris praecox*	Rough Double Tail	V	V	2V	Occurs in coastal and near-coastal districts from Ourimbah to Nelson Bay where it grows in sclerophyll forest (Harden 1993) often on hilltops or slopes (Bishop 2000).	Yes	Low. Preferred habitat not present
Orchidaceae	*Diuris tricolor*	Pine Donkey Orchid	V	V	3K	Grows in sclerophyll forest among grass, often with Callitris (Royal Botanic Gardens 2005), or in grassy Callitris woodland (Bishop 2000; Department of Environment and Conservation 2005a). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Soils include gritty orange-brown loam on granite, shallow red loamy sand on stony porphyry, skeletal lateritic soil and alluvial grey silty loam. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats (Department of Environment Climate Change and Water 2010). Within the Upper Hunter it is known to occur in *Eucalyptus albens/Eucalyptus crebra/Eucalyptus blakelyi/Corymbia maculata* woodland complexes and grasslands (Parsons Brinckerhoff 2004).	No	**Moderate,** although not recorded, surveys were undertaken outside suitable survey period and study area contains potential habitat.

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Orchidaceae	Prasophyllum sp. (Wybong (C.Phelps ORG5269)	a Leek-orchid		CE		Prasophyllum sp. Wybong (C. Phelps ORG 5269) is known from seven populations in open eucalypt woodland and grassland in New South Wales. The species' area of occupancy is estimated to be 1.5 km2 with an estimated population size based on surveys in 2006 of 460 mature individuals (Holzinger, pers. comm., 2006, 2009; Copeland, pers. comm., 2009). This species occurs within the Sydney Basin, New England Tablelands, Brigalow Belt South and NSW South Western Slopes IBRA Bioregions and the Border Rivers-Gwydir, Namoi, Hunter-Central Rivers and Central West Natural Resource Management Regions. The distribution of this species overlaps with the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland EPBC Act-listed threatened ecological community. (Department of Environment and Conservation 2005b)	No	Low. Preferred habitat not present
Orchidaceae	*Pterostylis gibbosa*	Illawarra Greenhood	E1	E	2E	Occurs in the southern part of the Central Coast region with a disjunct population in the Hunter Valley. Grows among grass in sclerophyll forest (Harden 1993). In the Illawarra it grows in Coastal Grassy Red Gum Forest and in Lowland Woolybutt-Melaleuca forest (NSW National Parks and Wildlife Service 2003).	Yes	Low. Preferred habitat not present
Poaceae	*Bothriochloa biloba*	Lobed Blue-grass	V	V	3V	Has a widespread distribution and grows in woodland on poorer soils (Harden 1993). Occurs on basaltic hills and grassland on drainage slopes on a variety of soils in association with *Eucalyptus punctata, E. albens, E. camaldulensis E. tereticornis, E. populnea* ssp *bimbil* and *Angophora floribunda* (DLWC, 2001).	Yes	**Moderate.** Potential habitat present.
Polygonaceae	*Persicaria elatior*	Tall Knotweed	V	V	3V	Occurs infrequently in coastal regions where it grows in damp places especially beside streams and lakes. Also occasionally occurs in swamp forest or associated with disturbance (Department of Environment and Conservation 2005b; Harden 2000).	No	Low, potential habitat not recorded

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Proteaceae	*Grevillea parviflora ssp. parviflora*	Small-flower Grevillea	V	V		Mainly known from the Prospect area (but now extinct there) and lower Georges River to Camden, Appin and Cordeaux Dam areas, with a disjunct populations near Putty, Cessnock and Cooranbong. Grows in heath or shrubby woodland in sandy or light clay soils usually over thin shales (Harden 2002; NSW Scientific Committee 1998b).	Yes	Low. Preferred habitat not present
Proteaceae	*Persoonia pauciflora*	North Rothbury Persoonia	E1	CE		Known distribution extremely restricted. All known individuals occur within 2.5 km of the original or type specimen, which was recorded near North Rothbury in the Cessnock Local Government Area. Occurs in dry open-forest or woodland habitats, generally with a projected foliage cover ranging between 10 to 40% and tree height range of between 6 to 18 m. The lower strata usually comprises of a moderate to sparsely distributed shrub layer, with a high percentage of groundcover species, particularly grasses. Vegetation communities are dominated by *Corymbia maculata, Eucalyptus fibrosa*, and/or *E. crebra*. Sub-dominant species include *E. punctata* and *E. moluccana*. Common understorey shrubs include *Acacia parvipinnula, Daviesia ulicifolia* and *Bursaria spinosa*. The majority of the population is known to occur on silty sandstone soils derived from the "Farley Formation"(Patrick 1999), (NSW National Parks and Wildlife Service 1999b).	Yes	Low. Not recorded and site is outside known distribution

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Rhamnaceae	*Pomaderris bodalla*	Bodalla Pomaderris	V			Endemic to NSW, it is currently known to occur on the south coast between Bodalla and Merimbula, and in the upper Hunter valley near Muswellbrook (Royal Botanic Gardens 2010). On the south coast, it occurs in moist open forest along sheltered gullies or along stream banks. In the upper Hunter valley, it occurs in open forest or woodland on open slopes. There are ten populations of *Pomaderris bodalla* currently known, and a further two imprecisely described locations from which the species was collected approximately 40 years ago. The majority of populations are small with seven of the populations having estimates of less than a hundred plants each. All populations have locally restricted distributions. The largest known population is in Wollemi National Park and is unlikely to include more than one thousand plants (Department of Environment and Conservation 2005b).	Yes	Low. Preferred habitat not present.
Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris	E1			Widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW north coast (Department of Environment and Conservation 2005b). It grows in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks (Department of Environment and Conservation 2005b).	Yes	Low. Preferred habitat not present
Rhamnaceae	*Pomaderris reperta*	Denman Pomaderris	E1	CE		Recorded from a small number of sites along a single ridgeline near Denman in the upper Hunter Valley (Muswellbrook local government area). Occupies woodland in association with *Eucalyptus crebra , E. blakelyi, Notelaea microcarpa*, and *Allocasuarina littoralis* (NSW Department of Environment and Conservation 2005).	Yes	Low. Preferred habitat not present

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Rutaceae	*Leionema lamprophyllum ssp. obovatum*	-	E2			Grows south from Tidbinbilla, in heath on exposed ridges at higher altitudes (Royal Botanic Gardens 2008). Also recorded near Pokolbin, where it is listed as an Endangered population in Pokolbin State Forest, part of the Singleton Local Government Area in the Hunter Catchment (NSW Scientific Committee 2007).	Yes	Low. Preferred habitat not present
Rutaceae	*Philotheca ericifolia*	-	V	V	3R	Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies, in the upper Hunter Valley and Pilliga to Peak Hill district (Royal Botanic Gardens 2004). It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include *Melaleuca uncinata, Eucalyptus crebra, E. rossii, E. punctata, Corymbia trachyphloia, Acacia triptera, A. burrowii, Beyeria viscosa, Philotheca australis, Leucopogon muticus* and *Calytrix tetragona*. Noted as being a moisture-loving plant, with plants common on the sides of a particular spur of the Hervey Ranges where soakage from the high background provides sufficient moisture for the plants (Department of Environment and Conservation 2005b).	Yes	Low. Preferred habitat not present
Santalaceae	*Thesium australe*	Austral Toadflax	V	V	3Vi	Grows in grassland or woodland often in damp sites. It is a semi-parasitic herb and hosts are likely to be *Themeda australis* and *Poa* spp. (Department of Environment and Climate Change 2008; Harden 1992).	Yes	Low . Not recorded and considered unlikely to occur within the study area.

Family	Scientific name	Common name	TSC Act[1]	EPBC Act[2]	ROTAP[3]	Preferred habitat	Survey timing appropriate for detection[4]	Likelihood of occurrence within the site
Sterculiaceae	*Rulingia prostrata*	Dwarf Kerrawang	E1	E	2Ei	Occurs south of Picton lakes where it mainly grows in gullies along the escarpment, south from Picton Lakes (Harden 2000), on the Southern Tablelands (one plant at Penrose State Forest, one plant at Rowes Lagoon and one plant at Tallong) and on the North Coast (less than 100 plants at the Tomago sandbeds north of Newcastle). It occurs on sandy, sometimes peaty soils in a wide variety of habitats: Snow Gum (*Eucalyptus pauciflora*) Woodland at Rose Lagoon; Blue leaved Stringybark (*E. agglomerata*) Open Forest at Tallong; and in Brittle Gum (*E. mannifera*) Low Open Woodland at Penrose; Scribbly Gum (*Eucalyptus haemastoma*)/ Swamp Mahogany (*E. robusta*) Ecotonal Forest at Tomago. Associated native species may include *Imperata cylindrica*, Empodisma minus and *Leptospermum continentale* (Department of Environment and Climate Change 2007).	Yes	Low. Preferred habitat not present
Tremandraceae	*Tetratheca juncea*	Black-eyed Susan	V	V	3Vi	Occurs in coastal districts from Bulahdelah to Port Macquarie where it grows in dry sclerophyll forest and occasionally swampy heath in sandy, (Harden 1992) low nutrient soils with a dense understorey of grasses. Specifically it is known to occur within Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland (Payne *et al.* 2002).	Yes	Low. Preferred habitat not present
Zannichelliaceae	*Zannichellia palustris*		E1		3R	Grows in fresh or slightly saline stationary or slowly flowing water (Royal Botanic Gardens 2005).	Yes	Low. In NSW, it is known only from the lower Hunter.

Notes:

1. TSC Act - *Threatened Species and Conservation Act 1995*. CE = Critically Endangered, E1 = Endangered V = Vulnerable E2= Endangered Population.
2. EPBC Act - *Environmental Protection and Biodiversity Conservation Act 1999*. CE = Critically Endangered, E = Endangered V = Vulnerable.
3. ROTAP (Rare or Threatened Australian Plants (Briggs & Leigh 1996) is a conservation rating for Australian plants. Codes are:
   - 1 Species only known from one collection
   - 2 Species with a geographic range of less than 100 km in Australia
   - 3 Species with a geographic range of more than 100 km in Australia
   - X Species presumed extinct; no new collections for at least 50 years
   - E Endangered species at risk of disappearing from the wild state if present land use and other causal factors continue to operate
   - V Vulnerable species at risk of long-term disappearance through continued depletion.

R Rare, but not currently considered to be endangered.
K Poorly known species that are suspected to be Threatened
C Known to be represented within a conserved area
a At least 1,000 plants are known to occur within a conservation reserve(s).
i Less than 1,000 plants are known to occur within a conservation reserve(s).

4. Based on the database of *Threatened species characteristics by CMA* (Department of Environment & Climate Change 2010).

5. Likelihood of Occurrence – see methods (see Section 2.5).

Appendix C References

Bishop, T 2000, *Field guide to the orchids of New South Wales and Victoria*, Second edn, University of New South Wales Press Pty. Ltd., Sydney.

Briggs, JD & Leigh, JH 1996, *Rare or Threatened Australian Plants*, CSIRO, Canberra.

Brooker, MIH & Kleinig, DA 1999, *Field guide to Eucalypts, Volume 1: South-eastern Australia*, Blooming Books, Hawthorn, Australia.

Department of Environment & Climate Change 2010, *Threatened species characteristics by CMA*, Department of Environment & Climate Change,

Department of Environment and Climate Change *Threatened Species Profile: Eucalyptus camfieldii* Department of Environment and Climate Change, viewed 5th June 2009 <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10287>.

Department of Environment and Climate Change *Threatened Species Profile: Melaleuca groveana* Department of Environment and Climate Change, viewed 9th June 2009 <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10516>.

Department of Environment and Climate Change 2007, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Climate Change 2008, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2008, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2005a, *Diuris ochroma (an orchid) - endangered species listing*, Department of Environment and Conservation, viewed 24 July 2009 2009, <http://www.environment.nsw.gov.au/determinations/DiurisOchromaEndSpListing.htm>.

Department of Environment and Conservation 2005b, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment Climate Change and Water 2010, *Threatened species, populations and communities database* Department of Environment, Climate Change and Water, <http://www.threatenedspecies.environment.nsw.gov.au/>.

Fairley, A & Moore, P 2002, *Native plants of the Sydney district. An identification guide*, Revised Edition edn, Kangaroo Press, Sydney.

Harden, G 1992, *Flora of New South Wales Volume 3*, University of New South Wales Press Ltd., Kensington.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Harden, G 2000, *Flora of New South Wales Volume 1 (Revised Edition)*, University of New South Wales Press Ltd., Kensington.

Harden, G 2002, *Flora of New South Wales Volume 2 (Revised Edition)*, 2nd edn, vol. 2, University of New South Wales Press Ltd., Kensington.

James, T 1997, *Urban bushland biodiversity survey. Native flora in western Sydney.* , NSW National Parks and Wildlife Service, Hurstville,

NSW Department of Environment and Conservation 2005, *Threatened Species: Species, Populations and Ecological Communities of NSW Catchments*, NSW Department of Environment and Conservation, 2005, <http://203.202.1.211/tsprofile/index.aspx>.

NSW National Parks and Wildlife Service 1999a, *Acacia bynoeana threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999b, *Persoonia pauciflora threatened species information*, NSW National Parks and Wildlife Service, Hurstville. .

NSW National Parks and Wildlife Service 1999c, *Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.*,

NSW National Parks and Wildlife Service 2002, *Cynanchum elegans threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003, *Native vegetation of the Illawarra escarpment and coastal plain*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998a, *Final determination to list Angophora inopina as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998b, *Final determination to list Grevillea parviflora ssp. parviflora as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999a, *Final determination to list Callistemon linearifolius as a vulnerable species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999b, *Final determination to list Eucalyptus fracta as a vulnerable species*, NSW National Parks and Wildlife, Hurstville.

NSW Scientific Committee 2004, *Final determination to list Eucalyptus castrensis as an endangered species*, NSW Scientific Committee, Hurstville.

NSW Scientific Committee 2005, *Final determination to list Eucalyptus camaldulensis as an endangered population in the Hunter Catchment*, Department of Environment and Conservation, Hurstville.

NSW Scientific Committee 2007, *Final determination to list Leionema lamprophyllum subsp. obovatum as an endangered population*, NSW National Parks and Wildlife Service, Hurstville.

Parsons Brinckerhoff 2004, *Woodland Ridge Estate Diuris tricolor Significance Assessment*, Parsons Brinckerhoff, Rhodes.

Patrick, G 1999, *Initial flora survey to sample potential habitat: abundance and distribution of the new plant species Persoonia (North Rothbury).* , Report prepared for the NSW National Parks and Wildlife Service, Hurstville.

Payne, R, Stevenson, D & Wellington, R 2002, *A standardised approach for counting black-eyed susan populations*, NSW National Parks and Wildlife, Hurstville.

Robinson, L 1994, *Field guide to the native plants of Sydney*, Kangaroo Press, Sydney.

Royal Botanic Gardens 2004, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Royal Botanic Gardens 2005, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, Sydney,

Royal Botanic Gardens 2008, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <http://plantnet.rbgsyd.nsw.gov.au/>.

Royal Botanic Gardens 2010, *PlantNet - The Plant Information Network System of Botanic Gardens Trust (version 2.0)*, Royal Botanic Gardens, <http://plantnet.rbgsyd.nsw.gov.au/>.

Appendix D

Threatened species of animal

Table D.1 Threatened species of animal predicted to occur in the locality

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Amphibians						
Crinia tinnula	Wallum Froglet	V		Occurs along coast from south-eastern Queensland to Sydney. Mostly associated with swamps, dams and flooded roadside ditches, usually in heathland, where it is confined to acid, paperbark swamps and sedge swamps of the 'wallum' country. Males call any time of year. Breed in late winter (Anstis 2002; NSW National Parks and Wildlife Service 2002).	Yes	Low
Litoria aurea	Green and Golden Bell Frog	E1	V	Has a fragmented distribution of mainly near coastal locations from Lakes Entrance (Victoria) to south of the NSW-Queensland border; as far west as Bathurst in the more elevated southern tablelands and central slopes of NSW. Various types of habitat utilised has been documented. For breeding utilises a wide range of waterbodies, including both natural and man-made structures, such as marshes, dams and stream sides, and ephemeral locations that are more often dry than wet. Is found in various small pockets of habitat in otherwise developed areas and has the tendency of often turning up in highly disturbed sites. Lotic situations such as fast flowing streams appear to be one of the few water bodies not utilised, at least for breeding purposes. Habitat attributes associated with the various waterbodies occupied by the GGBF, and that appear to make such habitat more likely to be occupied, include that the water body is shallow, still or slow flowing, ephemeral and/or widely fluctuating, unpolluted and without heavy shading. Permanent waterbodies are also known to be used and there is historical evidence of occupation of large, often deep and permanent bodies of water. There is a clear preference shown by GGBF for sites with a complexity of vegetation structure and associated terrestrial habitat attributes that appear to favour the species include extensive grassy areas and an abundance of shelter sites such as rocks, logs, tussock forming vegetation and other cover, considered to be used for foraging and shelter. Over-wintering sites may be adjacent to or some distance away from breeding sites; such sites include the bases of dense vegetation tussocks, beneath rocks, timber, within logs or beneath ground debris, including human refuse such as sheet iron, but the full range of possible habitat used for this purpose is not yet well understood (Department of Environment and Conservation 2004, 2005).	Yes	Low
Litoria booroolongensis	Booroolong Frog	E1	E	Confined to mountain streams of the Great Dividing Range (Cogger 2000). Usually found on or under boulders and debris in and beside the rocky beds of mountain streams; breeds in summer (Anstis 2002).	No	Low
Litoria brevipalmata	Green Thighed Frog	V		Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. Breeding occurs following heavy rainfall in late spring and summer, with frogs aggregating around grassy semi-permanent ponds and flood-prone grassy areas. The frogs are thought to forage in leaf-litter. Isolated localities along the coast and ranges from the NSW central coast to south-east Queensland (Department of Environment and Climate Change 2009).	No	Low

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Mixophyes balbus	Stuttering Frog	E1	V	Terrestrial species, found in rainforest, Antarctic beech forest or wet sclerophyll forest. The species depends on freshwater streams and riparian vegetation for breeding and habitation. No records are known from riparian habitat that has been disturbed (Cogger 2000; NSW Scientific Committee 2003).	No	Low
Mixophyes iteratus	Giant Barred Frog	E1	E	Terrestrial species which occurs in rainforests, antarctic beech or wet sclerophyll forests. Feeds on insects and smaller frogs (Cogger 2000). The species is associated with permanent flowing drainages, from shallow rocky rainforest streams to slow-moving rivers in lowland open forest. It is not known to utilise still water areas (NSW Scientific Committee 1999). More prevalent at lower altitudes and in larger streams than its congeners, although has been recorded up to 1000 m asl. (NSW National Parks and Wildlife Service 1999f).	No	Low
Pseudophryne australis	Red-crowned Toadlet	V		Occurs within 160 km of Sydney where it is restricted to Hawkesbury Sandstone. It breeds in deep grass and debris adjacent to ephemeral drainage lines. When not breeding individuals are found scattered on sandstone ridges under rocks and logs (Cogger 2000).	Yes	Low
Birds						
Anseranas semipalmata	Magpie Goose	V		Occurs in shallow wetlands such as large swamps and dams, especially with dense growth of rushes or sedges, and with permanent lagoons and grassland nearby. Feeds on seeds, tubers and green grass. Form large nesting colonies during the wet season. During the dry season this species migrates hundreds of kilometers to perennial swamps (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002).	Yes	Low
Anthochaera phrygia	Regent Honeyeater	E1	EM	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei* are important for feeding and breeding. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum) (Garnett & Crowley 2000).	Yes	**Moderate**
Apus pacificus	Fork-tailed Swift		M	Breeds from central Siberia eastwards through Asia, and is migratory, wintering south to Australia. Individuals never settle voluntarily on the ground and spend most of their lives in the air, living on the insects they catch in their beaks (Higgins 1999).	Yes	Low
Ardea ibis	Cattle Egret		M	Subsepecies A. i. coromanda is found across the Indian subcontinent and Asia as far north as Korea and Japan, and in South-east Asia, Papua New Guinea and Australia (McKilligan 2005).	Yes	**Moderate**

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Ardea modesta	Eastern Great Egret		M	Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. In Australia, the breeding season of the Great Egret is normally October to December in the south and March to May in the north. This species breeds in colonies, and often in association with cormorants, ibises and other egrets. (Australian Museum 2003).	Yes	**Recorded**
Botaurus poiciloptilus	Australasian Bittern	V		Occurs in shallow, vegetated freshwater or brackish swamps. Requires permanent wetlands with tall dense vegetation, particularly bulrushes and spikerushes. When breeding, pairs are found in areas with a mixture of tall and short sedges but will also feed in more open territory. (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002).	Yes	Low
Burhinus grallarius	Bush Stone-curlew	E1		Require sparsely grassed, lightly timbered, open forest of woodland. In southern Australia they often occur where there is a well structured litter layer and fallen timber debris. Feed on a range of invertebrates and small vertebrates, as well as seeds and shoots (NSW National Parks and Wildlife Service 1999a, 2003b).	Yes	Low
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Occurs in wetter forests and woodland from sea level to an altitude over 2000 m, timbered foothills and valleys, coastal scrubs, farmlands and suburban gardens (Pizzey & Knight 2007).	Yes	Low
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Occurs in eucalypt woodland and forest with Casuarina/Allocasuarina spp. Characteristically inhabits forests on sites with low soil nutrient status, reflecting the distribution of key Allocasuarina species. The drier forest types with intact and less rugged landscapes are preferred by the species. Nests in tree hollows (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 1999b).	Yes	Low
Circus assimilis	Spotted Harrier	V		The Spotted Harrier occurs throughout the Australian mainland in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant & Higgins 1993). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The diet of the Spotted Harrier includes terrestrial mammals, birds and reptiles, occasionally large insects and rarely carrion (NSW Scientific Committee 2010c).	Yes	**Moderate**
Climacteris picumnus	Brown Treecreeper	V		Occurs in eucalypt woodland and adjoining vegetation. Feeds on ants, beetles and larvae on trees and from fallen timber and leaf litter. Usually nests in hollows (Garnett & Crowley 2000).	Yes	**Moderate**
Dromaius novaehollandiae	Emu	E2		Varies widely- arid inland plains, tropical woodlands, heathlands, coastal dunes; not rainforests (Simpson & Day 1996).	Yes	Low
Ephippiorhynchus asiaticus	Black-necked Stork	E1		Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garnett & Crowley 2000).	Yes	**Moderate**

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Erythrotriorchis radiatus	Red Goshawk	CE	VM	Lives in coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers and along edges of rainforest. Nests are only built in trees taller than 20 meters which occur within 1 kilometre of a watercourse or wetland. Has a home range of 200 square kilometres and hunts for medium to large birds in open forests and gallery forest (Garnett & Crowley 2000).	Yes	Low
Gallinago hardwickii	Latham's Snipe		M	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed (Garnett & Crowley 2000).	Yes	Low
Glossopsitta pusilla	Little Lorikeet	V		The Little Lorikeet is a small green lorikeet with black bill and red patch on forehead and throat. The underside is yellow-green. Immatures are duller with less red on face and brown bill. Found in forests, woodland, treed areas along watercourses and roads. Forages mainly on flowers, nectar and fruit. Found along coastal east Australia from Cape York in Queensland down east coast and round to South Australia. Uncommon in southern Victoria (Higgins 1999).	Yes	**Recorded**
Grantiella picta	Painted Honeyeater	V		Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes, which are largely restricted to older trees. Less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).	Yes	**Moderate**
Haliaeetus leucogaster	White-bellied Sea-Eagle		M	Occurs in coastal areas including islands, estuaries, inlets, large rivers, inland lakes and reservoirs. Builds a huge nest of sticks in tall trees near water, on the ground on islands or on remote coastal cliffs (Pizzey & Knight 2007).	Yes	**Moderate**
Hieraaetus morphnoides	Little Eagle	V		The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet (Marchant & Higgins 1993).	Yes	**Moderate**
Hirundapus caudacutus	White-throated Needletail		M	Occurs in airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns. Breeds in the northern hemisphere and migrates to Australia in October-April (Pizzey & Knight 2007).	Yes	**Moderate**
Irediparra gallinacea	Comb-crested Jacana	V		Occurs in floating vegetation of permanent well-vegetated wetlands and dams. Walks on floating plants. Occasionally feeds along muddy wetland margins on east coast of NSW (Garnett & Crowley 2000).	Yes	Low

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Ixobrychus flavicollis	Black Bittern	V		Usually found in dense vegetation in and fringing streams, swamps, tidal creeks and mudflats, particularly amongst swamp she-oaks and mangroves. Feeds on aquatic fauna along streams, in estuaries and beside billabongs and pools. Breeding occurs in summer in secluded places in densely vegetated wetlands. It nests in trees that overhang the water (Garnett & Crowley 2000; NSW National Parks and Wildlife Service 2002).	Yes	Low
Lathamus discolor	Swift Parrot	E1	E	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering *Acacia pycnantha*, is indicated. Sites used vary from year to year. (Garnett & Crowley 2000; Swift Parrot Recovery Team 2001).	Yes	**Moderate**
Lophoictinia isura	Square-tailed Kite	V		This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes (Garnett & Crowley 2000).	Yes	**Moderate**
Melanodryas cucullata	Hooded Robin	V		Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000).	Yes	**Moderate**
Melithreptus gularis gularis	Black-chinned Honeyeater	V		Found in dry eucalypt woodland particularly those containing ironbark and box. Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000).	Yes	**Moderate**
Merops ornatus	Rainbow Bee-eater		M	Usually occur in open or lightly timbered areas, often near water. Breed in open areas with friable, often sandy soil, good visibility, convenient perches and often near wetlands. Nests in embankments including creeks, rivers and sand dunes. Insectivorous, most foraging is aerial, in clearings (Higgins 1999).	Yes	**Moderate**
Monarcha melanopsis	Black-faced Monarch		M	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating (Pizzey & Knight 2007).	Yes	**Moderate**
Monarcha trivirgatus	Spectacled Monarch		M	Occurs in the understorey of mountain/lowland rainforests, thickly wooded gullies and waterside vegetation. Migrates to NE NSW in summer to breed (Pizzey & Knight 2007).	Yes	Low

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Myiagra cyanoleuca	Satin Flycatcher		M	Occurs in heavily vegetated gullies, in forests and taller woodlands. During migration it is found in coastal forests, woodlands, mangroves, trees in open country and gardens (Pizzey & Knight 2007).	Yes	Low
Neophema pulchella	Turquoise Parrot	V		Occurs in the foothills of the great dividing range in eucalypt woodlands and forests with a grassy or sparsely shrubby understorey. Nests in hollows in trees, stumps or even fence posts. It feeds on seeds of both native and introduced grass and herb species (Garnett & Crowley 2000).	Yes	Low
Ninox connivens	Barking Owl	V		Occurs in dry sclerophyll woodland. In the south west it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett & Crowley 2000).	Yes	**Moderate**
Ninox strenua	Powerful Owl	V		A sedentary species with a home range of approximately 1000 hectares it occurs within open eucalypt, casuarina or callitris pine forest and woodland. It often roosts in dense vegetation including rainforest of exotic pine plantations. Generally feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett & Crowley 2000).	Yes	**Moderate**
Oxyura australis	Blue-billed Duck	V		Relatively sparse throughout species range. Regularly found breeding in south-east Queensland, north-east South Australia and throughout New South Wales. Found on temperate, fresh to saline, terrestrial wetlands, and occupies artificial wetlands. Prefers deep permanent open water, within or near dense vegetation. Nest in rushes, sedge, Lignum *Muehlenbeckia cunninghamii* and paperbark Melaleuca (Garnett & Crowley 2000).	Yes	**Moderate**
Pandion cristatus	Eastern Osprey	V	M	Generally a coastal species, occurring in estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks. Sometimes ascends larger rivers to far inland. Builds nests high in tree, on pylon or on ground on islands. Feeds on fish (Pizzey & Knight 2007).	Yes	Low
Petroica boodang	Scarlet Robin	V		In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. It prefers an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (Higgins & Peter 2002; NSW Scientific Committee 2010b).	Yes	**Moderate**

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Petroica phoenicea	Flame Robin	V		In NSW the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats (Higgins & Peter 2002). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank (NSW Scientific Committee 2010a).	Yes	**Moderate**
Pomatostomus temporalis	Grey-crowned Babbler	V		Found throughout western slopes and plains, southern and central tablelands and occurring in Northern Rivers area, mid-north coast and the Hunter Valley of NSW. Lives in open forest and woodland, acacia shrubland and adjoining farmland. Large stick dome nest with spout-like entrance (Pizzey & Knight 2007).	Yes	**Recorded**
Ptilinopus magnificus	Wompoo Fruit-Dove	V		Occurs in rainforests, monsoon forests, adjacent eucalypt forests, fruiting trees on scrubby creeks or in open country (Garnett & Crowley 2000).	Yes	Low
Ptilinopus regina	Rose-crowned Fruit-Dove	V		Occurs in subtropical and dry rainforests and occasionally in moist eucalypt forests and swamp forests where fruit is plentiful. They are thought to move locally as they follow the ripening fruit (NSW National Parks and Wildlife Service 2002).	Yes	Low
Ptilinopus superbus	Superb Fruit-Dove	V		Occurs in rainforests and fringes, scrubs, mangroves and wooded stream-margins, lantana thickets, isolated figs, pittosporums, lilly pillies and blackberries (Pizzey & Knight 2007).	Yes	Low
Pyrrholaemus sagittatus	Speckled Warbler	V		Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett & Crowley 2000).	Yes	**Moderate**
Rhipidura rufifrons	Rufous Fantail		M	Occurs in a range of habitats including the undergrowth of rainforests/wetter eucalypt forests/gullies, monsoon forests paperbarks, sub-inland and coastal scrubs, mangroves, watercourses, parks and gardens. When migrating they may also be recorded on farms, streets and buildings. Migrates to SE Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range (Pizzey & Knight 2007).	Yes	Low
Rostratula australis	Australian Painted Snipe	E1	VM	Inhabits shallow, vegetated, temporary or infrequently filled wetlands, including where there are trees such as *Eucalyptus camaldulensis* (River Red Gum), *E. populnea* (Poplar Box) or shrubs such as *Muehlenbeckia florulenta* (Lignum) or *Sarcocornia quinqueflora* (Samphire). Feeds at the water's edge and on mudlflats on seeds and invertebrates, including insects, worms, molluscs and crustaceans. Males incubate eggs in a shallow scrape nest (Garnett & Crowley 2000).	Yes	Low
Stagonopleura guttata	Diamond Firetail	V		Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).	Yes	**Moderate**

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Stictonetta naevosa	Freckled Duck	V		In most years this species appear to be nomadic between ephemeral inland wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (*Muehlenbeckia cunninghamii*) within which they build their nests (Garnett & Crowley 2000).	Yes	**Moderate**
Turnix maculosa	Red-backed Button-quail	V		The Red-backed Button-quail is a cryptic species and its specific ecology is poorly documented. The species is nocturnal and crepuscular and feeds on insects and seeds. They normally hide and freeze rather than flushing, although individuals will fly for short distances before dropping back to cover. Red-backed Button-quail may be encountered individually, in pairs or in small family groups .Red-backed Button-quail inhabit grasslands, woodlands and cropped lands of warm temperate areas that annually receive 400 mm or more of summer rain. Observations of populations in other parts of its range suggest the species prefers sites near water, including grasslands and sedgelands near creeks, swamps and springs, and wetlands. Red-backed Button-quail usually breed in dense grass near water, and nests are made in a shallow depression sparsely lined with grass and ground litter (Marchant & Higgins 1993).	Yes	Low
Tyto novaehollandiae	Masked Owl	V		Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	Yes	**Moderate**
Tyto tenebricosa	Sooty Owl	V		Occurs in wet eucalypt forest and rainforest on fertile soils with tall emergent trees. Typically found in old growth forest with a dense understorey but also occurs in younger forests if nesting trees are present nearby. It nests in large hollows within eucalypts and occasionally caves. It hunts in open and closed forest for a range of arboreal and terrestrial mammals including introduced species and sometimes birds (Garnett & Crowley 2000).	Yes	Low
Mammals						
Cercartetus nanus	Eastern Pygmy-possum	V		Found in a range of habitats from rainforest through sclerophyll forest to tree heath. It feeds largely on the nectar and pollen of banksias, eucalypts and bottlebrushes and sometimes soft fruits. It nests in very small tree holes, between the wood and bark of a tree, abandoned bird nests and shredded bark in the fork of trees (Turner & Ward 1995).	Yes	Low
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 1998).	**No**	**Moderate**

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Occurs from the Bundaberg area in south-east Queensland, south through NSW to western Victoria and Tasmania. In NSW, it occurs on both sides of the Great Dividing Range and north-east NSW represents a national stronghold (NSW National Parks and Wildlife Service 1999f). Occurs in wide range of forest types, although appears to prefer moist sclerophyll and rainforest forest types, and riparian habitat. Most common in large unfragmented patches of forest. It has also been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in riparian areas, it also ranges over dry ridges. Nests in rock caves and hollow logs or trees. Feeds on a variety of prey including birds, terrestrial and arboreal mammals, small macropods, reptiles and arthropods (NSW National Parks and Wildlife Service 1999d, 1999f).	Yes	Low
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings. Forages within the canopy of dry sclerophyll forest. It prefers wet habitats where trees are more than 20 m high (Churchill 2008)	Yes	**Moderate**
Miniopterus australis	Little Bent-wing Bat	V		Feeds on small insects beneath the canopy of well timbered habitats including rainforest, Melaleuca swamps and dry sclerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred (Strahan 1995).	**No**	**Moderate**
Miniopterus orianae oceanensis	Eastern Bent-wing Bat	V		Usually found in well timbered valleys where it forages on small insects above the canopy. Roosts in caves, old mines, stormwater channels and sometimes buildings and often return to a particular nursery cave each year (Churchill 2008)	**No**	**Moderate**
Micronomus norfolkensis	Eastern Free-tail Bat	V		The Eastern Free-tail Bat is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures (Churchill 2008).	Yes	**Moderate**
Myotis adversus	Large-footed Myotis	V		Colonies occur in caves, mines, tunnels, under bridges and buildings. Colonies always occur close to bodies of water where this species feeds on aquatic insects (Churchill 2008)	Yes	**Moderate**
Nyctophilus species 2	South-eastern Long-eared Bat	V	V	Roosts in tree hollows and under loose bark in arid and semi-arid Australia (Strahan 1995) and forages in the understorey of woodlands and open savanna and swamps (Churchill 1998).	Yes	**Moderate**
Petaurus australis	Yellow-bellied Glider	V		Restricted to tall, mature eucalypt forest in high rainfall areas of temperate to sub-tropical eastern Australia. Feeds on nectar, pollen, the sap of eucalypts and sometimes insects. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and year round food resources are available from a mixture of eucalypt species (NSW National Parks and Wildlife Service 1999g, 2003d).	Yes	Low

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Petaurus norfolcensis	Squirrel Glider	V		Found in dry sclerophyll forest and woodland but not found in dense coastal ranges. Nests in hollows and feeds on gum of acacias, eucalypt sap and invertebrates (NSW National Parks and Wildlife Service 1999e).	Yes	**Recorded**
Petrogale penicillata	Brush-tailed Rock-wallaby	E1	V	Occurs in inland and sub-coastal south eastern Australia where it inhabits rock slopes. It has a preference for rocks which receive sunlight for a considerable part of the day. Windblown caves, rock cracks or tumbled boulders are used for shelter. Occur in small groups or "colonies" each usually separated by hundreds of metres (NSW National Parks and Wildlife Service 2003a).	Yes	Low
Phascogale tapoatafa	Brush-tailed Phascogale	V		Largely arboreal it occurs in a range of habitats which have reliable rainfall (500-2000mm), but has preference for open dry sclerophyll forest on ridges (up to 600 m alt) with little/sparse ground cover. It nests in tree hollows and feeds at dusk on arthropods and small vertebrates (Strahan 1995).	Yes	**Moderate**
Phascolarctos cinereus	Koala	V		Found in sclerophyll forest. Throughout New South Wales, Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 non-eucalypt species. However, in any one area, Koalas will feed almost exclusively on a small number of preferred species. The preferred tree species vary widely on a regional and local basis. Some preferred species in NSW include Forest Red Gum *Eucalyptus tereticornis*, Grey Gum *E. punctata*, Monkey Gum *E. cypellocarpa* and Ribbon Gum *E. viminalis*. In coastal areas, Tallowwood *E. microcorys* and Swamp Mahogany *E. robusta* are important food species, while in inland areas White Box *E. albens*, Bimble Box *E. populnea* and River Red Gum *E. camaldulensis* are favoured (NSW National Parks and Wildlife Service 1999c, 2003c).	Yes	**Moderate**
Planigale maculata	Common Planigale	V		Occurs in a range of habitats from rainforest, sclerophyll forest, grasslands, marshlands and rocky areas, usually where there is ground cover and close to water (NSW National Parks and Wildlife Service 2002). Builds small saucer-shaped nests of grass and bark (Strahan 1995).	Yes	Low
Pseudomys novaehollandiae	New Holland Mouse		V	The New Holland Mouse is a small, burrowing native rodent. The species is similar in size and appearance to the introduced house mouse (*Mus musculus*), although it can be distinguished by its slightly larger ears and eyes, the absence of a notch on the upper incisors and the absence of a distinctive 'mousy' odour. Known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes (Threatened Species Scientific Committee 2010).	Yes	Low
Pseudomys oralis	Hastings River Mouse	E1	E	Recent sightings of the species has been made near low creek banks in tall, open eucalypt forest with dense ground cover of sedges, grasses and/or ferns (Strahan 1995).	Yes	Low
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lilly pillies. It roosts in the branches of large trees in forests or mangroves (Churchill 2008; NSW National Parks and Wildlife Service 2001)	**No**	**Recorded**

Scientific name	Common name	TSC Act[1]	EPBC Act[2]	Preferred habitat	Survey timing appropriate for detection[3]	Likelihood of occurrence within the site[4]
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V		Occurs in eucalypt forest where it feeds above the canopy and in mallee or open country where it feeds closer to the ground. Generally a solitary species but sometimes found in colonies of up to 10. It roosts in tree hollows. Thought to be a migratory species (Churchill 2008).	Yes	**Moderate**
Scoteanax rueppellii	Greater Broad-nosed Bat	V		The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically it forages at a height of 3-6 metres but may fly as low as one metre above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 2008)	Yes	**Moderate**
Vespadelus troughtoni	Eastern Cave Bat	V		A cave-dwelling species found in eastern Australia from Cape York to NSW. They inhabit tropical mixed woodland and wet sclerophyll forests on the coast and the dividing range, but extend into drier forests on the western slopes (Churchill 1998).	Yes	**Moderate**
Reptiles						
Hoplocephalus bitorquatus	Pale-headed Snake	V		A partly arboreal, nocturnal species found in a range of habitats from rainforest and wet sclerophyll forest to the drier eucalypt forests of the western slopes. Feeds largely on frogs and lizards (Cogger 2000).	No	Low
Fish		**FM Act[5]**				
Macquaria australasica	Macquarie Perch	E		Found in the Murray-Darling Basin (particularly upstream reaches) of the Lachlan, Murrumbidgee and Murray rivers, and parts of south-eastern coastal NSW, including the Hawkesbury/Nepean and Shoalhaven catchments. Occur in both river and lake habitats, especially the upper reaches of rivers and their tributaries. They are quiet, furtive fish that feed on aquatic insects, crustaceans and mollusks (Department of Primary Industries 2006).	No	Low

Notes:

1. TSC Act - *Threatened Species and Conservation Act 1995*. CE = Critically Endangered, E1 = Endangered V = Vulnerable E2= Endangered Population.
2. EPBC Act - *Environment Protection and Biodiversity Conservation Act 1999*. CE = Critically Endangered, E = Endangered V = Vulnerable.
3. Based on the database of *Threatened species characteristics by CMA* (Department of Environment & Climate Change 2010).
4. Likelihood of Occurrence – see methods (Section 2.5).
5. FM Act- *Fisheries Management Act 1994*. E= Endangered.

Appendix D References

Anstis, M 2002, *Tadpoles of South-eastern Australia: a Guide with Keys*, vol. 1, 1 vols., New Holland Publishers, Sydney.

Australian Museum 2003, *Great Egret factsheet*, Australian Museum,

Churchill, S 1998, *Australian Bats*, Reed New Holland, Sydney.

Churchill, S 2008, *Australian Bats*, 2nd edn, Allen & Unwin, Sydney.

Cogger, HG 2000, *Reptiles and Amphibians of Australia*, Reed Books, Sydney.

Department of Environment & Climate Change 2010, *Threatened species characteristics by CMA*, Department of Environment & Climate Change,

Department of Environment and Climate Change 2009, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2009, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2004, *Green and Golden Bell Frog environmental impact assessment guidelines* Department of Environment and Conservation (NSW), Hurstville.

Department of Environment and Conservation 2005, *Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea)*, Department of Environment and Conservation (NSW), Hurstville, NSW,

Department of Primary Industries, WaE 2006, *Macquarie Perch- Macquaria australasica species information sheet (Primefacts)*.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds*, Environment Australia, Canberra.

Higgins, PJ (ed.) 1999, *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbirds*, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, PJ & Peter, JM (eds) 2002, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne.

Marchant, S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds Volume 2: Raptors to Lapwings*, vol. 2, Volume 2: Raptors to Lapwings, Oxford University Press, Melbourne.

McKilligan, N 2005, *Herons, egrets and bitterns: their biology and conservation in Australia*, CSIRO Publishing, Collingwood, Victoria.

NSW National Parks and Wildlife Service 1999a, *Bush Stone-curlew threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999b, *Glossy Black-cockatoo threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999c, *Koala threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999d, *Spotted-tailed Quoll threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999e, *Squirrel Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 1999f, *Terms of licence under the Threatened Species Conservation Act 1995. Appendix B of the Integrated Forestry Operations Approval for the Upper North East Region.*,

NSW National Parks and Wildlife Service 1999g, *Yellow-bellied Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001, *Grey-headed Flying Fox threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2002, *Threatened Species of the Upper North Coast of New South Wales - Fauna*, NSW National Parks and Wildlife Service, Northern Directorate, Coffs Harbour.

NSW National Parks and Wildlife Service 2003a, *Brush-tailed Rock Wallaby Warrumbungles endangered population threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003b, *Draft Recovery Plan for the Bush Stone-curlew Burhinus grallarius*, National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003c, *Draft Recovery Plan for the Koala*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2003d, *Recovery Plan for the Yellow-bellied Glider (Petaurus australis)*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1999, *Final determination to list the Giant Barred Frog as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2003, *Final determination to list the Stuttering Frog as an endangered species*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 2010a, *Final determination to list the Flame Robin (Petroica phoenicea) as a vulnerable species*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2010b, *Final determination to list the Scarlet Robin (Petroica boodang) as a vulnerable species*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2010c, *Spotted Harrier (Circus assimilis) Vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

Pizzey, G & Knight, F 2007, *Field Guide to the Birds of Australia*, Harper and Collins, Sydney.

Simpson, K & Day, N 1996, *Field Guide to the Birds of Australia*, 5th edn, Viking. Penguin Books Australia Ltd., Ringwood.

Strahan, R 1995, *The Mammals of Australia*, Reed New Holland, Sydney.

Swift Parrot Recovery Team 2001, *Swift Parrot Recovery Plan*, Department of Primary Industries, Water and Environment, Hobart.

Threatened Species Scientific Committee 2010, *Commonwealth Listing Advice on Pseudomys novaehollandiae (New Holland Mouse)*, Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Traill, BJ & Duncan, S 2000, *Status of birds in the New South Wales temperate woodlands region*, Consultancy report to the NSW National Parks and Wildlife Service by the Australian Woodlands Conservancy, Chiltern, Victoria.

Turner, V & Ward, SJ 1995, 'Eastern Pygmy-possum', in R Strahan (ed.), *The Mammals of Australia*, Reed New Holland, Sydney, pp. 217-8.

Appendix E

Significance assessments

Contents

Page number

E.1. Significance assessments introduction 3

E.2. Central Hunter Spotted Gum 6

Profile6

EP&A Act assessment 7

E.3. Diuris tricolor 9

Profile9

EP&A Act assessment 11

E.4. Bothriochloa biloba 13

Profile13

EPBC Act significance assessment 14

E.5. Squirrel Glider (Petaurus norfolcensis) 17

EP&A Act assessment 19

E.6. Brush-tailed Phascogale (*Phascogale tapoatafa*) 22

EP&A Act assessment 23

E.7. Threatened Woodland Birds 26

EP&A Act assessment 28

E.8. Threatened Aquatic Birds 31

EP&A Act assessment 33

E.9. Threatened Raptors 35

EP&A Act assessment 37

E.10. Threatened Owls 39

EP&A Act assessment 40

E.11. Threatened Opportunistic Blossom Nomads 43

EP&A Act assessment 46
EPBC Act significance assessment for the Regent Honeyeater 48
EPBC Act significance assessment for the Swift Parrot 50
EPBC Act significance assessment for Grey-headed Flying-fox 52

E.12. Microchiropteran bats 54

EP&A Act assessment for hollow-dwelling microchiropteran bats 57
EPBC Act significance assessment for South-eastern Long-eared Bat 59
EP&A Act assessment for cave-dwelling microchiropteran bats 63
EPBC Act significance assessment for Large-eared Pied Bat 65

E.13. Appendix E References 68

E.1. Significance assessments introduction

One Endangered Ecological Community, two Threatened plants and 34 Threatened animals listed under state or Commonwealth legislation were either recorded in the Study Area or identified as having a moderate to high likelihood-of-occurrence. Consequently, assessments of the significance of impacts for these species and communities have been completed.

For Threatened biodiversity listed under the *Threatened Species Conservation Act 1995* (TSC Act), this section details the heads of consideration for Threatened species assessment as suggested in the Department of Environment and Conservation/Department of Primary Industries draft Guidelines for Threatened Species Assessment (Department of Environment and Conservation 2005a). The guidelines present methods to consider the impacts on biodiversity of Proposals assessed under Part 3A of the Environmental Planning and Assessment Act 1979, including presenting heads of consideration for determining the significance of impacts.

For Threatened biodiversity listed under the EPBC Act significance assessment have been completed in accordance with the EPBC Act Significant Impact Guidelines (Department of the Environment and Heritage 2006).

Species listed under both the TSC Act and the EPBC Act have been assessed using both assessment guidelines separately.

Name	Conservation status[1]		Outcome of assessment	
	State	National	State	National
Ecological communities				
Central Hunter Ironbark - Spotted Gum – Grey Box Forest	E	-	Not significant	-
Threatened plants				
Bothriochloa biloba	-	V	-	Not significant
Diuris tricolor	V	-	Not significant	-
Threatened animals				
Squirrel Glider	V	-	Not significant	-
Brush-tailed Phascogale	V	-	Not significant	-
Threatened Woodland Birds				
Brown Treecreeper	V	-	Not significant	-
Hooded Robin	V	-	Not significant	-
Scarlet Robin	V	-	Not significant	-

Name	Conservation status[1]		Outcome of assessment	
	State	National	State	National
Flame Robin	V	-	Not significant	-
Grey-crowned Babbler	V	-	Not significant	-
Speckled Warbler	V	-	Not significant	-
Diamond Firetail	V	-	Not significant	-
Painted Honeyeater	V	-	Not significant	-
Black-chinned Honeyeater	V	-	Not significant	-
Threatened Aquatic Birds				
Black-necked Stork	E	-	Not significant	-
Blue-billed Duck	V	-	Not significant	-
Freckled Duck	V	-	Not significant	-
Threatened Raptors				
Little Eagle	V	-	Not significant	-
Spotted Harrier	V	-	Not significant	-
Square-tailed Kite	V	-	Not significant	-
Threatened Owls				
Barking Owl	V	-	Not significant	-
Powerful Owl	V	-	Not significant	-
Masked Owl	V	-	Not significant	-
Threatened Opportunistic Blossom Nomads				
Regent Honeyeater	E	E,M	Not significant	Not significant
Swift Parrot	E	E	Not significant	Not significant
Little Lorikeet	V	-	Not significant	-
Grey-headed Flying-fox	V	V	Not significant	Not significant
Hollow-dwelling Microchiropteran Bats				
Eastern False Pipistrelle	V	-	Not significant	-

Name	Conservation status[1]		Outcome of assessment	
	State	National	State	National
Eastern Free-tail bat	V	-	Not significant	-
South-eastern Long-eared Bat	V	V	Not significant	Not significant
Yellow-bellied Sheathtail Bat	V	-	Not significant	-
Greater Broad-nosed Bat	V	-	Not significant	-
Cave-dwelling Microchiropteran Bats				
Large-eared Pied Bat	V	V	Not significant	Not significant
Little Bent-wing Bat	V	-	Not significant	-
Eastern Bent-wing Bat	V	-	Not significant	-
Large-footed Myotis	V	-	Not significant	-
Eastern Cave Bat	V	-	Not significant	-

1. State conservation status. E = Endangered, V = Vulnerable,
National E = Endangered, V = Vulnerable for plants, animals and ecological communities (EPBC Act), M = Migratory.

E.2. Central Hunter Spotted Gum

Profile

Status

Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the NSW North Coast and Sydney Basin Bioregions is listed as an Endangered Ecological Community under the TSC Act.

Description

Central Hunter Ironbark - Spotted Gum - Grey Box Forest typically forms an open forest or woodland dominated by *Eucalyptus crebra* (Narrow-leaved Ironbark), *Corymbia maculata* (Spotted Gum) and *Eucalyptus moluccana* (Grey Box). Other tree species such as *Eucalyptus fibrosa* (Broad-leaved Ironbark) and *Eucalyptus tereticornis* (Forest Red Gum) may be present, and occasionally dominate or co-dominate. A sparse layer of small trees including *Allocasuarina luehmannii* (Bulloak) or *Acacia parvipinnula* (Silver-stemmed Wattle) may be present in some areas. The shrub layer varies from sparse to moderately dense. Common shrub species include *Daviesia ulicifolia* subsp. *ulicifolia* (Gorse Bitter Pea), *Pultenaea spinosa* (Grey Bush Pea), *Breynia oblongifolia* (Coffee Bush), *Hakea sericea* (Bushy Needlebush) and *Bursaria spinosa* subsp. *spinosa* (Native Blackthorn). Ground cover can be sparse to moderately dense and consists of numerous forbs, a few grass species and occasional ferns and sedges. Common species include *Cheilanthes sieberi* subsp. *sieberi* (Poison Rock Fern), *Cymbopogon refractus* (Barbed Wire Grass), *Pratia purpurascens* (Whiteroot), *Lomandra multiflora* subsp. *multiflora* (Many-flowered Mat-rush), *Pomax umbellata* (Pomax), *Glycine tabacina* (Variable Glycine), *Dianella revoluta* (Blue Flax Lily), *Laxmannia gracilis* (Slender Wire Lily), *Vernonia cinerea* var. *cinerea*, *Desmodium varians* (Variable Tick-trefoil) and *Dichondra repens* (Kidney Weed) (DECCW 2010c).

Distribution

Central Hunter Ironbark - Spotted Gum - Grey Box Forest occurs in the central Hunter Valley mainly between Maitland and Muswellbrook. It occurs in the Muswellbrook, Singleton, Cessnock, Maitland and Dungog LGAs (DECCW 2010c).

Habitat and ecology

- Occupies undulating country including low rises and slopes, occurring on all aspects. It may also occur on alluvial and colluvial soils in valleys.
- It mostly occurs on clayey soils found on Permian sediments (DECCW 2010c).

Threats

Threats to this community include:

- Inappropriate fire regime.
- Clearing and fragmentation of Central Hunter Spotted Gum - Ironbark forest for agriculture, development and mining.

- Weed invasion by species such as Olea europaea subsp. cuspidata (African Olive), Lantana camara (Lantana), Hyparrhenia hirta (Coolatai Grass) and Sporobolus africanus (Giant Parramatta Grass).
- Grazing by domestic stock (DECCW 2010c).

Recovery actions

The following recovery actions have been identified:

- exclude grazing by domestic stock in remnants of this community by appropriate fencing
- prevent further clearing and fragmentation of remnants
- control invasive weed species
- apply appropriate fire regimes.

The Project will result in further clearing which is inconsistent with an identified recovery action.

Specific impacts

The Project would remove 22.12 ha of this community, including 8.75 ha of forest and 13.4 ha of derived grassland.

EP&A Act assessment

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

Not applicable

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

The Project would remove 22.12 ha of this community. The vegetation to be removed is in moderate to poor condition, is highly fragmented and many of the remnants are also subject to ongoing disturbance as a result of grazing.

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

Not applicable

How is the proposal likely to affect current disturbance regimes?

The Project boundary current disturbance regimes include minor weed incursions within this community, feral animal invasion, and current mining activities. The area of potential habitat which surrounds the proposed rail corridor is already disturbed from past vegetation clearing, establishment of exotic species and erosion as such it is considered that the Project is unlikely to alter the current disturbance regimes that are already in place. If sediment/erosion

control measures and a weed management plan are implemented some of these impacts can be minimised.

How is the proposal likely to affect habitat connectivity?

Habitat connectivity is unlikely to be further fragmented as a result of the Project since the potential habitat is already fragmented with existing tracks, rail and past clearing for mining and grazing activities. Whilst the proposed rail corridor will widen the linear corridor by an addition 10-50 m it is considered habitat connectivity would not be significantly altered.

How is the proposal likely to affect critical habitat?

No critical habitat has been listed for this species under the *Threatened Species Conservation Act 1995*.

The potential habitat to be affected is fragmented, disturbed and isolated and is therefore unlikely to represent habitat critical to the survival of this species.

Conclusion

The Project would remove 22.12 ha of this community. The vegetation to be removed is in moderate to poor condition, is highly fragmented and many of the remnants are also subject to ongoing disturbance as a result of grazing. The project is unlikely to significantly increase fragmentation or disturbance regimes and is unlikely to significantly impact the community.

E.3. Diuris tricolor

Profile

Status

Diuris tricolor (Pine Donkey Orchid or Tricolour Donkey Orchid) is listed as Vulnerable under the TSC Act.

Description

The Pine Donkey Orchid is a terrestrial species (it grows from the ground rather than from rocks or vegetation).

Distribution

Occurs within Queensland, New South Wales and Victoria. Within NSW, it is sporadically distributed on the western slopes, extending from south of Narrandera all the way to the far north of NSW. Localities include the Condobolin-Nymagee road, Wattamondara towards Cowra, Cooyal, Adelong, Red Hill north of Narrandera, Coolamon, near Darlington Point, Eugowra, Girilambone, Dubbo, Muswellbrook, and several sites west of Wagga Wagga (DECCW 2010c).

Habitat and ecology

The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (Callitris spp.). It is found in sandy soils, either on flats or small rises. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta,* Ironbark and Acacia Shrubland (Jones 2006). The understorey is often grassy with herbaceous plants such as Bulbine species. Flowers from September to November or generally spring (Jones 2006).

Threats

Threats to this species include:

- Habitat clearing and modification. The species requires a grassy component to the ground layer to provide some protection and moisture-retaining litter.
- The short duration of its flowering means that it will be impossible to detect when some developments are assessed for their impact on threatened species.
- Feral animal impacts. The sandy soils and grassy open areas where this orchid grows are vulnerable to rabbit and goat disturbance.
- Weed competition (DECCW 2010c).

Recovery actions

The following recovery actions have been identified as well as 10 priority actions (Table B-1). None are likely to be affected by the Project.

- avoid changing land use where Pine Donkey Orchid is known to survive
- instigate monitoring studies within known populations
- conduct experimental studies on the effects of fire and grazing disturbance
- investigate regeneration including seed-set, germination and seedling survival
- conduct searches for further populations
- organise proactive surveying in potential habitats (DECCW 2010c).

Table 3-1 Recovery actions

Recovery strategy	Priority actions	Likely to be affected by proposal
Captive Husbandry or ex-situ collection/propagation	Collect seed and soil for NSW Seedbank. Develop collection program (including mycorrhizal symbiont) in collaboration with BGT - multiple provenances.	No
	Investigate seed viability, germination, dormancy and longevity (in natural environment and in storage) (+ symbionts and soil for orchids, gentians).	No
Community and land-holder liaison/awareness and/or education	Develop a fact sheet and distribute via community newsletters, regional shows and field days and by promoting the DEC threatened species website.	No
	Develop an Expression of Interest (EOI) for incentives targeted towards private landowners to locate new sites for conservation.	No
Conservation Status Review	Following surveys, assess the current conservation status and prepare & submit a nomination for de-listing if required.	No
Habitat management: Site Protection (eg Fencing/Signage)	Erect rabbit, goat and stock-proof fences around populations that are highly threatened from trampling and grazing by feral animals and stock.	No
Habitat Protection (inc vca/jma/critical habitat nomination etc)	Conduct surveys and assessments of less known sites to confirm presence of species and develop and implement conservation management agreements with landholders for high priority sites.	No. However, it is not known if species occurs within the site as surveys for the Project were not undertaken during flowering season
Monitoring	Annually monitor at least 5 populations that represent the spatial distribution of the species.	No
Research	Conduct experimental trials into the effects of fire, grazing and weed disturbances.	No
Survey/Mapping and	Conduct baseline surveys to locate new populations	No. However,

Recovery strategy	Priority actions	Likely to be affected by proposal
Habitat assessment	and extend the ranges of currently known populations. Surveys should include all State Forests where suitable habitat occurs.	surveys for the Project were not undertaken during flowering season

Specific impacts

It was not observed in the Project boundary during the field assessment; however, it is considered likely to occur due to availability of suitable habitat and known previous records in similar habitats in the region. The Project would remove 22.12 ha of potential habitat.

EP&A Act assessment

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

Diuris tricolor is a terrestrial deciduous herbs, emerging annually from a subterranean tuber. It is likely to be pollinated through a process called pseudocopulation {Jones, 2006 #2940}. The glands on the perianth segments are a source of the sexual attractants for the pollinators, usually male thynnine wasps drawn to the flowers by scent mimicking the female thynnine wasp pheromone. Once in sight of the flower, the male attempts to copulate with the labellum of the flower, mistaking it for a female wasp, and effects pollination. Habitat for these pollinators is vital for the continuation of the life cycle of this cryptic orchid. The Project will remove 22.12 ha of habitat for both this species and its associated pollinator.

The lifecycle of *Diuris tricolor* within the Project boundary is unlikely to be to be affected by the Project.

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

Habitat for this species includes sclerophyll forest among grass, often with native Cypress Pine (*Callitris spp.*). It is found in sandy soils, either on flats or small rises (Jones 2006).

The Project will remove 22.12 ha of habitat for this species. However, this is not a significant proportion of the habitat available within the region, and as such is unlikely to result in a decline in habitat availability.

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

Diuris tricolor current known habitat distribution is widespread throughout NSW occurring within the following Catchment Management Areas: Central West, Hawkesbury/Nepean, Hunter/Central Rivers, Lachlan, Murrumbidgee, Namoi and Western CMA's, usually recorded as common and locally frequent in populations. Therefore the Project is not at the limit of its known distribution.

How is the proposal likely to affect current disturbance regimes?

The Project boundary current disturbance regimes include minor weed incursions, feral animal invasion, and current mining activities. The area of potential habitat which surrounds the proposed rail corridor is already disturbed from past vegetation clearing, establishment of exotic species and erosion as such it is considered that the Project is unlikely to alter the current disturbance regimes that are already in place. If sediment/erosion control measures and a weed management plan are implemented some of these impacts can be minimised.

How is the proposal likely to affect habitat connectivity?

Habitat connectivity is unlikely to be further fragmented as a result of the Project since the potential habitat is already fragmented with an existing tracks and rail and whilst the proposed rail corridor will widen the linear corridor by an addition 10-50 m it is considered habitat connectivity would not be significantly affected. Connectivity within a plant population relates to the ability of individuals to disperse and cross pollinate. This species cross pollinates via insect pollinators (Wasps and Bees) which are capable of flying between populations of *Diuris sp.* Therefore it is concluded that habitat connectivity for *Diuris tricolor* in the wider region would not be significantly affected.

How is the proposal likely to affect critical habitat?

No critical habitat has been listed for this species under the *Threatened Species Conservation Act 1995*.

The potential habitat to be affected is fragmented, disturbed and isolated and is therefore unlikely to represent habitat critical to the survival of this species.

Conclusion

Based on the above assessment, *Diuris tricolor* is unlikely to be significantly affected by the Project.

E.4. Bothriochloa biloba

Profile

Status

Bothriochloa biloba (Lobed Blue-grass) is listed as Vulnerable under the EPBC Act.

Description

Bothriochloa biloba is a perennial grass to 1 m high.

Distribution

Occurs in Queensland and NSW. The species has a broad distribution in northern New South Wales, but most records have been from the northern portions of the Brigalow Belt South and Nandewar bioregions.

Habitat and ecology

It grows in woodland on poorer soils (Harden 1993). Occurs on basaltic hills and grassland on drainage slopes on a variety of soils in association with *Eucalyptus punctata, E. albens, E. camaldulensis E. tereticornis, E. populnea* ssp *bimbil* and *Angophora floribunda* (DLWC, 2001).

The response of *B. biloba* to grazing is unclear, however, the species appears to be negatively affected by overstocking and is more prevalent in areas that are conservatively grazed (such as roadsides and travelling stock routes, or rotationally grazed paddocks) (DECCW 2010c).

Threats

- Conversion of habitat to cultivation.
- Long periods of cultivation (greater than 4-5 years).
- Invasion and competition from Coolatai Grass, Hyparrhenia hirta, and other exotic perennial grasses. In particular, spread of Coolatai Grass along travelling stock routes is a major threat to the species.
- Potential impacts as a result of soil disturbance in road reserves, altered fire regimes in association with land use changes(DECCW 2010c).

Recovery actions

None identified

Specific impacts

This species was not recorded, however, the survey was undertaken outside the flowering period of this species and it is considered likely to occur due to availability of suitable habitat and known previous records in similar habitats in the region. The Project would remove 22.12 ha of potential habitat.

EPBC Act significance assessment

Bothriochloa biloba is listed as Vulnerable under the EPBC Act. The following assessment has been undertaken following the *Principal Significant Impact Guidelines 1.1* (Department of the Environment and Heritage 2006).

Under the *EPBC Act*, important populations are:

- likely to be key source populations either for breeding or dispersal
- likely to be necessary for maintaining genetic diversity, and/or
- at or near the limit of the species range.

The potential habitat within the site is degraded, fragmented and isolated and as such is unlikely to support key source populations either for breeding or dispersal or a population necessary for maintaining genetic diversity.

Bothriochloa biloba current known habitat distribution is widespread throughout NSW extending from Nowra in the south east to Dubbo in the west and to the north into Queensland. Therefore the Project is not at the limit of its known distribution.

Therefore, if present, the population of *Bothriochloa biloba* in the Project boundary would not be considered an important population.

Will the action lead to a long-term decrease in the size of an important population of a species?

Not applicable. If present within the site, the population would not be considered an important population.

Will the action reduce the area of occupancy of an important population?

Not applicable. If present within the site, the population would not be considered an important population.

Will the action fragment an existing important population into two or more populations?

Not applicable. If present within the site, the population would not be considered an important population.

Will the action adversely affect habitat critical to the survival of a species?

No critical habitat has been listed for *Bothriochloa biloba* under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006).

The habitat that would be affected as a result of the Project do not represent habitat critical to the survival of the *Bothriochloa biloba.*

Will the action disrupt the breeding cycle of an important population?

Not applicable. If present within the site, the population would not be considered an important population.

Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

The action will impact 22.12 ha of potential habitat for this species via the removal of habitat, the action will may also increase indirect disturbances such as weed incursions and sediment and erosion impacts into adjacent areas of habitat. Whilst, the Project will remove 22.12 ha of potential habitat. This species occurs widely in the Hunter, and northern NSW. Therefore whilst the Project will decrease the habitat for this species it is unlikely to lead to the decline of the species in the region.

Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat?

The current disturbance regimes include minor weed incursions, feral animal invasion, and current mining activities. The area of potential habitat which surrounds the proposed rail corridor is already disturbed from past vegetation clearing, establishment of exotic species and erosion as such it is considered that the Project is unlikely to alter the current disturbance regimes that are already in place. Weeds occur commonly but sparsely within the forested and derived grassland areas but dominate within the cleared areas of the rail corridor where the soil and groundcover vegetation have been disturbed. Construction has the potential to spread weeds but the implementation of a weed management plan will minimise these impacts. The proposed rail corridor is unlikely to result in invasive species that is harmful to the vulnerable species becoming established in the vulnerable species' habitat that are not already occurring. However, the Project will increase the width of the existing corridor through the potential habitat.

Will the action introduce disease that may cause the species to decline?

No, there are no known diseases associated with *Bothriochloa biloba.*

Will the action interfere substantially with the recovery of the species?

No recovery plans have been prepared for *Bothriochloa biloba* and the Project boundary has not been identified as important habitat for the recovery of the species.

Conclusion

The potential population of *Bothriochloa biloba* in the Project boundary is not considered an important population. Based on the small, fragmented area of degraded habitat, *Bothriochloa biloba* is unlikely to be significantly affected by the Project.

E.5. Squirrel Glider (Petaurus norfolcensis)

Status

The Squirrel Glider is listed as Vulnerable under the TSC Act.

Description

Adult Squirrel Gliders have a head and body length of about 20 cm. They have blue-grey to brown-grey fur above, white on the belly and the end third of the tail is black. There is a dark stripe from between the eyes to the mid-back and the tail is soft and bushy averaging about 27 cm in length. Squirrel Gliders are up to twice the size of Sugar Gliders, their facial markings are more distinct and they nest in bowl-shaped, leaf lined nests in tree hollows. Squirrel Gliders are also less vocal than Sugar Gliders (DECCW 2010c).

Distribution

The Squirrel Glider is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria (NSW National Parks and Wildlife Service 1999).

Habitat and ecology

Squirrel Gliders inhabit mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt/Bloodwood forests with a heath understorey in coastal areas. Suitable vegetation communities include at least one species of plant that flowers heavily in winter and one or more of the smooth-barked eucalypts (Department of Environment and Conservation 2005b).

Squirrel Gliders are nocturnal and display seasonal trends in feeding behaviour that are in accordance with phenological patterns consists of trees and shrubs (Goldingay & Sharpe 1998). Their diet includes acacia gum, eucalypt sap, nectar, honeydew and manna, lichens with invertebrates and pollen providing protein (NSW National Parks and Wildlife Service 1999).

Squirrel Gliders are agile climbers and can glide for more than 50 m in one movement. Nightly movements are estimated at between 300 m and 500 m. Home-ranges have been estimated at between 0.65 ha and 8.55 ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources, with more productive forests attributed to smaller home ranges (Quin 1995). Tree hollows greater than 5 cm diameter, in both living and dead trees as well as hollow stumps, are used as den sites for refuge and nesting (Gibbons & Lindenmayer 2000). Studies in Queensland showed that Squirrel Gliders used ironbark eucalypts and stags more than the hollows of smooth barked eucalypts and non-eucalypt tree species (Rowston 1998).

Squirrel Gliders use tree hollows for diurnal shelter either alone or in family groups of up to six individuals and offspring that occupy the same hollow simultaneously. The size and composition of groups of gliders occupying a particular hollow varies from day to day because gliders regularly swap den trees (van der Ree 2002). The nests are bowl-shaped and lined with leaves within tree hollows (Triggs 1996).

Threats

A range of threats to viability of local individuals and populations are attributable to loss and degradation of habitat, including:

- loss and fragmentation of habitat
- loss of hollow-bearing trees
- loss of flowering understorey and midstorey shrubs in forests (DECCW 2010c).

Recovery actions

The Threatened species profile (DECCW 2010c) identifies nine priority actions to recover the Squirrel Glider (Table D-1).

Table 5-1 Recovery strategies for the Squirrel Glider

Recovery actions	Priority
Control feral horses at relevant sites to promote retention and growth of mid-storey shrubs.	Medium
Prepare EIA guidelines which address the retention of hollow bearing trees maintaining diversity of age groups, species diversity. Give priority to largest hollow bearing trees.	Low
Ensure the largest hollow bearing trees (including dead trees) are given highest priority for retention in PVP assessments and other environmental planning instruments, or other land assessment tools.	Medium
Investigate the effectiveness of logging prescriptions.	Low
Prepare a recovery plan for the Squirrel Glider.	Low
Conduct surveys and assessments of less known sites to confirm presence of species and negotiate, develop and implement conservation management agreements for high priority sites.	High
Delineate boundaries of population to identify the extent to which populations are interconnected (to determine propensity to move across cleared land).	Medium
Conduct surveys on the Far South Coast, from Murramarong National Park south to Eden, to determine population size and extent and connectivity of populations (surveys should incorporate potential habitat on public as well as private land).	Low
Model and predict the distribution of Squirrel Gliders across the south west slopes.	Low

Specific measures to help recover the species include:

- Retain den trees and recruitment trees (future hollow-bearing trees).
- Retain food resources, particularly sap-feeding trees and understorey feed species such as Acacias and banksias.
- Replace top one or two strands of barbed wire on fences with regular wire in and adjacent to habitat.
- Retain and protect areas of habitat, particularly mature or old growth forest containing hollow-bearing trees and sap-feeding trees.

- In urban and rural areas retain and rehabilitate habitat to maintain or increase the total area of habitat available, reduce edge effects, minimise foraging distances and increase the types of resources available.

Specific impacts

One Squirrel Glider was recorded within an area of Central Hunter Ironbark - Spotted Gum - Grey Box Forest during field surveys undertaken for this assessment. The Project will remove approximately 8.75 ha of vegetation and 12 hollow bearing trees which potentially provide foraging and breeding habitat for the Squirrel Glider.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The Squirrel Glider was recorded in an area of Central Hunter Ironbark - Spotted Gum - Grey Box Forest. The area of potential habitat and number of hollow bearing trees proposed to be removed is relatively small in terms of the extent of similar habitat available within the study area and surrounding landscape. As such it is considered that the Project is unlikely to have an adverse effect upon the lifecycle of the species such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 8.75 ha of vegetation and 12 hollow-bearing trees which provide potential habitat for the Squirrel Glider.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for the Squirrel Glider. Whilst the proposed site compound and access track are located outside of the rail reserve, it is understood that the final design of these features will avoid all hollow-bearing trees present. It is considered that the Project is unlikely to significantly fragment or isolate potential habitat for the Squirrel Glider.

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

Areas of potential habitat to be removed are predominately located adjacent to the existing rail reserve, and as such are subject to edge effects and not considered significant habitat for the Squirrel Glider. The squirrel Glider is known to occupy a home-range of between 0.65 and 8.55 ha. The extent of potential habitat to be removed, including hollow-bearing trees, represents a small proportion of habitat available within the study area and surrounding landscape.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat is listed for Vulnerable species such as the Squirrel Glider, nor is the study site critical for the survival of the species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A relevant recovery action for the species includes the retention of habitat, including hollow-bearing trees.

The Project will remove approximately 8.75 ha of potential habitat for the Squirrel Glider, including 12 hollow-bearing trees. The extent of habitat removal proposed is relatively small in terms of the availability of similar or greater quality habitat in the study area and surrounding landscape. As such, it is unlikely that the Project will interfere with the recovery of the species.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to the Squirrel Glider, the Project is consistent with two key threatening processes:

- clearing of native vegetation
- loss of hollow-bearing trees.

The extent of native vegetation clearing and habitat removal associated with the Project is considered relatively minor in terms of available habitat for the Squirrel Glider within the study area and surrounding landscape.

Conclusion

The species was recorded during field surveys undertaken for this assessment. The Project will remove approximately 8.75 ha of vegetation and 12 hollow-bearing trees which potentially provide habitat for the Squirrel Glider. Vegetation removal associated with the Project will be linear in nature, predominately clearing areas of vegetation adjacent to the existing rail reserve. The area of potential habitat to be removed is relatively small in terms of the extent of similar or greater quality habitat available in the study area and surrounding landscape. As such, the Project is not likely to have a significant impact on the Squirrel Glider.

E.6. Brush-tailed Phascogale (*Phascogale tapoatafa*)

Status

The Brush-tailed Phascogale is listed as Vulnerable under the TSC Act.

Description

The Brush-tailed Phascogale is tree-dwelling marsupial carnivore. It has a characteristic, black, bushy 'bottlebrush' tail, with hairs up to 4 cm long. Its fur is grey above and pale cream below and it has conspicuous black eyes and large naked ears. Adults have a head and body length of about 20 cm, a tail length of about 20 cm and weigh 110 - 235 grams (DECCW 2010c).

Distribution

The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide (DECCW 2010c).

Habitat and ecology

The Brush-tailed Phascogale prefers dry sclerophyll open forest with a sparse groundcover of herbs, grasses, shrubs or leaf litter. The species also inhabits heath, swamps, rainforest and wet sclerophyll forest.

They are agile climbers, foraging preferentially in rough barked trees of 25 cm DBH or greater. The species feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates. Females have exclusive territories of approximately 20–60 ha, while males have overlapping territories of up to 100 ha. They nest and shelter in tree hollows with entrances 2.5–4 cm wide and use many different hollows over a short time span. Mating occurs May–July; males die soon after the mating season whereas females can live for up to three years but generally only produce one litter (DECCW 2010c).

Threats

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Predation by foxes and cats.
- Competition for nesting hollows with the introduced honeybee.

Recovery actions

The DECCW Threatened species profile (DECCW 2010c) identifies seven priority actions to recover the Brush-tailed Phascogale (Table E-1).

Table 6-1 Recovery strategies for the Brush-tailed Phascogale

Recovery actions	Priority
Undertake a targeted community education program that raises awareness about threats such as predation from cats.	Medium
Undertake fox and wild dog control at priority sites.	Medium
Design and implement an ecological burn (Dinner Creek) including habitat requirements of the species in Demon Nature Reserve.	Medium
Develop and provide environmental assessment guidelines for Local Councils and other consent or determining authorities to enable adequate consideration of the potential impacts of activities or actions on phascogales.	High
Establish a long term monitoring program targeting at least 30 populations across the known range of Brush-tailed phascogales. The program will incorporate sites used for experimental fox control (as per Fox TAP).	High
Monitor the effectiveness of forestry threatened species licence conditions and refine and negotiate changes if required.	Medium
Undertake research into the impact of hazard reduction burn practices.	Low

Specific measures to help recover the species include:

- Undertake fox and feral cat control.
- Provide nest boxes in areas where tree-hollows have been removed.
- Retain and protect habitat, particularly mature or old growth forest containing hollow-bearing trees.
- Retain nest trees and recruitment trees (future hollow-bearing trees).

Specific impacts

The Brush-tailed Phascogale was not recorded during field surveys undertaken for this assessment; however potential habitat exists on site in the form of Central Hunter Ironbark - Spotted Gum - Grey Box Forest and associated hollow-bearing trees. The Project will remove approximately 8.75 ha of vegetation and 12 hollow bearing trees which potentially provide foraging and breeding habitat for the Brush-tailed Phascogale.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The species was not recorded during field surveys undertaken for this assessment, however it is considered to have moderate likelihood of occurrence, as suitable habitat is present on site. The area of potential habitat and number of hollow bearing trees proposed to be removed is relatively small in terms of the extent of similar habitat available within the surrounding landscape. As such it is considered that the Project is unlikely to have an adverse effect upon the lifecycle of the species such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 8.75 ha of vegetation and 12 hollow-bearing trees which provide potential habitat for the Brush-tailed Phascogale.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for the Brush-tailed Phascogale. Whilst the proposed site compound and access track are located outside of the rail reserve, it is understood that the final design of these features will avoid all hollow-bearing trees present. The Project is unlikely to significantly fragment or isolate potential habitat for the Brush-tailed Phascogale.

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

Areas of potential habitat to be removed are predominately located adjacent to the existing rail reserve, and as such are subject to edge effects and not considered significant habitat for the Brush-tailed Phascogale. Females of the species are known to occupy a home-range of between 20 and 60 ha, whilst the home-range of males can extend up to 100 ha. The extent of potential habitat to be removed, including hollow-bearing trees, represents a small proportion of habitat available within the study area and surrounding landscape.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat has been listed for the species, nor is the study site critical for the survival of the Brush-tailed Phascogale.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with any recovery strategies outlined on the DECCW Threatened species profile (refer to Table E-1). The profile notes the retention of habitat, including hollow-bearing trees as a specific measure to help recover the species.

The Project will remove approximately 8.75 ha of potential habitat for the Brush-tailed Phascogale, including 12 hollow-bearing trees. The extent of habitat removal proposed is relatively small in terms of the availability of similar or greater quality habitat in the surrounding landscape. As such, it is unlikely that the Project will interfere with the recovery of the species.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to the Brush-tailed Phascogale, the Project is consistent with two key threatening processes:

- clearing of native vegetation
- loss of hollow-bearing trees.

The extent of native vegetation clearing and habitat removal associated with the Project is considered relatively minor in terms of available habitat for the species within the study area and surrounding landscape.

Conclusion

Whilst the Brush-tailed Phascogale was not recorded during field surveys undertaken for this assessment, the species is considered to occur on site with a moderate likelihood, as potential habitat is present. The Project will remove approximately 8.75 ha of vegetation and 12 hollow-bearing trees which potentially provide habitat for the Brush-tailed Phascogale. Vegetation removal associated with the Project will be linear in nature, predominately clearing areas of vegetation adjacent to the existing rail reserve. The area of potential habitat to be removed is relatively small in terms of the extent of similar or greater quality habitat available in the study areas and surrounding landscape. As such, the Project is unlikely to have a significant impact on the Brush-tailed Phascogale.

E.7. Threatened Woodland Birds

The following woodland birds have been grouped for assessment owing to similarities in ecology and habitat preference:

- Brown Treecreeper (*Climacteris picumnus*).
- Hooded Robin (*Melanodryas cucullata*).
- Scarlet Robin (*Petroica boodang*).
- Flame Robin (*Petroica phoenicea*).
- Grey-crowned Babbler (*Pomatostomus temporalis*).
- Speckled Warbler (*Pyrrholaemus sagittatus*).
- Diamond Firetail (*Stagonopleura guttata*).
- Painted Honeyeater (*Grantiella picta).*
- Black-chinned Honeyeater (*Melithreptus gularis gularis*).

These species have been assessed as a guild because of their similarity of habitats and habits, which are described in Table F-1.

Table 7-1 Details of Threatened woodland birds

Common Name	TSC Act	EPBC Act	Habitat and distribution
Brown Treecreeper	V	-	Occurs in eucalypt woodland and adjoining vegetation. Feeds on ants, beetles and larvae on trees and from fallen timber and leaf litter. Usually nests in hollows (Garnett & Crowley 2000).
Hooded Robin	V	-	Found in south-eastern Australia, generally east of the Great Dividing Range. Found in eucalypt woodland and mallee and acacia shrubland. This is one of a suite of species that has declined in woodland areas in south-eastern Australia (Garnett & Crowley 2000; Traill & Duncan 2000).
Scarlet Robin	V	-	In NSW, the Scarlet Robin occupies open forests and woodlands from the coast to the inland slopes. Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. It prefers an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (Higgins & Peter 2002).

Common Name	TSC Act	EPBC Act	Habitat and distribution
Flame Robin	V	-	In NSW the Flame Robin breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats (Higgins & Peter 2002). The Flame Robin forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other woody debris. The robin builds an open cup nest of plant fibres and cobweb, which is often near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.
Grey-crowned Babbler	V	-	Found throughout western slopes and plains, southern and central tablelands and occurring in Northern Rivers area, mid-north coast and the Hunter Valley of NSW. Lives in open forest and woodland, acacia shrubland and adjoining farmland. Large stick dome nest with spout-like entrance (Pizzey & Knight 2007).
Speckled Warbler	V	-	Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground (Garnett & Crowley 2000).
Diamond Firetail	V	-	Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and mallee. Most populations occur on the inland slopes of the dividing range. Feed on seeds, mostly of grasses (Garnett & Crowley 2000).
Painted Honeyeater	V	-	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes, which are largely restricted to older trees. Less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks (Garnett & Crowley 2000).
Black-chinned Honeyeater (*Melithreptus gularis gularis)*	V	-	Found in dry eucalypt woodland particularly those containing ironbark and box. Occurs within areas of annual rainfall between 400-700 mm. Feed on insects, nectar and lerps (Garnett & Crowley 2000).

Threats

Threats that affect these species include clearing of woodland resulting in loss and fragmentation of habitat; modification and destruction of ground habitat through heavy grazing and compaction by stock; removal of litter and fallen timber; introduction of exotic pasture grasses; and frequent fire (Department of Environment and Conservation 2006; Reid 1999; Trail & Duncan 2000).

Recovery actions

Specific measures to help recover these species include:

- Do not allow further loss of dead standing or fallen timber from firewood collection or on-farm practices such as 'tidying up'; do not allow removal of hollow-bearing dead or living trees and stumps on private and public lands.
- Fencing of known habitat to protect natural features and to allow natural regeneration.

- Increase remnant size and connectivity through incentives and DEC threatened species extension services.
- Avoid the use of exotic berry-producing shrubs in landscape and garden plantings in areas adjacent to habitat.
- Keep domestic dogs and cats indoors at night. Desex domestic dogs and cats. Assess the appropriateness of dog and cat ownership in new subdivisions.
- Undertake fox control programs.
- NPWS should be consulted when planning development to minimise impact on populations.
- Report any new sightings to the Department of Environment, Climate Change and Water.
- Control weeds in areas of known habitat, especially the exotic, winter-fruiting shrubs such as cotoneasters, hawthorns, firethorns and privets that support Pied Currawongs.

Specific impacts

The Grey-crowned Babbler was recorded during field surveys undertaken for this assessment and an additional eight Threatened species of woodland bird are considered likely to occur on site with a moderate likelihood. The Project will remove approximately 8.75 ha of vegetation and 12 hollow bearing trees which potentially provide foraging and breeding habitat for these species'.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The Grey-crowned Babbler was the only Threatened woodland bird recorded during diurnal bird surveys undertaken for this assessment, however the remaining eight Threatened species are considered likely to occur on site with a moderate likelihood, as potential habitat is present. The area of potential habitat proposed to be removed is relatively small in terms of the extent of similar or greater quality habitat available within the study area and surrounding landscape. As such it is considered that the Project is unlikely to have an adverse effect upon the lifecycle of the species' such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 8.75 ha of vegetation which provides potential habitat for the Threatened woodland birds recorded or potentially present on site.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for the Threatened woodland birds. Construction of the site compound and access track will not affect any significant habitat for these species. The Project is unlikely to significantly fragment or isolate potential habitat for the Threatened woodland birds.

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

Areas of potential habitat to be removed are predominately located adjacent to the existing rail reserve, and as such are subject to edge effects and not considered significant habitat for the Threatened woodland birds.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. The study site does not contain critical habitat for these species, nor is the site critical for their survival.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Owing to the small area of potential habitat to be removed (8.75 ha) and the mobility of the Threatened birds, it is unlikely that the Project will interfere with the recovery of the species'.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to the Threatened woodland birds, the Project is consistent with one key threatened process:

- clearing of native vegetation.

The extent of native vegetation clearing and habitat removal associated with the Project is considered relatively minor in terms of available habitat for the species within the study area and surrounding landscape.

Conclusion

The Grey-crowned Babbler was recorded during field surveys undertaken for this assessment and potential habitat exists on site for an additional eight Threatened woodland birds. Vegetation removal associated with the Project will be linear in nature, predominately clearing areas of vegetation adjacent to the existing rail reserve. The area of potential habitat to be removed is relatively small in terms of the extent of similar or greater quality habitat available in the study area and surrounding landscape. As such, the Project is not likely to have a significant impact on the Threatened woodland birds.

E.8. Threatened Aquatic Birds

The following aquatic birds have been grouped for assessment owing to similarities in ecology and habitat preference:

- Black-necked Stork (*Ephippiorhynchus asiaticus).*
- Blue-billed Duck (*Oxyura australis*).
- Freckled Duck (*Stictonetta naevosa).*

The Black-necked Stork, Blue-billed Duck and Freckled Duck have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as a result of the Project.

Table 8-1 Details of Threatened aquatic birds

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Black-necked Stork	E	-	Feed in shallow water up to 0.5 m deep on fish, reptiles and frogs. Build nests in trees close to feeding sites (Garnett & Crowley 2000).	Removal of remnant vegetation and individual trees is regarded as one of the major threats to this species. The scarcity of nest sites also increases competition for those available with other species of bird. Modifications to wetlands also threaten this species and while artificial water sources do provide new areas of habitat, such habitat is often sub-optimal for Black-necked Stork (NSW Scientific Committee 1998).
Blue-billed Duck	V	-	Relatively sparse throughout species range. Regularly found breeding in south-east Queensland, north-east South Australia and throughout New South Wales. Found on temperate, fresh to saline, terrestrial wetlands, and occupies artificial wetlands. Prefers deep permanent open water, within or near dense vegetation. Nest in rushes, sedge, Lignum *Muehlenbeckia cunninghamii* and paperbark Melaleuca (Garnett & Crowley 2000).	▪ Frequent burning which reduces the floristic diversity and simplifies the structure of the breeding and foraging habitat. ▪ Destruction or degradation of breeding habitat through drainage, flood mitigation works and ground water extraction ▪ Regulation of river flows and water harvesting schemes can poses a major threat to flooding regimes of wetland breeding areas. ▪ Clearing and overgrazing of Cumbungi and Lignum. ▪ Increased salinity can result in degradation and loss of tall dense wetland vegetation used for nesting. ▪ Illegal hunting. ▪ Pesticides and herbicide pollution of wetlands. ▪ Rubbish dumping

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Freckled Duck	V	-	In most years this species appear to be nomadic between ephemeral inland wetlands. In dry years they congregate on permanent wetlands while in wet years they breed prolifically and disperse widely, generally towards the coast. In inland eastern Australia, they generally occur in brackish to hyposaline wetlands that are densely vegetated with Lignum (*Muehlenbeckia cunninghamii*) within which they build their nests (Garnett & Crowley 2000).	▪ Draining and clearing of wetland and swamp habitat. ▪ Changes to natural river flows and flood patterns as a result of dams, weirs and irrigation. ▪ Grazing and trampling of wetland habitat by grazing stock. ▪ Illegal shooting.

Recovery actions

Specific measures to help recover these species include:

- Provide stock watering points away from wetlands.
- Retain and protect wetlands and maintain a natural density of riparian and wetland vegetation.
- Retain or reintroduce ecologically sustainable water flows to swamp, wetland and creek habitat.
- Fence swamps and wetlands to protect from domestic stock.
- Report illegal shooting to the DECCW.
- Develop salinity management plans for affected catchments.
- Make sure pesticides and herbicides are kept well away from wetlands.
- Assist in determining distribution and population size by recording sightings and submitting them to the NPWS Wildlife Atlas.
- Align or re-route powerlines away from wetlands and floodplains and potential nesting areas on floodplains, and attach discs to existing powerlines where birds regularly fly.

Specific impacts

Field surveys undertaken for this assessment did not record the three Threatened aquatic birds. Approximately 0.26 ha of potential foraging habitat for these species will be removed as part of the Project. Primary aquatic habitat is present within the study area in the form of large farm dams; however these areas will not be disturbed/modified by the Project.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The area of potential foraging habitat proposed to be removed is relatively small in terms of the extent of similar habitat available within the study areas and surrounding landscape. As such the Project is unlikely to have an adverse effect upon the lifecycle of the species such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 0.26 ha of potential foraging habitat for the species.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve and do not provide significant habitat for the Threatened aquatic birds. It is considered that the Project is unlikely to significantly fragment or isolate potential habitat for the Threatened species.

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

The area of potential habitat to be removed does not constitute primary habitat and is likely to only provide a limited foraging resource. The area to be removed is relatively small in terms of the extent of similar or greater quality habitat within the surrounding landscape. The Project will not affect any areas of aquatic habitat potentially supporting these species, including the large farm dams located adjacent to the existing rail alignment.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat has been listed for these species, nor is the study site critical for their survival.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A recovery plan has not been developed for the three Threatened aquatic birds.

The Project is not inconsistent with any specific measures identified by DECCW for the recovery of these species.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to the three species, the Project is consistent with two key threatening processes:

- clearing of native vegetation
- Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands.

The extent of potential foraging habitat proposed to be removed represents a small area (<0.1%) in terms of the availability of similar or greater quality habitat in the locality. No areas of aquatic habitat will be removed or modified by the Project.

Conclusion

The three species of aquatic bird were not recorded during field surveys undertaken for this assessment, however they are considered likely to occur on site with a moderate likelihood, as suitable habitat is present. The Project will remove approximately 0.26 ha of potential foraging habitat for these species; however no areas of aquatic habitat will be affected by the Project. As such, the Project is not likely to have a significant impact on these species.

E.9. Threatened Raptors

The following raptors have been grouped for assessment owing to similarities in ecology and habitat preference:

- Little Eagle *(Hieraaetus morphnoides)*
- Spotted Harrier *(Circus assimilis)*
- Square-tailed Kite *(Lophoictinia isura).*

The Little Eagle, Spotted Harrier and Square-tailed Kite have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as a result of the Project.

Table 9-1 Details of Threatened Raptors

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Little Eagle	V	-	The Little Eagle is distributed throughout the Australian mainland occupying habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. Prey includes birds, reptiles and mammals, with the occasional large insect and carrion. Most of its former native mammalian prey species in inland NSW are extinct and rabbits now form a major part of the diet (Marchant & Higgins 1993).	Over 50 % of forest and woodlands in NSW have been cleared (NSW Scientific Committee 2010). Thus, the main threat affecting this species is further clearing and degradation of foraging and breeding habitat (NSW Scientific committee 2009a). On the NSW tablelands and western slopes, important habitat is 53 – 84 % cleared and moderately to highly stressed (NSW Scientific committee 2009a). Loss of breeding sites may bring this species into increasing interspecific competition with the larger and more dominant Wedge-tailed Eagle.
Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods) (Marchant & Higgins 1993). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. The diet of the Spotted Harrier includes terrestrial mammals, birds and reptiles, occasionally large insects and rarely carrion.	The main threat that affects this species is the clearing and degradation of foraging and breeding habitat, particularly where it affects prey densities. Other threats include the possibility of secondary poisoning from rodenticides and pindone used to control rabbits (NSW Scientific Committee 2009c).

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Square-tailed Kite	V	-	This species hunts primarily over open forest, woodland and mallee communities as well as over adjacent heaths and other low scrubby habitats in wooded towns. It feeds on small birds, their eggs and nestlings as well as insects. Seems to prefer structurally diverse landscapes (Garnett & Crowley 2000).	The DECCW Threatened species profile (DECCW 2010b) lists the following threats to the species: ▪ clearing, logging, burning, and grazing of habitats resulting in a reduction in nesting and feeding resources ▪ disturbance to or removal of potential nest trees near watercourses ▪ illegal egg collection and shooting.

Recovery actions

Specific measures to help recover these species include:

- Buffer habitat areas from the impacts of other activities.
- Protect known populations and areas of potential habitat from clearing, fragmentation or disturbance.
- Rehabilitate known and potential habitat.
- Retain and protect nesting and foraging habitat
- Protect areas of habitat from overgrazing.
- Protect areas of habitat from development.
- Protect known habitat from fires of a frequency greater than that recommended for the retention of biodiversity.
- Report suspected illegal bird shooting and egg-collecting to DECCW.

Specific impacts

Field surveys undertaken for this assessment did not record the three Threatened raptors. The Project will result in the removal of approximately 64.14 ha of potential habitat for these species.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The three Threatened species of raptor were not recorded during field surveys undertaken for this assessment. Owing to the small amount of potential habitat to be removed and the species' mobility, it is considered that the Project is unlikely to have an adverse effect upon the lifecycle of these species such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 64.14 ha of potential habitat for these species.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for these species. Whilst the proposed site compound and access track are located outside of the rail reserve, the extent of habitat removal associated with these features is very small in terms of similar habitat in the study area and surrounding landscape. It is considered that the Project is unlikely to significantly fragment or isolate potential habitat for these species.

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

The extent of potential habitat to be removed represents a small proportion of habitat available within the surrounding landscape. Owing to the small extent of potential habitat removal and the mobility of the species, the Project is unlikely to affect the long-term survival of these species.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat has been listed for these species, nor is the study site critical for their survival.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A recovery plan has not been developed for these species.

The Project is not inconsistent with any specific measures identified by DECCW for the recovery of these species.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to the three Threatened raptors, the Project is consistent with one key threatened process:

- clearing of native vegetation.

The extent of native vegetation clearing and habitat removal associated with the Project is considered relatively minor in terms of the available habitat for these species within the surrounding landscape.

Conclusion

The three Threatened raptors considered likely to occur on site with a moderate likelihood were not recorded during field surveys undertake for this assessment. Whilst potential habitat exists on site, the area proposed to be removed represents a very small (<0.1%) proportion of suitable habitat within the locality. As such, the Project is unlikely to have a significant impact upon the three Threatened species of raptor.

E.10. Threatened Owls

The following owls have been grouped for assessment owing to similarities in ecology and habitat preference:

- Barking Owl *(Ninox connivens).*
- Powerful Owl *(Ninox strenua).*
- Masked Owl *(Tyto novaehollandiae)*.

The Barking Owl, Powerful Owl and Masked Owl have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as a result of the Project.

Table 10-1 Details of Threatened Owls

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Barking Owl	V		Occurs in dry sclerophyll woodland. In the south west it is often associated with riparian vegetation while in the south east it generally occurs on forest edges. It nests in large hollows in live eucalypts, often near open country. It feeds on insects in the non-breeding season and on birds and mammals in the breeding season (Garnett & Crowley 2000).	The following threats relate to these species: ▪ loss of mature hollow-bearing trees and changes to forest and woodland structure ▪ clearing of habitat for grazing, agriculture, forestry and other developments ▪ a combination of grazing and regular burning affects ground cover for mammal pray, particularly in open, grassy forests.
Powerful Owl	V		A sedentary species with a home range of approximately 1000 ha it occurs within open eucalypt, casuarina or callitris pine forest and woodland. It often roosts in denser vegetation including rainforest of exotic pine plantations. Generally feeds on medium-sized mammals such as possums and gliders but will also eat birds, flying-foxes, rats and insects. Prey are generally hollow dwelling and require a shrub layer and owls are more often found in areas with more old trees and hollows than average stands (Garnett & Crowley 2000).	
Masked Owl	V		Occurs within a diverse range of wooded habitats including forests, remnants and almost treeless inland plains. This species requires large-hollow bearing trees for roosting and nesting and nearby open areas for foraging. They typically prey on terrestrial mammals including rodents and marsupials but will also take other species opportunistically. Also known to occasionally roost and nest in caves (Garnett & Crowley 2000).	

Recovery actions

Specific measures to help recover these species include:

- Apply a mosaic pattern during fire hazard reduction to ensure the same areas are not burned too frequently.
- Retain standing dead trees and large fallen logs.
- Protect woodland and open forest remnants, especially those containing hollow-bearing trees.
- Retain and enhance vegetation along watercourses and surrounding areas to protect important habitat of the owls and their prey.
- Maintain a buffer of undisturbed native vegetation at least 200 m radius around known nest sites.
- Fence habitat remnants and protect from heavy grazing.
- Searches for the species should be conducted in suitable habitat in proposed development areas and proposed forest harvesting compartments.
- Minimise visits to nests and other disturbances, including surveys using call playback, when owls are breeding.
- Drive carefully at night through forest areas.
- Limit the use of pesticides used in suitable native habitat.

Specific impacts

Field surveys undertaken for this assessment did not record the three Threatened species of owl. The Project will remove approximately 8.75 ha of potential habitat for these species, including 12 hollow-bearing trees.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

These species were not recorded during field surveys undertaken for this assessment, however they are considered to have a moderate likelihood of occurrence, as suitable habitat is present on site. The area of potential habitat and number of hollow bearing trees proposed to be removed is relatively small in terms of the extent of similar habitat available within the study area and surrounding landscape. As such the Project is unlikely to have an adverse effect upon the lifecycle of the species' such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 8.75 ha of potential habitat for these species.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for these species. Whilst the proposed site compound and access track are located outside of the rail reserve, it is understood that the final design of these features will avoid all hollow-bearing trees present. It is considered that the Project is unlikely to significantly fragment or isolate potential habitat for these species.

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

Areas of potential habitat to be removed are predominately located adjacent to the existing rail reserve, and as such are subject to edge effects and not considered significant habitat for these species. Owing to the small extent of potential habitat to be removed and the mobility of the species', the Project is unlikely to affect their long-term survival.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat has been listed for these species, nor is the study site critical for their survival.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

A recovery plan has not been developed for these species.

The Project is not inconsistent with any specific measures identified by DECCW for the recovery of these species.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to the three Threatened owls, the Project is consistent with two key threatening processes:

- clearing of native vegetation
- loss of Hollow-bearing Trees.

The extent of native vegetation clearing and habitat removal associated with the Project is considered relatively minor in terms of available habitat for these species within the study area and surrounding landscape.

Conclusion

Whilst the three Threatened species of owl were not recorded during field surveys undertaken for this assessment, the species' are considered to occur on site with a moderate likelihood, as potential habitat is present. The Project will remove approximately 8.75 ha of vegetation and 12 hollow-bearing trees which potentially provide habitat for the Threatened owls. Vegetation removal associated with the Project will be linear in nature, predominately clearing areas of vegetation adjacent to the existing rail reserve. The area of potential habitat to be removed is relatively small in terms of the extent of similar or greater quality habitat available in the study area and surrounding landscape. As such, the Project is not considered to have a significant impact on these species.

E.11. Threatened Opportunistic Blossom Nomads

The following opportunistic blossom nomads have been grouped for assessment owing to similarities in ecology and habitat preference:

- Regent Honeyeater (*Xanthomyza Phrygia*).
- Swift Parrot (*Lathamus discolor*).
- Little Lorikeet (*Glossopsitta pusilla*).
- Grey-headed Flying-fox (*Pteropus poliocephalus).*

The Regent Honeyeater, Swift Parrot, Little Lorikeet and Grey-headed Flying-fox have been assessed together as they generally share similar habitat requirements; threats that affect their recovery; and potential impacts as a result of the Project.

Table 11-1 Details of Threatened opportunistic blossom nomads

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Regent Honeyeater	E	E,M	Occurs mostly in box-ironbark forests and woodland and prefers the wet, fertile sites such as along creek flats, broad river valleys and foothills. Riparian forests with *Casuarina cunninghamiana* and *Amyema cambagei* are important for feeding and breeding. Important food trees include *Eucalyptus sideroxylon* (Mugga Ironbark), *E. albens* (White Box), *E. melliodora* (Yellow Box) and *E. leucoxylon* (Yellow Gum) (Garnett & Crowley 2000).	Threats to Regent Honeyeater include: ▪ historical loss, fragmentation and degradation of habitat ▪ suppression of natural regeneration of overstorey tree species and shrub species from overgrazing ▪ inappropriate forestry management practices that remove large, mature resource-abundant trees. ▪ competition from larger aggressive honeyeaters, particularly Noisy Miners, Noisy Friarbirds and Red Wattlebirds ▪ egg and nest predation (Department of Environment and Conservation 2006).

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Swift Parrot	E	E	Breeding occurs in Tasmania, majority migrates to mainland Australia in autumn, over-wintering, particularly in Victoria and central and eastern NSW, but also south-eastern Queensland as far north as Duaringa. Until recently it was believed that in New South Wales, swift parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the north and south coasts including the Sydney region, but new evidence indicates that the forests on the coastal plains from southern to northern NSW are also extremely important. In mainland Australia is semi-nomadic, foraging in flowering eucalypts in eucalypt associations, particularly box-ironbark forests and woodlands. Preference for sites with highly fertile soils where large trees have high nectar production, including along drainage lines and isolated rural or urban remnants, and for sites with flowering *Acacia pycnantha*, is indicated. Sites used vary from year to year. (Garnett & Crowley 2000),(Swift Parrot Recovery Team 2001).	On mainland Australia, the main threat affecting this species is the loss of habitat through clearing for agriculture and urban and industrial development. During the breeding season and winter migration, collisions with wire netting fences, windows and cars, threaten this species, particularly where such obstacles are in close proximity to suitable habitat (Tzaros C. 2002).
Little Lorikeet	V		The Little Lorikeet inhabits forests and woodlands, with most associations occurring in dry, open eucalypt forest and woodlands (DECCW 2010a).	Most breeding records come from the western slopes, a region that has extensive habitat loss from historic clearing. Coupled with the fact that in NSW, over 50 % of forests and woodlands have been cleared (Lunney & Burgin 2004), the main threat that affects the species is the further loss and degradation of foraging and breeding habitat from land clearing (NSW Scientific Committee 2009b). Furthermore, nest hollows are not being recruited at a rate that compensates the loss of breeding habitat (Courtney J. 2006) and the loss of eucalypt woodland results in large reductions in food availability, particularly White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, an important habitat for Little Lorikeet, which is listed as Critically Endangered under the EPBC Act.

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Grey-headed Flying-fox	V	V	Occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps. Urban gardens and cultivated fruit crops also provide habitat for this species. Feeds on the flowers and nectar of eucalypts and native fruits including lilly pillies. It roosts in the branches of large trees in forests or mangroves (Churchill 2008; NSW National Parks and Wildlife Service 2001).	Key threats to this species include: ▪ loss of foraging habitat ▪ disturbance of roosting sites ▪ unregulated shooting ▪ electrocution on powerlines.

Recovery actions

Specific measures to help recover these species include:

- Provide landholders and other community members with information on the ecology and conservation requirements of the species.
- Encourage landholders/agistees to remove stock from sensitive riparian breeding sites.
- No loss of mature key nectar tree species. Minimise the removal of mistletoes at key sites.
- Continue treeplanting programs at key breeding and foraging locations.
- Retain stands of winter-flowering feed-trees, particularly large mature individuals.
- Revegetate with winter-flowering tree species where appropriate.
- Retain large old trees, especially those that are hollow-bearing.
- Ensure recruitment of trees into the mature age class so that there is not a lag period of decades between the death of old trees and hollow formation in younger trees.
- Protect large flowering Eucalyptus trees throughout the habitats frequented by this species. Manage remnant woodlands and forest for recovery of old-growth characteristics.
- Reduce the abundance of feral Honeybees and limit the exploitation of nectar by domestic bees where resources are spatially or temporally sparse (e.g. in years of drought).
- Manage and enforce licensed shooting.
- Identify powerline blackspots and implement measures to reduce deaths.

Specific impacts

The Grey-headed Flying-fox was recorded during field surveys undertaken for this assessment and an additional three Threatened opportunistic blossom nomads are considered likely to occur on site with a moderate likelihood. The Project will remove approximately 9.4 ha of vegetation which potentially provides habitat for these species'.

EP&A Act assessment

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The Grey-headed Flying-fox was the only Threatened opportunistic blossom nomad recorded during surveys undertaken for this assessment, however three Threatened species are considered likely to occur on site with a moderate likelihood, as potential habitat is present. The area of potential habitat proposed to be removed is relatively small in terms of the extent of similar habitat available within the study area and surrounding landscape. As such it is considered that the Project is unlikely to have an adverse effect upon the lifecycle of these species such that a viable local population is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

The Project will remove approximately 9.4 ha of potential habitat or these species.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for these species. Whilst the proposed site compound and access track are located outside of the rail reserve, development of these features will not affect any areas of potential habitat for these species. The Project is unlikely to significantly fragment or isolate potential habitat for the Threatened opportunistic blossom nomads.

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

Areas of potential habitat to be removed are predominately located adjacent to the existing rail reserve, and as such are subject to edge effects and not considered significant habitat for these species. Owing to the mobility of these species and the small extent of potential habitat to be removed, it is unlikely the Project will affect the long-term survival of the Threatened opportunistic blossom nomads.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat has been listed for these species, nor is the study site critical for their survival.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Owing to the small extent of potential habitat to be removed, the Project is not considered inconsistent with any specific recovery measures identified by DECCW.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to these species, the Project is consistent with one key threatened process:

- clearing of native vegetation.

The extent of native vegetation clearing and habitat removal associated with the Project is considered relatively minor in terms of the availability of similar or greater quality habitat in the study area and locality.

Conclusion

The Grey-headed Flying-fox was recorded during field surveys undertaken for this assessment and potential habitat exists on site for an additional three Threatened opportunistic blossom nomads. Vegetation removal associated with the Project will be linear in nature, predominately clearing areas of vegetation adjacent to the existing rail reserve. The area of potential habitat to be removed is relatively small in terms of the extent of similar or greater quality habitat available in the surrounding landscape. As such, the Project is not considered to have a significant impact on these species.

EPBC Act significance assessment for the Regent Honeyeater

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will result in one or more of the following.

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

The Regent Honeyeater was not recorded during diurnal bird surveys undertaken for this assessment. Potential habitat for this species exists on site, however the extent proposed to be removed represents a very small proportion of available habitat in the locality and as such, the Project is not likely to lead to a long-term decrease in any populations potentially present.

Reduce the area of occupancy of the species

The Project will remove approximately 9.4 ha of potential habitat for this species. This area is relatively small in terms of the extent of similar or greater quality habitat in the study area and surrounding landscape.

Fragment an existing population into two or more populations

The Regent Honeyeater has not been recorded within the study site. Owing to the small extent of potential habitat to be removed and the mobility of this species, the Project is unlikely to fragment any populations potentially present.

Adversely affect habitat critical to the survival of a species

No critical habitat for this species is listed under the EPBC Act, nor is the study site critical to the survival of this species.

Disrupt the breeding cycle of a population

No individuals of Regent Honeyeater or nests have been recorded within the study site during the field surveys despite the presence of suitable habitat. The study site represents a small proportion of the suitable habitat for the species in the locality (0.1%). The Project is unlikely to disrupt the breeding cycle of an important population for this species.

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

The Project will remove approximately 9.4 ha of potential habitat for this species. This area of potential habitat is relatively small in terms of the extent of similar of greater quality habitat within the study area and surrounding landscape. As such, it is considered unlikely that the Project would cause the Regent Honeyeater to decline.

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

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Regent Honeyeater would become further established as a result of the Project.

Introduce disease that may cause the species to decline, or

No. It is not likely that disease would be increased by the Project.

Interfere with the recovery of the species.

Specific objectives of the Regent Honeyeater recovery plan (Menkhorst *et al.* 1999) include:

- Maintain and enhance the value of Regent Honeyeater habitat at the key sites and throughout the former range, by active participation in land-use planning processes and by active vegetation rehabilitation at strategic sites.
- Monitor trends in the Regent Honeyeater population size and dispersion across its range to allow assessment of the efficacy of management actions.
- Facilitate research on strategic questions that will enhance the capacity to achieve the long-term objectives. In particular, determine the whereabouts of Regent Honeyeaters during the non-breeding season and during breeding season absences from known sites. Identify important sites and habitat requirements at these times.
- Maintain and increase community awareness, understanding and involvement in the recovery effort.
- Maintain the captive population of Regent Honeyeaters at a size that will provide adequate stock to: provide insurance against the demise of the wild population; continuously improve captive-breeding and husbandry techniques; provide adequate stock for trials of release strategies; and maintain 90% of the wild heterozygosity in the captive population.

Based on the potential ecological impacts of the Project on this species, as discussed above, it is likely that the Project would be in conflict with the first objective above to a small extent, by not improving habitat carrying capacity for the Regent Honeyeater. Owing to the small extent of potential habitat to be removed, it is considered that the Project will not interfere substantially with the recovery of the Regent Honeyeater.

Conclusion

The Regent Honeyeater was not recorded within the study site during diurnal surveys undertaken for this assessment. Potential habitat exists on site in the form of Central Hunter Ironbark - Spotted Gum – Grey Box Forest. The Project would remove approximately 9.4 ha of potential habitat for the Regent Honeyeater, which represents a small proportion of available habitat in the locality. Owing to the mobility of the species and small extent of potential habitat to be removed, the Project is unlikely to significantly impact upon this species or interfere with its recovery.

EPBC Act significance assessment for the Swift Parrot

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will result in one or more of the following.

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

The Swift Parrot was not recorded during diurnal bird surveys undertaken for this assessment. Potential foraging habitat for this species exists on site, however the extent proposed to be removed represents a very small proportion of available habitat in the locality and as such, the Project is not likely to lead to a long-term decrease in any populations potentially present.

Reduce the area of occupancy of the species

The Project will remove approximately 9.4 ha of foraging habitat for this species. This area is relatively small in terms of the extent of similar or greater quality habitat available in the study area and surrounding landscape.

Fragment an existing population into two or more populations

The Swift Parrot has not been recorded within the study site. Owing to the small extent of potential habitat to be removed and the mobility of this species, the Project is unlikely to fragment any populations potentially present.

Adversely affect habitat critical to the survival of a species

No critical habitat for this species is listed under the EPBC Act, nor is the study site critical to the survival of this species.

Disrupt the breeding cycle of a population

No individuals of Swift Parrot have been recorded within the study site during the field surveys despite the presence of suitable foraging habitat. The study site represents a small proportion of the suitable foraging habitat for the species in the locality. Therefore, due to the small area (9.4 ha) of potential foraging habitat proposed to be removed it is considered that the Project is unlikely to disrupt the breeding cycle of an important population for this species.

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

The Project will remove approximately 9.4 ha of potential foraging habitat for this species. This area of potential habitat is relatively small in terms of the extent of similar of greater quality habitat within the study area and surrounding landscape. As such, it is unlikely that the Project would cause the Swift Parrot to decline.

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

It is not likely that invasive species (such as introduced predators) that are potentially harmful to the Swift Parrot would become further established as a result of the Project.

Introduce disease that may cause the species to decline, or

No. It is not likely that disease would be increased by the Project.

Interfere with the recovery of the species.

The *Action Plan for Australian Birds* (Garnett & Crowley 2000) addresses the need for further ecological research on the species and the conservation and protection of roosting habitat and identification of specific breeding requirements.

Specific objectives of the Swift Parrot Recovery Plan (Swift Parrot Recovery Team 2001) include:

- Identify priority habitats and sites across the range of the Swift Parrot.
- Implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity.
- Reduce the incidence of collisions with man-made structures.
- Determine population trends within the breeding range.
- Quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat.
- Increase public awareness about the recovery program and to involve the community in the recovery.

Based on the potential ecological impacts of the Project on this species, as discussed above, it is likely that the Project would be in conflict with the second objective above to a small extent, by not improving habitat carrying capacity for the Swift Parrot. Owing to the small extent of potential habitat to be removed, it is considered that the Project will not interfere substantially with the recovery of the Swift Parrot.

Conclusion

The Swift Parrot was not recorded within the study during diurnal surveys undertaken for this assessment. Potential foraging habitat exists on site in the form of Central Hunter Ironbark - Spotted Gum – Grey Box Forest and rehabilitation. The Project would remove approximately 9.4 ha of potential foraging habitat for the Swift Parrot, which represents a small proportion of available habitat in the locality. Owing to the mobility of the species and small extent of potential foraging habitat to be removed, the Project is unlikely to significantly impact upon this species or interfere with its recovery.

EPBC Act significance assessment for Grey-headed Flying-fox

Is this an important population?

Grey-headed Flying-foxes occur across a range of wooded habitats where their favoured food, eucalypt blossom occurs. They set up roosting camps in association with blossom availability, which are usually situated in dense vegetation and associated with water. Grey-headed Flying-foxes can migrate up to 75 km north during the winter and during this time young flying-foxes establish camps.

The study area does not contain suitable habitat for roosting camps and such habitat does not occur within its close vicinity. Therefore, a population of Grey-headed Flying-fox in the study area is not considered to be important, as no roost sites would be affected by the Project.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following.

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

Not applicable. Grey-headed Flying-fox in the study site is not part of an important population.

Reduce the area of occupancy of an important population

Not applicable. Grey-headed Flying-fox in the study site is not part of an important population.

Fragment an existing important population into two or more populations

Not applicable. Grey-headed Flying-fox in the study site is not part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

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

The Project would remove approximately 9.4 ha of suitable foraging habitat for this species. As the species is highly mobile, with individuals foraging up to 50 km from roost sites, it is likely that suitable foraging resources could be accessed in the locality. Therefore, this would not meet the above criteria.

Disrupt the breeding cycle of an important population

Not applicable. Grey-headed Flying-fox in the study site is not part of an important population.

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

No. The Project would only affect approximately 9.4 ha of suitable foraging habitat for this species. As this species is known to forage up to 50 km from roost sites, the Project is not likely to significantly affect the availability of quality habitat for this species.

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

It is not likely that invasive species (such as introduced predators) that are harmful to the Grey-headed Flying-fox would become further established as a result of the Project.

Introduce disease that may cause the species to decline

No. There are no known diseases that are likely to increase in the area as a result of the Project.

Interfere substantially with the recovery of the species.

Due to the limited foraging habitat likely to be affect by the Project (approximately 9.4 ha) and as no roost camps are located in the vicinity of the study site, the Project is not likely to interfere with the recovery of this species.

Conclusion

The Grey-headed Flying-fox was recorded during field surveys undertaken for this assessment. The species frequents habitats that contain eucalypt blossom and native fruits such as figs, which are their favoured foods. The study site contains the eucalypt dominated Central Hunter Ironbark - Spotted Gum – Grey Box Forest and mine rehabilitation. A relatively small amount of suitable foraging habitat (9.4 ha) will be removed by the Project, although this is unlikely to be significant to local populations, due to the abundance of similar and greater quality foraging habitat elsewhere within the study area and in the wider locality. There are no Grey-headed Flying-fox camps within the study site or its vicinity. Therefore habitat attributes occurring within the study site are not considered important to the long-term survival of the Grey-headed Flying-fox.

E.12. Microchiropteran bats

Microchiropteran bats fall into two broad groups based on their roosting requirements, hollow-dwelling species and cave-dwelling species. Each group is dealt with separately within the following test of significance.

Hollow-dwelling microchiropteran bats

The following species of microchiropteran bat were considered to have potential foraging and limited roosting habitat in the subject site:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis)*
- Eastern Free-tail bat (*Micronomus norfolkensis)*
- South-eastern Long-eared Bat (*Nyctophilus species 2*)
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris)*
- Greater Broad-nosed Bat (*Scoteanax rueppellii).*

These species have been assessed as a guild because of their similarity of habitats and habits, which are described in Table K-1.

Table 12-1 Details of Threatened species of hollow-dwelling microchiropteran bat

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Eastern False Pipistrelle	V		Usually roosts in tree hollows in higher rainfall forests. Sometimes found in caves (Jenolan area) and abandoned buildings (Churchill 2008).	Its population and distribution are suspected to be reduced. It faces severe threatening processes. It is an ecological specialist (it depends on particular types of diet or habitat).
Eastern Free-tail Bat	V		Thought to live in Sclerophyll forest and woodland. Small colonies have been found in tree hollows or under loose bark. It feeds on insects above the forest canopy or in clearings at the forest edge (Churchill 2008).	Vulnerable to loss of tree hollows and loss of feeding grounds by forestry activities, clearing for agriculture and housing. Its population is suspected to have been reduced. It is an ecological specialist and depends on particular types of diet or habitat (Churchill 2008).

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
South-eastern Long-eared Bat	V	V	The South-eastern Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands.	Threats include: ▪ Habitat loss. ▪ Habitat fragmentation. ▪ Fire. ▪ Forestry activities. ▪ Overgrazing. ▪ Predation by feral species. ▪ Tree hollow competition. ▪ Exposure to agrichemicals. ▪ Climate change.
Yellow-bellied Sheathtail Bat	V		A wide-ranging species across northern and eastern Australia. In the most southerly part of its range (Victoria, south-western NSW South Australia), it is a rare visitor in late summer/autumn. This species flies high and fast over forest canopies foraging for insects in most habitats across its wide range. Generally roosts in tree hollows (Churchill 2008).	Vulnerable to loss of tree hollows and clearing and fragmentation of forest and woodland habitat.
Greater Broad-nosed Bat	V		The preferred hunting areas of this species include tree-lined creeks and the ecotone of woodlands and cleared paddocks but it may also forage in rainforest. Typically it forages at a height of 3-6 m but may fly as low as 1 m above the surface of a creek. It feeds on beetles, other large, slow-flying insects and small vertebrates. It generally roosts in tree hollows but has also been found in the roof spaces of old buildings (Churchill 2008).	Its population is suspected to have been reduced. It is an ecological specialist (it depends on particular types of diet or habitat).

Recovery actions

No recovery plan has been prepared for any microchiropteran bat under the TSC Act. The DECCW has however; identified 25 priorities action statements to help recover these species (refer Table K-2).

Table 12-2 Priorities action statements for microchiropteran bats

Priority action
Objective 1: Promote bats throughout the rural community as ecologically interesting and important, but sensitive to disturbance at caves/disused mine tunnels.
Objective 2: Compile register of all known roost sites in natural and artificial structures including current and historical data and identify significance of roost, e.g. maternity, hibernation, transient roost.
Objective 3: Control foxes and feral cats around roosting sites, particularly maternity caves and hibernation sites.
Objective 4: Control goats around roosting sites, particularly maternity caves and hibernation sites.
Objective 5: Exclude prescription burns from 100m from cave entrance, ensure smoke/flames of fires do not enter caves/roosts in artificial structures.
Objective 6: Prepare fire management plans for significant roost caves, disused mines, culverts, especially maternity and winter roosts.
Objective 7: Prepare management plans for significant bat roosts especially all known maternity colonies and winter colonies.
Objective 8: Ensure protection of known roosts and forest within 10 km of roosts in PVP assessments (offsets should include nearby remnants in high productivity) and other environmental planning instruments.
Objective 9: Identify and protect significant roost habitat in artificial structures (e.g. culverts, old buildings and derelict mines).
Objective 10: Restrict access where possible to known maternity sites. (e.g.: signs).
Objective 11: Restrict caving activity during critical times of year in important roosts used by species, particularly maternity and hibernation roosts.
Objective 12: Search for significant roost sites and restrict access where possible. (e.g. gating of caves). Significant includes maternity, hibernation and transient sites including in artificial structures.
Objective 13: Undertake non-chemical removal of weeds (e.g. lantana, blackberry) to prevent obstruction of cave entrances.
Objective 14: Promote the conservation of these significant roost areas using measures such as incentive funding to landholders, offsetting and biobanking, acquisition for reserve establishment or other means.
Objective 15: Monitor the breeding success of maternity colonies in cave roosts over a number of years to determine the viability of regional populations.
Objective 16: For roost caves vulnerable to human disturbance, monitor their visitation by people, particularly during winter and spring/summer maternity season and in school holidays.
Objective 17: Identify types of winter roosts used by species. Winter roosts suspected to be banana palms and tree hollows
Objective 18: Determine the effectiveness of PVP assessment, offsets and actions for bats.
Objective 19: Establish a gating design for disused mines across species range that will not adversely impact species.
Objective 20: Identify important foraging range and key habitat components around significant roosts.
Objective 21: Identify the susceptibility of the species to pesticides.
Objective 22: Measure genetic population structure among cave roosts of maternity colonies to estimate dispersal and genetic isolation, and vulnerability to regional population extinction.
Objective 23: Study the ecological requirements of maternity colonies and their environs and migratory patterns.
Objective 24: Study the effect of different burning regimes on cave disturbance and surrounding foraging habitat.
Objective 25: Undertake a regular census of maternity colonies (e.g. Willi Willi) and other key roosts in network, especially where there are population estimates from banding in the 1960s.

Note: priorities action statements taken from Little Bent-wing Bat threatened species profile(Department of Environment and Climate Change 2005).

EP&A Act assessment for hollow-dwelling microchiropteran bats

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

In the study site 12 hollow-bearing trees will be removed. While a number of hollow-bearing trees representing potential roosting opportunities for hollow-dwelling microchiropteran bats will be removed during the Project, an abundance of similar or high quality roosting opportunities occur elsewhere within the study area and in the wider locality.

While vegetation to be removed represents both foraging and roosting opportunities for hollow-dwelling microchiropteran bats, it is considered unlikely that the removal of this vegetation will significantly affect locally occurring microchiropteran bat populations, due to the linear nature of vegetation clearing works and the retention of similar and higher quality habitat within the study area and the wider locality.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

Approximately 64.14 ha of vegetation representing suitable foraging and roosting opportunities for these species are likely to be affected by the Project. Potential foraging/roosting habitat in the study site represents only a small part of a much greater area of potential habitat accessible to locally occurring species. Vegetation to be removed is not considered to be of great significance to these species, due to the abundance of retained habitat of similar or higher quality elsewhere, both in the study area and wider locality.

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

Areas of potential habitat to be removed are predominately located along the edge of the existing rail reserve. These areas are already subject to edge effects and are unlikely to provide significant habitat for the microchiropteran bats. Whilst the proposed site compound and access track are located outside of the rail reserve, it is understood that the final design of these features will avoid all hollow-bearing trees present. The Project is unlikely to significantly fragment or isolate potential habitat for hollow-dwelling microchiropteran bat species.

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

The subject site provides a relatively small amount of suitable foraging/roosting habitat for these species. A limited amount of potential foraging/roosting habitat (approximately 64.14 ha) will be affected. Foraging/roosting opportunities occurring in the study area, such as ecotonal zones/hollow-bearing trees, will continue to exist and an abundance of similar and higher quality foraging/roosting opportunities will be retained both within the study area and in the wider locality. The proposed development would not impact habitat considered critical to the long-term survival of populations in the locality and is unlikely to further create a barrier to movement for these species.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Critical habitat refers to those areas of land listed in the Register of Critical Habitat kept by the Director General of the DECCW. No critical habitat has been listed for any microchiropteran bat to date. Furthermore, it is estimated that approximately 64.14 ha of marginal quality habitat would be affected by the Project, and as such, is not considered critical to the survival of these species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

No recovery plan has been prepared for any microchiropteran bat under the TSC Act. The DECCW has however; identified 25 priorities action statements within 11 recovery strategies to help recover these species (refer Table K-2). The Project is not likely to adversely affect any of these recovery actions.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to hollow-dwelling microchiropteran bats, the Project is consistent with three key threatening processes:

- clearing of native vegetation
- removal of dead wood and dead trees
- loss of hollow-bearing trees.

None of these key threatening processes are likely to significantly affect hollow-dwelling microchiropteran bats in the locality. Threat abatement plans have not been prepared for these processes.

Conclusion

No Threatened hollow-dwelling microchiropteran bats were recorded during the field survey undertaken for this assessment; however potential habitat is present on site. The Project will remove 12 hollow-bearing trees and approximately 64.14 ha of vegetation which potentially provides a foraging resource for these species. Microhabitat foraging opportunities, such as ecotonal edges, that occur in the study area will continue to exist and an abundance of similar and higher quality foraging habitat will be retained within the study area and in the wider locality. Furthermore, roosting/breeding habitat opportunities occur elsewhere within the study area and the wider locality and will be retained throughout the Project. Therefore, the Project is not likely to have a significant adverse affect on these species.

EPBC Act significance assessment for South-eastern Long-eared Bat

Is this an important population?

The South-eastern Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands. What is of most importance to this species is the presence of hollow-bearing trees, which provide suitable roosting and breeding habitat. Although the study site contains foraging and roosting habitat, the extent proposed to be removed/modified by the Project represents a small proportion of available habitat in the study area and wider locality.

Potential occurrences of this species within the study site are not at the limits of the species' distribution and as such the site can only be considered to represent a part of the foraging range of widely occurring individuals. For these reasons, if present within the site, individuals of this species would not be considered to be part of an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following.

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

Not applicable, if present the South-eastern Long-eared Bat would not be part of an important population.

Reduce the area of occupancy of an important population

Not applicable, if present the South-eastern Long-eared Bat would not be part of an important population.

Fragment an existing important population into two or more populations

Not applicable, if present the South-eastern Long-eared Bat would not be part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006).

The extent of the habitat that would be cleared as a result of the Project does not represent habitat critical to the survival of the South-eastern Long-eared Bat.

Disrupt the breeding cycle of an important population

Not applicable, if present the South-eastern Long-eared Bat would not be part of an important population.

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

No. The Project would only affect approximately 64.14 ha of suitable habitat, including 12 hollow-bearing trees. The Project is not likely to significantly affect the availability of quality habitat for this species.

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

The Project is not likely to increase the likelihood of an invasive species becoming established in the habitat of the South-eastern Long-eared Bat.

Introduce disease that may cause the species to decline

The Project is not likely to increase the likelihood of a disease becoming established or proliferating in a local population that would result in a decline of the South-eastern Long-eared Bat.

Interfere substantially with the recovery of the species.

Due to small extent of potential habitat to be removed and the availability of similar or greater quality habitat within the surrounding landscape, the Project is not likely to interfere with the recovery of this species.

Conclusion

The South-eastern Long-eared Bat occurs in a range of inland woodland vegetation types. The hollow-bearing trees and canopy of the Central Hunter Ironbark - Spotted Gum – Grey Box Forest community provide potential roosting and foraging habitat for this species on site.

Although a relatively small area of potential habitat (64.14 ha and 12 hollow-bearing trees) will be removed, there is an abundance of similar or much higher quality habitat elsewhere within the study area and the wider locality. As a consequence relatively small amounts of foraging habitat to be removed are not considered to be significant to this species. Therefore, it is unlikely that the Project will have a significant impact upon the South-eastern Long-eared Bat.

Cave-dwelling microchiropteran bats

The following species of microchiropteran bat were considered to be limited to foraging potential within the subject site, due to the lack of suitable cave roosting opportunities:

- Large-eared Pied Bat (*Chalinolobus dwyeri*).
- Little Bent-wing Bat (*Miniopterus australis*).
- Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*).
- Large-footed Myotis (*Myotis adversus*).
- Eastern Cave Bat (*Vespadelus troughtoni*).

These species have been assessed as a guild because of their similarity of habitats and habits, which are described in Table K-3.

Table 12-3 Details of Threatened species of cave-dwelling microchiropteran bat

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Large-eared Pied Bat	V	V	Occurs in moderately wooded habitats and roosts in caves, mine tunnels and the abandoned, bottle-shaped mud nests of Fairy Martins. Thought to forage below the forest canopy for small flying insects (Churchill 2008).	Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture, forestry or development. Damage to roosting and maternity sites from mining operations and recreational caving activities. Use of pesticides.

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Little Bent-wing Bat	V		Feeds on small insects beneath the canopy of well timbered habitats including rainforest, Melaleuca swamps and dry Sclerophyll forests. Roosts in caves and tunnels and has specific requirements for nursery sites. Distribution becomes coastal towards the southern limit of its range in NSW. Nesting sites are in areas where limestone mining is preferred (Strahan 1995).	The species is an ecological specialist (it depends on particular types of diet or habitat) and it concentrates (individuals within populations of the species congregate or aggregate at specific locations).
Eastern Bent-wing Bat	V		Distributed across the east coast of Australia, rests in caves, old mines, stormwater channels and comparable structures including occasional buildings (Dwyer 1998),. Typically found in well-timbered valleys where it forages, above tree canopy on small insects (Churchill 2008).	Loss of habitat, feral predators such as cats and foxes, disturbances of winter roosts, relies on very few nursery caves at high density (Dwyer 1998).
Large-footed Myotis	V		Found in roosting caves, tunnels, tree hollows and possibly dense vegetation (Churchill 1998). Roosts have been located in hanging trees. Buildings and underneath bridges have also been listed as roost sites for the species. The species is always associated with permanent, usually slow-flowing water bodies. Forages over small creeks, coastal rivers, estuaries lakes and inland rivers. Records come from a wide range of vegetation communities associated with water (Richards 1998).	Not certain. Is likely to be susceptible to changes in water quality, which may result from vegetation clearing and logging (sedimentation), sewage and fertilizer run-off (eutrophication), pesticide/herbicide leakage (chemical pollution) and altered flow regimes (changes to river ecology). Where populations concentrate in roosts which are susceptible to disturbance, human activities such as recreational use of caves and removal of old wooden bridges would also be a threat (Duncan *et al.* 1999). The species may have been subject of over-collection in the past (Richards 1998)

Common Name	TSC Act	EPBC Act	Habitat and distribution	Threats
Eastern Cave Bat	V		A cave-dwelling species found in eastern Australia from Cape York to NSW. They inhabit tropical mixed woodland and wet sclerophyll forests on the coast and the dividing range, but extend into drier forests on the western slopes (Churchill 2008).	Clearing and isolation of forest and woodland habitats near cliffs, caves and other suitable roosting and maternity sites mainly as a result of mining operations and agricultural/residential development. Loss of suitable feeding habitat near roosting and maternity sites as a result of modifications from timber harvesting and inappropriate fire regimes usually associated with grazing. Use of pesticides and herbicides. Very little is known about the ecology, behaviour and habitat requirements.

Recovery actions

Refer to Table K-2.

EP&A Act assessment for cave-dwelling microchiropteran bats

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

There are no roosting opportunities within the study site for cave-dwelling microchiropteran bat species. Foraging opportunities for these species exist on site within the canopies of bushland vegetation.

Only relatively small linear areas of foraging habitat (approximately 64.14 ha), would be affected by the Project. These species often prefer to forage along the ecotonal edges between open and wooded habitats and these types of foraging opportunities will continue to exist throughout the study area.

Therefore, the Project is unlikely to cause significant adverse effects upon cave-dwelling microchiropteran bat species, due to the linear nature of vegetation removal, which contains no roosting/breeding microhabitat elements, and the retention of well timbered foraging areas elsewhere adjacent to the study site, that will remain intact post-development.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

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

i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable

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

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed

Only potential foraging habitat for cave-dwelling microchiropteran bat species was recorded within the study site during field surveys. Approximately 64.14 ha of vegetation representing potential foraging opportunities for these species are likely to be affected by the Project. Potential foraging habitat within the study site is likely to represent only a small part of a greater home range for local species and as such not of great significance, due to the abundance of retained habitat of similar or higher quality elsewhere, both within the study area and in the wider locality.

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

The study site provides a relatively small amount of suitable foraging habitat for these species. A limited amount of potential foraging habitat (approximately 64.14 ha) will be affected. Foraging opportunities occurring in the study site will continue to exist and an abundance of similar and higher quality foraging opportunities will be retained both within the study area and in the wider locality. The Project would not impact habitat considered critical to the long-term survival of populations in the locality and is unlikely to further create a barrier to movement for these species.

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

The study site provides a relatively small amount of potential foraging habitat for these species, but there are no other important habitat features, such as caves and other comparable structures to suit their roosting/breeding requirements. A limited linear amount of potential foraging habitat (64.14 ha) will be removed by the Project.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat has been listed for any microchiropteran bat to date. Furthermore, it is estimated that approximately 64.14 ha of foraging habitat would be affected by the Project, and as such, is not considered critical to the survival of these species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

No recovery plan has been prepared for any microchiropteran bat under the TSC Act. The DECCW has however; identified 25 priorities action statements within 11 recovery strategies to help recover these species (refer Table K-2). The Project is not likely to adversely affect any of these recovery actions.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

With respect to cave-dwelling microchiropteran bats, the Project is consistent with one KTP, being clearing of native vegetation. This KTP is not likely to significantly affect these species in the locality. A threat abatement plan has not been prepared for this process.

Conclusion

While the study site provides potential foraging resources for cave dwelling microbat species, no roosting opportunities are present. The Project will result in the removal of approximately 64.14 ha of potential foraging habitat. Microhabitat foraging opportunities, such as ecotonal edges, that occur within the study area will continue to exist and an abundance of similar and higher quality foraging habitat will be retained within the study area and in the wider locality. Therefore, the Project is not likely to have a significant adverse affect on these species.

EPBC Act significance assessment for Large-eared Pied Bat

Is this an important population?

The Large-eared Pied Bat occurs across a wide range of different vegetation contexts, from rainforest edges and the wet sclerophyll forests of the coast and ranges to dry woodlands and *Callitris* pine dominant woodlands west of the divide. What is of most importance to this species is the presence of escarpments and rocky outcroppings in association with the above vegetation types, which provide caves and crevices for roosting and breeding purposes. The study site provides no such roosting/breeding opportunities, although these habitats do occur in the region further afield. Although the site does provide foraging opportunities, due to the presence of insect attracting canopy foliage, such habitat occurs widely within the vicinity of the study site and the wider locality. As a consequence, foraging resources within the site are not considered critical to maintaining populations.

Potential occurrences of this species within the study site are not at the limits of the species' distribution and as such the site can only be considered to represent a part of the foraging range of widely occurring individuals. For these reasons, if present within the site, individuals of this species would not be considered to be part of an important population.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following.

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

Not applicable, if present the Large-eared Pied Bat would not be part of an important population.

Reduce the area of occupancy of an important population

Not applicable, if present the Large-eared Pied Bat would not be part of an important population.

Fragment an existing important population into two or more populations

Not applicable, if present the Large-eared Pied Bat would not be part of an important population.

Adversely affect habitat critical to the survival of a species

No critical habitat is listed for this species under the EPBC Act.

Habitat critical to the survival of a species may also include areas that are not listed on the Register of Critical Habitat if they are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community (Department of the Environment and Heritage 2006).

The extent of the habitat that would be cleared as a result of the Project does not represent habitat critical to the survival of the Large-eared Pied Bat.

Disrupt the breeding cycle of an important population

Not applicable, if present the Large-eared Pied Bat would not be part of an important population.

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

No. The Project would only affect approximately 64.14 ha of suitable foraging habitat only. As no roosting or breeding habitat was observed in the study site, the Project is not likely to significantly affect the availability of quality habitat for this species.

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

The proposed development is not likely to increase the likelihood of an invasive species becoming established in the habitat of the Large-eared Pied Bat.

Introduce disease that may cause the species to decline

The proposed development is not likely to increase the likelihood of a disease becoming established or proliferating in a local population that would result in a decline of the Large-eared Pied Bat.

Interfere substantially with the recovery of the species.

Due to the limited foraging habitat likely to be affected by the Project (approximately 64.14 ha) and as no roosting or breeding habitat is located in the vicinity of the study site, the Project is not likely to interfere with the recovery of this species.

Conclusion

The Large-eared Pied Bat occurs across a wide range of vegetation types for foraging purposes, including habitat types consistent with those occurring within the study site. However, the presence of escarpment and rocky outcrop habitats, which offer roosting and breeding caves/crevices are of prime importance to the viability and maintenance of 'important populations' and these habitat attributes do not occur within the study site.

Although a relatively small area of potential foraging habitat (64.14 ha) will be removed, there is an abundance of similar or much higher quality habitat elsewhere within the study area and the wider locality. As a consequence relatively small amounts of foraging habitat to be removed are not considered to be significant to this species. Therefore, it is unlikely that the Project will have a significant impact upon the Large-eared Pied Bat.

E.13. Appendix E References

Churchill, S 1998, *Australian Bats*, Reed New Holland, Sydney.

Churchill, S 2008, *Australian Bats*, 2nd edn, Allen & Unwin, Sydney.

Courtney J., DSJS 2006, 'Breeding habits and conservation status of the Musk Lorikeet Glossopsitta concinna and Little Lorikeet G. pusilla in Northern New South Wales. ', *Australian Field Ornithology* vol. 23, pp. 109-24.

DECCW 2010a, *Threatened Species Profile - Little Lorikeet*, Department of Environment Climate Change and Water, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=20111>.

DECCW 2010b, *Threatened Species Profile - Square-tailed Kite*, Department of Environment Climate Change and Water, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10495>.

DECCW 2010c, *Threatened species, populations and communities of NSW*, Department of Environment Climate Change and Water, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx>.

Department of Environment and Climate Change 2005, *Threatened species profile for the Little Bent-wing Bat, Miniopterus australis*, <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10533>.

Department of Environment and Conservation 2005a, *Draft guidelines for Threatened species assessment under Part 3A*, Department of Environment and Conservation, Hurstville.

Department of Environment and Conservation 2005b, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of Environment and Conservation 2006, *Threatened species, populations and ecological communities*, NSW Department of Environment and Conservation, 2006, <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.

Department of the Environment and Heritage 2006, *EPBC Act Policy Statement 1.1 Significant Impact Guidelines*, Department of the Environment and Heritage, Canberra.

Duncan, A, Baker, BG & Montgomery, N 1999, *The Action Plan for Australian Bats*, Canberra.

Dwyer, PD 1998, 'Common Bent-wing Bat. ', in R Strahan (ed.), *The Mammals of Australia*, New Holland Publishers, Sydney.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds*, Environment Australia, Canberra.

Gibbons, P & Lindenmayer, DB 2000, *Conserving hollow-dependent fauna in timber-production forests*, Australian National University, Centre for Resource and Environmental Studies., Canberra.

Goldingay, RL & Sharpe, DJ 1998, 'Feeding behaviour of the Squirrel Glider at Bungawalbin Nature Reserve, north-eastern New South Wales', *Wildlife Research*, vol. 25, no. 1, pp. 243-54.

Harden, G 1993, *Flora of New South Wales Volume 4*, University of New South Wales Press Ltd., Kensington.

Higgins, PJ & Peter, JM (eds) 2002, *Handbook of Australian, New Zealand and Antarctic Birds*, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne.

Jones, DL 2006, *A complete guide to native orchids of Australia including island Territories*, Reed New Holland, Sydney.

Lunney, D & Burgin, S 2004, 'Urban Wildlife: More than Meets the Eye', in D Lunney & S Burgin (eds), *Urban Wildlife: More than Meets the Eye*, ROYAL ZOOLOGICAL SOC NEW SOUTH WALES, TARONGA ZOO MOS, MOSMAN NSW, 2088, AUSTRALIA.

Marchant, S & Higgins, PJ (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds Volume 2: Raptors to Lapwings*, vol. 2, Volume 2: Raptors to Lapwings, Oxford University Press, Melbourne.

Menkhorst, P, Schedvin, N & Geering, D 1999, *Regent Honeyeater (Xanthomyza phrygia) Recovery Plan 1999-2003*, Department of Natural Resources and Environment, Canberra.

NSW National Parks and Wildlife Service 1999, *Squirrel Glider threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW National Parks and Wildlife Service 2001, *Grey-headed Flying Fox threatened species information*, NSW National Parks and Wildlife Service, Hurstville.

NSW Scientific Committee 1998, *Final Determination to list Black-necked Stork - Endangered Species Listing*, Department of Environment and Climate Change, Hurstville.

NSW Scientific committee 2009a, *Little Eagle (Hieraaetus morphnoides) - proposed vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2009b, *Little Lorikeet (Glossopsitta pusilla) - vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2009c, *Spotted Harrier (Circus assimilis) - proposed vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

NSW Scientific Committee 2010, *Little Eagle (Hieraaetus morphnoides) Vulnerable species listing*, Department of Environment, Climate Change and Water, Hurstville, NSW.

Pizzey, G & Knight, F 2007, *Field Guide to the Birds of Australia*, Harper and Collins, Sydney.

Quin, DG 1995, 'Population ecology of the Squirrel Glider (*Petaurus norfolcensis*) and the Sugar Glider (*P. breviceps*) (Maruspialia : Petauridae) at Limeburners Creek, on the central north coast of New South Wales ', *Wildlife Research*, vol. 22, no. 4, pp. 471 - 505.

Reid, JRW 1999, *Threatened and declining birds in the New South Wales Sheep-Wheat Belt: Diagnosis, characteristics and management*, NSW National Parks and Wildlife Service, Hurstville.

Richards, GC 1998, 'Large-footed Myotis', in R Strahan (ed.), *Mammals of Australia*, New Holland Publishers, Sydney.

Rowston, C 1998, 'Nest and refuge-tree usage by Squirrel Gliders, *Petaurus norfolcensis*, in south-east Queensland', *Wildlife Research*, vol. 25, no. 2, pp. 157 - 64.

Strahan, R 1995, *The Mammals of Australia*, Reed New Holland, Sydney.

Swift Parrot Recovery Team 2001, *Swift Parrot Recovery Plan*, Department of Primary Industries, Water and Environment, Hobart.

Trail, BJ & Duncan, S 2000, *Status of birds in New South Wales temperate woodlands region: consultancy report to the NSW National Parks and Wildlife Service*, Australian Woodlands Conservancy, Victoria.

Traill, BJ & Duncan, S 2000, *Status of birds in the New South Wales temperate woodlands region*, Consultancy report to the NSW National Parks and Wildlife Service by the Australian Woodlands Conservancy, Chiltern, Victoria.

Triggs, B 1996, *Tracks, scats and other traces: a field guide to Australian mammals*, Oxford University Press, Melbourne.

Tzaros C. 2002, 'Swift flight to recovery', *Wingspan*, vol. 12, pp. 8-11.

van der Ree, R 2002, 'The population ecology of the Squirrel Glider (*Petaurus norfolcensis*) within a network of remnant linear habitats', *Wildlife Research*, vol. 29, no. 4, pp. 329 - 40.

Appendix F

Fauna survey effort

Appendix F: Describes detailed fauna survey effort completed in August 2010

Table F-1 Fauna survey effort

Date	Survey method	Effort	Survey site	Fauna habitat and location description[3]	Location (MGA94 Zone 56)	
					Easting	Northing
16/08/10-20/08/10	Terrestrial trapping	100 trap nights (Elliott A)	S1	Dry open forest	325378	6402406
			S2		325635	6402251
			S3		325798	6402358
			S4		326167	6402031
17/08/10-20/08/10	Arboreal trapping	18 trap nights (Elliott B)	S1	Dry open forest	325378	6402406
			S2		325635	6402251
			S3		325798	6402358
			S4		326167	6402031
17/08/10-19/08/10	Harp trap	2 nights	Supplementary	Culvert at chainage 246329 km	326424	6401712
17/08/10-19/08/10	Harp trap	2 nights	S1	Dry open forest	325481	6402371
17/08/10-20/08/10	Anabat	30 minutes	S1	Dry open forest	325378	6402406
			S3		325798	6402358
			S4		326167	6402031
17/08/2010	Anabat	30 minutes	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
19/08/2010	Anabat	30 minutes	Supplementary	Access track off Bridgeman Road	327787	6401805
19/08/2010	Anabat	1 hour	Supplementary	Drive transect of existing rail corridor	N/A	N/A
17/08/2010	Anabat[1]	1 night	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
18/08/2010	Anabat[1]	1 night	S1	Dry open forest	325481	6402371
17/08/10-18/08/10	Call playback (owls)	30 minutes	S1	Dry open forest	325378	6402406
			S3		325798	6402358
			S4		326167	6402031
19/08/2010	Call playback (owls)	30 minutes	Supplementary	Access track off Bridgeman Road, Singleton	327787	6401805
18/08/2010	Call playback (Green & Golden Bell Frog)	20 minutes	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
18/08/2010	Call playback (Green & Golden Bell Frog)	20 minutes	Supplementary	Aquatic habitat at chainage 249370 km	324900	6403990
18/08/2010	Call playback (Green & Golden Bell Frog)	20 minutes	Supplementary	Aquatic habitat at chainage 248020 km	325074	6402667

Date	Survey method	Effort	Survey site	Fauna habitat and location description[3]	Location (MGA94 Zone 56)	
					Easting	Northing
17/08/10-20/08/10	Spotlighting	1 hour	S1	Dry open forest	325378	6402406
			S3		325798	6402358
			S4		326167	6402031
17/08/2010	Spotlighting	1 hour	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
18/08/2010	Spotlighting	1 hour	Supplementary	Cleared land at potential main compound location	324003	6405925
19/08/2010	Spotlighting	2.5 hours	Supplementary	Drive transect of existing rail corridor	N/A	N/A
19/08/2010	Spotlighting	1 hour	Supplementary	Access track off Bridgeman Road	327787	6401805
17/08/10-20/08/10	Herpetofauna survey	40 minutes	S1	Dry open forest	325378	6402406
			S2		325635	6402251
			S3		325798	6402358
			S4		326167	6402031
17/08/2010	Herpetofauna survey	40 minutes	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
19/08/2010	Herpetofauna survey	40 minutes	Supplementary	Aquatic habitat located near potential main compound site	324003	6405925
17/08/10-20/08/10	Bird Survey	20 minutes	S1	Dry open forest	325378	6402406
			S2		325635	6402251
			S3		325798	6402358
			S4		326167	6402031
18/08/2010	Bird Survey	1 hour	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
18/08/2010	Bird survey	1 hour	Supplementary	Aquatic habitat at chainage 249370 km	324900	6403990
19/08/2010	Habitat assessment	30 minutes	S1	Dry open forest	325378	6402406
			S2		325635	6402251
			S3		325798	6402358
			S4		326167	6402031
18/08/2010	Habitat assessment	30 minutes	Supplementary	Aquatic habitat at chainage 246329 km	326405	6401696
16/08/10-20/08/10	Opportunistic recordings	5 days	Across study area	-	Refer Figure 3-1 in main report	

Note: 1: Anabat Bat Detector set to record throughout the night. 2: General habitat assessment included hollow-bearing tree assessment (20 m x 50 m area). 3: Location description provided for supplementary sites only.

Appendix G

Hollow tree data

Table G-1: Hollow-bearing tree data

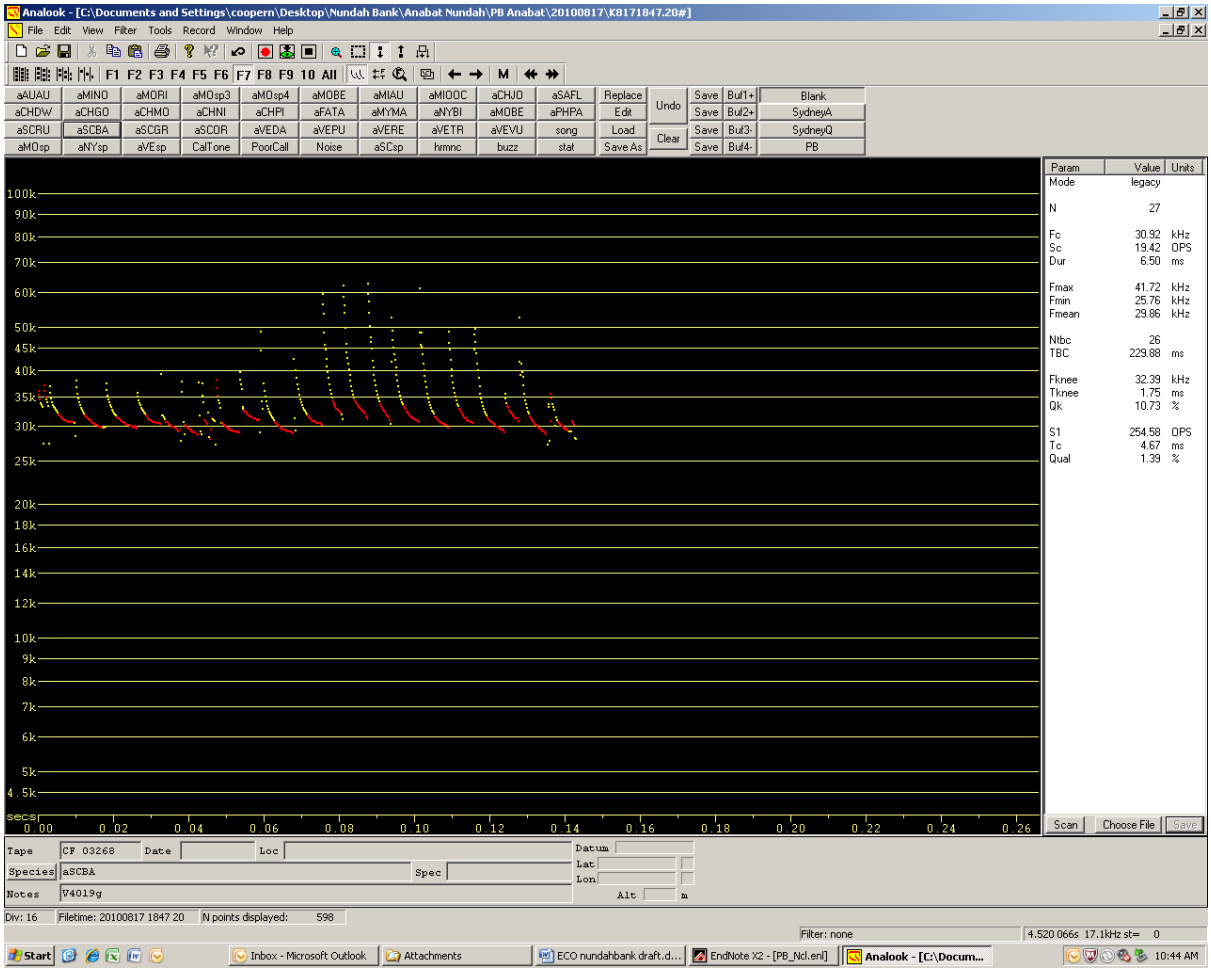
See Figure 3.1 in main report.

Tree ID	Scientific name	MGA 56		Height (m)	DBH (m)	Hollow size class (cm)			
		Easting	Northing			<5	6-15	16-30	>30
H1	*Eucalyptus crebra*	326137	6401886	19		1			
H2	*Angophora floribunda*	326234	6402063	8	0.4	3	4		
H3	Stag	326356	6401734	9	1	3	1		
H4	Stag	326361	6401729	10	0.8	2		1	
H5	*Eucalyptus moluccana*	326607	6399934	14	0.9	3	2		
H6	*Eucalyptus crebra*	326648	6400673	10	0.6	1	2		
H7	*Eucalyptus crebra*	326625	6400878	10	0.6	4	1		
H8	Stag	324436	6405182	N/A	0.4	1	1		
H9	*Eucalyptus crebra*	326647	6400981	5	0.75		2		
H10	*Eucalyptus moluccana*	326744	6400950	14	0.9	3	1		
H11	*Eucalyptus crebra*	326674	6400865	8	0.4		1		
H12	*Eucalyptus crebra*	326669	6400828	14	0.75	3			
H13	*Eucalyptus crebra*	326650	6400745	9	0.75	1	1		
H14	*Eucalyptus tereticornis*	323995	6405937	8	0.65	3	2		
H15	Stag	323986	6405910	14	1	7	5	1	
H16	*Eucalyptus moluccana*	323951	6405889	16	1		2	2	
H17	*Eucalyptus moluccana*	326794	6401961	12	0.9		2		
H18	*Eucalyptus moluccana*	326781	6401958	8	0.35	2			
H19	*Eucalyptus moluccana*	326780	6401970	9	0.6	2			
H20	*Eucalyptus moluccana*	326775	6401987	9	0.5	2			
H21	*Eucalyptus crebra*	326767	6401958	16	0.55	3			
H22	*Eucalyptus crebra*	326759	6401967	16	0.65	2	1		
H23	*Eucalyptus crebra*	326749	6401994	15	0.55	2	2		
H24	*Eucalyptus crebra*	326417	6401974	13	0.85	2	2		
H25	*Eucalyptus crebra*	326343	6401930	13	0.95	1	1	1	
H26	*Eucalyptus crebra*	326582	6401468	14	0.75	2		1	
H27	*Eucalyptus crebra*	326567	6401463	14	0.8	3			
H28	*Eucalyptus crebra*	326566	6401417	14	0.75		2		
H29	*Eucalyptus moluccana*	326691	6401418	13	0.6			1	
H30	*Eucalyptus moluccana*	326252	6399728	12	0.5	2			
H31	*Eucalyptus moluccana*	326250	6399725	13	0.95	8			
H32	*Eucalyptus moluccana*	326266	6399709	16	1.3	4	2		
H33	*Eucalyptus moluccana*	326265	6399718	15	0.6	2	3		

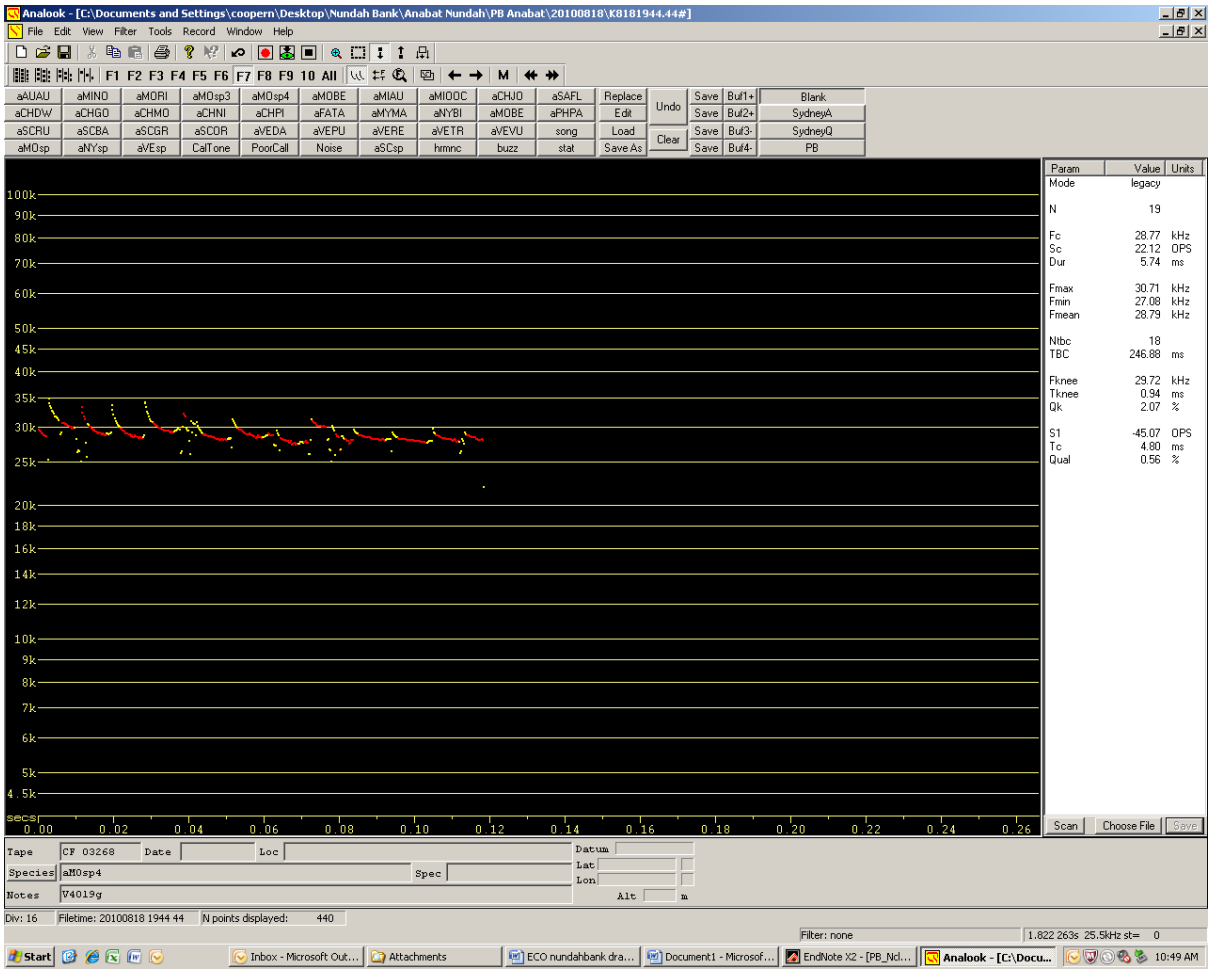
Tree ID	Scientific name	MGA 56		Height (m)	DBH (m)	Hollow size class (cm)			
		Easting	Northing			<5	6-15	16-30	>30
H34	*Eucalyptus moluccana*	326262	6399727	15	0.85		1		
H35	*Eucalyptus moluccana*	326267	6399728	14	0.65	2			
H36	*Eucalyptus moluccana*	326279	6399721	16	0.65	1	1		
H37	*Eucalyptus moluccana*	326289	6399722	14	1.2	3	4		
H38	*Eucalyptus moluccana*	326353	6399707	5	0.25	1			
H39	*Eucalyptus moluccana*	326357	6399706	15	0.5	3			
H40	*Eucalyptus moluccana*	326359	6399710	17	0.65		1		
H41	Stag	326364	6399711	4	0.25	2			
H42	*Eucalyptus moluccana*	326466	6399681	16	0.8			1	

Appendix H

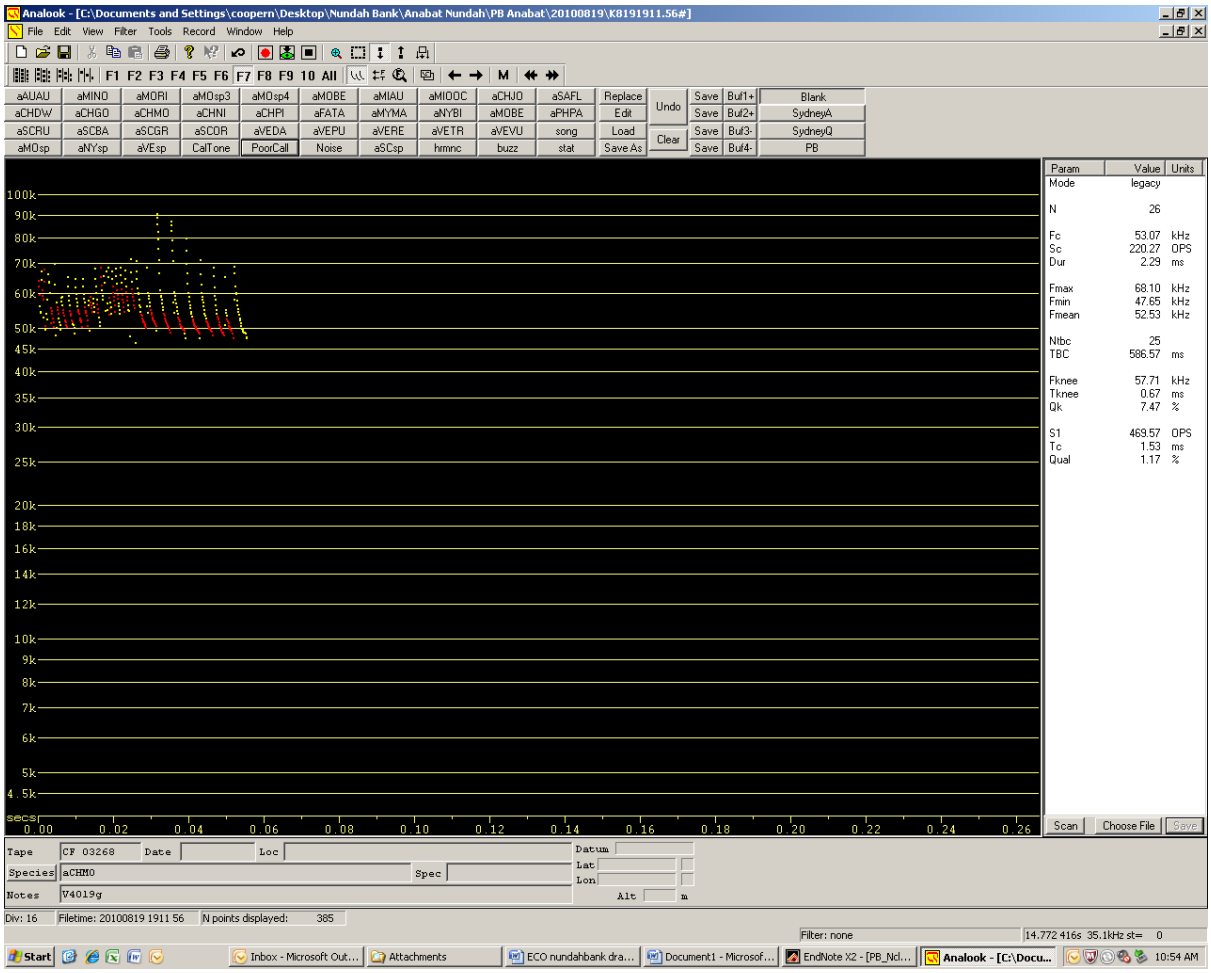
Bat call sonograms



Scotorepens balstoni Inland Broad-nosed Bat



Mormopterus species 4 Southern Freetail Bat



Chalinolobus morio Chocolate Wattled Bat